

design development

December 9, 2008

ustar building #2, utah state university

**Life Sciences Research Center**

logan, utah

**project manual**  
**volume one**

*prepared for:*

state of utah

department of facilities construction management

4110 state office building, salt lake city, utah 84111

project no. 06292770

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project no. 0818



Design Development  
VOLUME ONE  
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UTAH STATE UNIVERSITY  
USTAR – Life Sciences Lab Design  
Logan, Utah

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## INSTRUCTIONS AND SUBCONTRACTORS LIST FORM

The three low bidders, as well as all other bidders that desire to be considered, are required by law to submit to DFCM within 24 hours of bid opening a list of **ALL** first-tier subcontractors, including the subcontractor's name, bid amount and other information required by Building Board Rule and as stated in these Contract Documents, based on the following:

### DOLLAR AMOUNTS FOR LISTING

**PROJECTS UNDER \$500,000: ALL FIRST-TIER SUBS \$20,000 OR OVER MUST BE LISTED**  
**PROJECTS \$500,000 OR MORE: ALL FIRST-TIER SUBS \$35,000 OR OVER MUST BE LISTED**

- Any additional subcontractors identified in the bid documents shall also be listed.
- The DFCM Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law.
- List subcontractors for base bid as well as the impact on the list that the selection of any alternate may have.
- Bidder may not list more than one subcontractor to perform the same work.
- If there are no subcontractors for the job that are required to be reported by State law (either because there are no subcontractors that will be used on the project or because there are no first-tier subcontractors over the dollar amounts referred to above), then you do not need to submit a sublist. If you do not submit a sublist, it will be deemed to be a representation by you that there are no subcontractors on the job that are required to be reported under State law. At any time, DFCM reserves the right to inquire, for security purposes, as to the identification of the subcontractors at any tier that will be on the worksite.

### LICENSURE:

The subcontractor's name, the type of work, the subcontractor's bid amount, and the subcontractor's license number as issued by DOPL, if such license is required under Utah Law, shall be listed. Bidder shall certify that all subcontractors, required to be licensed, are licensed as required by State law. A subcontractor includes a trade contractor or specialty contractor and does not include suppliers who provide only materials, equipment, or supplies to a contractor or subcontractor.

### 'SPECIAL EXCEPTION':

A bidder may list 'Special Exception' in place of a subcontractor when the bidder intends to obtain a subcontractor to perform the work at a later date because the bidder was unable to obtain a qualified or reasonable bid under the provisions of U.C.A. Section 63A-5-208(4). The bidder shall insert the term 'Special Exception' for that category of work, and shall provide documentation with the subcontractor list describing the bidder's efforts to obtain a bid of a qualified subcontractor at a reasonable cost and why the bidder was unable to obtain a qualified subcontractor bid. The Director must find that the bidder complied in good faith with State law requirements for any 'Special Exception' designation, in order for the bid to be considered. If awarded the contract, the Director shall supervise the bidder's efforts to obtain a qualified subcontractor bid. The amount of the awarded contract may not be adjusted to reflect the actual amount of the subcontractor's bid. Any listing of 'Special Exception' on the sublist form shall also include amount allocated for that work.

### GROUNDS FOR DISQUALIFICATION:

The Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law. Director may withhold awarding the contract to a particular bidder if one or more of the proposed subcontractors are considered by the Director to be unqualified to do the Work or for such

**INSTRUCTIONS AND SUBCONTRACTORS LIST FORM**  
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other reason in the best interest of the State of Utah. Notwithstanding any other provision in these instructions, if there is a good faith error on the sublist form, at the sole discretion of the Director, the Director may provide notice to the contractor and the contractor shall have 24 hours to submit the correction to the Director. If such correction is submitted timely, then the sublist requirements shall be considered met.

**CHANGES OF SUBCONTRACTORS SPECIFICALLY IDENTIFIED ON SUBLIST FORM:**

Subsequent to twenty-four hours after the bid opening, the contractor may change its listed subcontractors only after receiving written permission from the Director based on complying with all of the following criteria.

- (1) The contractor has established in writing that the change is in the best interest of the State and that the contractor establishes an appropriate reason for the change, which may include, but not is not limited to, the following reasons: the original subcontractor has failed to perform, or is not qualified or capable of performing, and/or the subcontractor has requested in writing to be released.
- (2) The circumstances related to the request for the change do not indicate any bad faith in the original listing of the subcontractors.
- (3) Any requirement set forth by the Director to ensure that the process used to select a new subcontractor does not give rise to bid shopping.
- (4) Any increase in the cost of the subject subcontractor work is borne by the contractor.
- (5) Any decrease in the cost of the subject subcontractor work shall result in a deductive change order being issued for the contract for such decreased amount.
- (6) The Director will give substantial weight to whether the subcontractor has consented in writing to being removed unless the Contractor establishes that the subcontractor is not qualified for the work.

**EXAMPLE:**

Example of a list where there are only four subcontractors:

TYPE OF WORK	SUBCONTRACTOR, "SELF" OR "SPECIAL EXCEPTION"	SUBCONTRACTOR BID AMOUNT	CONTRACTOR LICENSE #
ELECTRICAL	ABCD Electric Inc.	\$350,000.00	123456789000
LANDSCAPING	"Self" *	\$300,000.00	123456789000
CONCRETE (ALTERNATE #1)	XYZ Concrete Inc	\$298,000.00	987654321000
MECHANICAL	"Special Exception" (attach documentation)	Fixed at: \$350,000.00	(TO BE PROVIDED AFTER OBTAINING SUBCONTRACTOR)

\* Bidders may list "self", but it is not required.

**PURSUANT TO STATE LAW - SUBCONTRACTOR BID AMOUNTS CONTAINED IN THIS SUBCONTRACTOR LIST SHALL NOT BE DISCLOSED UNTIL THE CONTRACT HAS BEEN AWARDED.**





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DFCM Project No. \_\_\_\_\_

**CONSTRUCTION MANAGER/  
GENERAL CONTRACTOR AGREEMENT**

for

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
hereinafter referred to as the "Project."

THIS AGREEMENT, made and entered into this \_\_\_\_ day of \_\_\_\_\_, 20\_\_ by and between the DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT, hereinafter called "DFCM," and \_\_\_\_\_, incorporated in the State of \_\_\_\_\_ and authorized to do business in the State of Utah, hereinafter called the "Construction Manager/General Contractor" or "CM/GC," whose address is \_\_\_\_\_.

WITNESSETH: WHEREAS, DFCM intends to have the Services and Work performed at \_\_\_\_\_, and

WHEREAS, the CM/GC agrees to perform Construction Management services and perform as a General Contractor for the sum herein stated.

NOW, THEREFORE, DFCM and the CM/GC for the consideration provided in this Agreement, agree as follows:

**ARTICLE 1.  
CM/GC'S SERVICE AND RESPONSIBILITIES**

- A. In General.** The CM/GC accepts the relationship of trust and confidence established by this Agreement and covenants with the DFCM as follows:
1. **Cooperation.** To cooperate with the DFCM, as well as the Architect/ Engineer (A/E) selected by DFCM for the design services for the Project;
  2. **Best Skills, Efforts and Judgments.** Use the CM/GC's best skills, efforts and Judgments in furthering the interest of the DFCM;
  3. **Efficient Business Administration and Supervision.** To furnish efficient business administration and supervision;
  4. **Perform the Services and Work.** To furnish at all times an adequate supply of workers, the appropriate materials and equipment, and perform the Services and Work in the best and most expeditious and economic manner in accordance with the Contract Documents; and
  5. **Inspection and Approval.** That the Work shall be subject to inspection and approval of DFCM or its authorized representative.

- B. **Independent Contractor.** In performing its obligations hereunder, the CM/GC shall be deemed an independent contractor and not an agent or employee of DFCM. The CM/GC shall have exclusive authority to manage, direct, and control the Services and Work; all of which must meet the Contract Documents.
- C. **General Contractor and Professional Service Duties.** The term "CM/GC" as used in this Agreement is deemed to include all the duties of a General Contractor, including those described by the terms "General Contractor" and "Contractor" in the DFCM General Conditions dated May 25, 2005, (hereinafter referred to as the "DFCM General Conditions"), which are a part of the Contract Documents and hereby incorporated by reference as part of this Agreement as well as the professional services of a business, administrative and management consultant to DFCM; including all budget, scheduling, quality, safety and all other services related to assuring compliance with this Agreement and the Contract Documents. The DFCM and CM/GC shall be bound by all the requirements and provisions of said DFCM General Conditions. The definitions in the General Conditions shall apply to this Agreement except as specifically modified by this Agreement. It is intended that this CM/GC's Agreement not reiterate all the applicable provisions of said DFCM General Conditions and the fact that some provisions are reiterated herein does not lessen the importance of the provisions that are not so reiterated. If the CM/GC is selected prior to the selection of the A/E for the Project, the CM/GC shall assist in the selection of the A/E.
- D. **Standard of Care.** The Standard of Care for the Services and Work under this Agreement shall be as follows: The CM/GC and all those for whom the CM/GC is liable at any tier shall exercise the degree of skill and diligence as is exercised by licensed members of their respective professions having substantial experience providing similar services on projects similar in type, magnitude and complexity to the Project that is the subject of this Agreement. The CM/GC shall be liable to DFCM or the State of Utah, less any "betterment" obtained by the Owner, for all Owner costs, damages, claims, liabilities, additional burdens, judgments, fines, penalties, damages, demolition, removal or modification of Work, any A/E or Owner delay damages, increased material costs, or third-party claims (i.e. an A/E claim against DFCM or the State of Utah), to the extent caused by acts, failure to act, negligence, errors or omissions that do not meet this standard of care. This standard of care may be further modified in the Attachments hereto. Owner reserves the right to deduct from any payment otherwise due under this Agreement, the amount related to any such error or omission.

## ARTICLE 2. FLCC AND BASIS OF COMPENSATION

*Special Provision when Agreement is limited to only cover Preconstruction Services.*

(USE ONLY ON AGREEMENTS FOR PRE-CONSTRUCTION SERVICES ONLY) This Agreement shall initially include only the scope of work (services) and compensation for the pre-construction phase for an initial contract Sum of \_\_\_\_\_ DOLLARS (\$\_\_\_\_\_).

- A. **Amount of FLCC.** The Fixed Limit of Construction Costs (FLCC) for this Agreement is \$\_\_\_\_\_, which includes the CM/GC's fees. The FLCC may only be increased in advance and in writing by DFCM.
- B. **FLCC as Ultimate Limitation.** The scope of Work (including CM/GC services) must at all times be within the FLCC. The DFCM as well as the State of Utah shall not be liable to the CM/GC for any amount over the FLCC. The FLCC as stated herein may be modified in writing and in advance by the DFCM or as a result of the entitlement of the CM/GC for additional monies in accordance with the procedures and substantive requirements of the DFCM General Conditions and Contract Documents.

C. **FLCC Reasonable.** By executing this Agreement and at the time of submittal of each GMP proposal, the CM/GC agrees that the FLCC is a reasonable limit for the total cost of the Project.

D. **Pre-Construction Phase Compensation.** For Work (including services) performed as described in Article 5.A. (Pre-Construction Phase), the CM/GC will be compensated \$\_\_\_\_\_. This shall include the cost of all labor and salaries as well as consumable materials required to perform the services. This compensation shall include insurance, benefits, employment taxes, overhead and profit.

E. **Construction Phase Compensation.**

1. **CM/GC Fee.** The CM/GC's Construction Management Fee for Services and Work performed during the entire construction phase, including punch list completion will be \$\_\_\_\_\_. This includes the cost as outlined in the CM/GC's Management Plan dated \_\_\_\_\_, which is hereby incorporated by reference.

a. **Fee Includes.** This Fee includes overhead (e.g. home office), profit for the entire job and home office personnel who will be managing the project during bidding, construction and closeout, including the warranty period. This fee also includes employment taxes, insurance, workers compensation, as well as salaries and benefits for all personnel that are not identified in Article 2.E.3 below.

b. **Fee Does Not Include.** This fee does not include general conditions (temporary construction costs) or the monthly supervision cost described below. As used in this Article 2, "general conditions" means temporary construction costs directly related to the Services and Work.

c. **How Fee Modified.** This fee is subject to modification by DFCM only as the scope of the work changes, and can be adjusted appropriately as the scope of work changes affect the size and/or duration of the Project.

d. **Scope Changes Impact on Fee.** Following the establishment of the GMP, the CM/GC change order markup described in Article 6.B.7. of this Agreement, will compensate the CM/GC for the additional overhead and profit associated with a change in scope of Work, however; a decrease in scope of Work and Contract Time, prior to or after the establishment of the GMP, shall result in a decrease in the amount of the CM/GC Fee, at the effective percentage rate established in the original proposal, prorated for the amount of Contract Time that is reduced from the original schedule.

Fee Not Increased Due to Material/Labor Costs. The CM/GC Fee shall not be increased due to an increase in cost of material, labor, general conditions or site supervision.

2. **Deemed Included in Fee.** Compensation for the following items is deemed already included in the CM/GC's fee and not subject to any additional payment beyond said fee by DFCM:

a. **Wrongful Acts or Negligence.** Costs, losses and expenses, including legal and consultant expenses, to the extent they have resulted from the act, fault or negligence of the CM/GC, any Subcontractor or supplier at any tier or anyone for whom the CM/GC may be liable, including but not limited to any loss or expense related to securing the property as required by this Agreement or to prevent injury to persons, the correction of defective or nonconforming Work, disposal of materials and equipment wrongly supplied, or making good any damage to property.

- b. Maintaining/Operating Offices. All expenses related to maintaining and operating the CM/GC's principal and branch offices.
  - c. Capital Expenses. Any part of the CM/GC's capital expenses, including interest on the CM/GC's capital employed for the Work.
  - d. Overhead/General Expenses. Overhead or general expenses of any kind, except as may be expressly included in Article 3 of this Agreement.
  - e. Food/Refreshments. Food and refreshments for construction meetings or in association with the Project, unless approved in writing and in advance by DFCM based on a showing of benefit to the Project.
  - f. Incentive Awards. Incentive awards of any kind, unless approved in writing and in advance by DFCM based on a showing of benefit to the Project.
  - g. Training. Training costs either associated or not associated with the Project, unless approved in writing and in advance by DFCM based on a showing of benefit to the Project.
3. **Not Part of Fee, but Part of GMP Proposal.** The following items, while not part of the fee, are to be included in any GMP proposal or approved GMP:
- a. Supervision Costs. The total amount of the construction supervision costs shall not exceed the monthly amount submitted in the Proposal multiplied by the number of months in the DFCM-approved schedule.
    - i. This cost shall be paid in an amount based on the hourly rates in the CM/GC's management plan, to the CM/GC of such supervision but cannot exceed the total amount as indicated in Article 2.E.3.a. above, submitted with back-up documents that evidence the amount of hours, provided with the monthly pay request.
  - b. Self-Performed Work. If DFCM authorizes the CM/GC to self-perform portions of the Work, said Work shall be compensated as a Cost of the Work and reimbursed at actual cost incurred based on documentation (direct personnel expense, including labor burden, materials, equipment, etc.) plus a fixed negotiated fee that shall not exceed   0   % of the cost of said Work.
    - i. Includes. Self performed work eligible for said fee shall only include labor, materials, and equipment provided directly by the CM/GC and not by subcontractors.
    - ii. Does not Include. Self-performed work eligible for said fee shall not include items furnished by the CM/GC as a general conditions (temporary construction cost) item.
  - c. Temporary Construction Costs (General Conditions). The CM/GC shall be compensated for temporary construction costs (commonly referred to in the industry as "general,

conditions") and reimbursed at actual cost incurred up to the line item amount for such costs in the approved GMP. Temporary Construction Costs means such items, to the extent used on the Project: construction trailer, office equipment, computers, phonescranes, power, water, heat, temporary toilets, and safety precautions including site items such as snow removal, cost of debris removal, fencing, security and similar items. In order to qualify as a temporary construction cost, such item must be necessary for the construction of the Project.

- i. Rental Rates. Rental rates for all necessary machinery and equipment, exclusive of hand tools, used at the site of the Work, whether rented from the CM/GC or others, including installation, minor repairs and replacements, dismantling, removal, transportation and delivery costs thereof, shall be at rental charges at actual cost, and in no case greater than the applicable "R.S. Means Construction Cost Data." If the equipment is owned by the CM/GC, then the rental rate shall not exceed the demonstrated cost of ownership by the CM/GC for the applicable time period and in no case greater than the applicable "R.S. Means Construction Cost Data." Other than hand tools with a value under \$100, equipment that is necessary to be purchased for use on the Project by the CM/GC shall first be approved in writing by the DFCM. Following the completed use, the CM/GC may retain ownership of the equipment upon credit of remaining market value compensated to DFCM, otherwise DFCM shall retain ownership.
- d. Cost of Subcontractors. Actual payments made by the CM/GC to Subcontractors for Work performed pursuant to subcontracts properly entered into under this Agreement.
- e. Taxes. Sales, use or similar taxes related to the Services and Work and for which the CM/GC is liable and imposed by any governmental authority.
- f. Insurance Premiums. Actual cost of premiums for insurance, which the CM/GC is required by the Contract Documents to purchase and maintain based on the amount of the approved GMP.
- g. Bonds. Actual cost of payment and performance bonds based on the amount of the approved GMP.

### ARTICLE 3. CONSTRUCTION COST

- A. **Construction Cost Includes.** Construction Cost shall be the total of the following for the entire Project: the Preconstruction phase payment by DFCM to the CM/GC, the cost of separate subcontracts, the cost of self-performed Work, the CM/GC fee, eligible supervision costs, eligible general conditions (eligible temporary construction costs), allowed use of CM/GC's Contingency, as well as payment and performance bond costs.
- B. **Construction Cost Does Not Include.** Construction Cost does not include the compensation of the A/E and its consultants, or the cost of inspections or testing provided for by DFCM.
- C. **Standard of Care for Cost Estimate.** The cost estimate provided by the CM/GC shall be consistent with the standard of care in the industry for a project of similar magnitude and complexity. If it is reasonably determined by DFCM that the CM/GC breached this standard of care in providing budget and cost estimates, DFCM reserves the right to seek all available appropriate remedies from the CM/GC.

- D. CM/GC Incentive to Manage Within FLCC.** If the final costs of the Project are less than or equal to the final approved FLCC, then the CM/GC shall be entitled to 30% of the savings between the final approved GMP and the final costs, or \$100,000, whichever is less, and the balance shall belong to the State. For purposes of this paragraph, changes to the final GMP that are the responsibility of DFCM (i.e. DFCM initiated scope changes, unforeseen conditions and design error/ omissions) under the Contract Documents, shall not affect the CM/GC's entitlement herein.
- E. Contingency for Undefined Design.** The CM/GC shall include an estimating contingency in their cost estimate for undefined design. The Contractor shall continue to reduce this estimating contingency as the design becomes more defined and ultimately shall be eliminated.
- F. Guaranteed Maximum Price (GMP).** Prior to any construction, the CM/GC shall submit a GMP proposal for a specific scope of Work (including services) to DFCM, and have it approved by DFCM. Notwithstanding any other provision of this Agreement, the CM/GC guarantees that the construction cost for the agreed to scope of Work will not exceed the GMP for that scope of Work. The GMP may only be increased by a Change Order for circumstances described in Article 7 of the DFCM General Conditions. The CM/GC's GMP proposal shall include the CM/GC's Contingency of up to 2% of the total cost of the proposed scope of Work, including eligible general conditions, temporary construction costs, CM/GC fee, supervision cost, bond and insurance. If there is to be more than one bid package, the GMP proposal must be calculated by the CM/GC in order to ensure that the completion of all bid packages and future anticipated increases in the GMP will not exceed the FLCC. The total of the CM/GC's Contingency for the entire project cannot exceed 2% of the FLCC.
1. **CM/GC's Contingency.** Any use of the CM/GC's Contingency shall be based on a documented proposal by the Contractor and approved by DFCM, which approval shall not be unreasonably withheld. This contingency fund shall only be used for the following types of Services and Work and for only direct cost of construction:
    - a. Where the procurement of the bid package(s) results in costs that are likely to, or does exceed the FLCC, the CM/GC's Contingency can be used to offset this increased cost;
    - b. For construction errors, or replacement of defective Work that is self-performed by the CM/GC;
    - c. For completion of Work as a result of Subcontractor default; and/or
    - d. For items or the value of items included in the Contract Documents, but missed by the CM/GC in the line items of the approved GMP proposal. This may include such items as general conditions (temporary construction costs), self-performed Work and other items that are directly related to the CM/GC itself and not the subcontractor or suppliers.
  2. **When CM/GC's Contingency Cannot Be Us ed.** This CM/GC's Contingency cannot be used for:
    - a. Errors by subcontractors, suppliers or manufacturers at any tier;
    - b. Coordination issues between subcontractors at any tier that are not related to CM/GC error; and/or
    - c. Replacement of defective Work installed by subcontractors at any tier.

3. **Contractor's Contingency Exhausted.** If the entire CM/GC's Contingency fund is used, any additional funds to complete the scope of work (including services) defined in the Construction Documents must be provided at 100% by the CM/GC.
4. **Carry Forward of CM/GC's Contingency.** At the end of the final completion (construction) of each bid package, where there are multiple bid packages, any remaining CM/GC's Contingency shall carry forward to the future bid package Work.
5. **CM/GC's Contingency at Final Completion.** At Final Completion of the Project, if there are any funds remaining in the CM/GC's Contingency the funds may qualify for distribution in accordance with Article 3. D.
6. **Issues Not Related to CM/GC's Contingency.** Design errors and omissions, unforeseen site conditions, and Owner requested scope changes do not apply to the CM/GC's Contingency.

**ARTICLE 4.  
PAYMENTS TO THE CM/GC**

- A. **Payments for Basic Services.** Payments for Basic Services, approved additional services and reimbursable costs, upon proper invoicing, justification and documentation, shall be made monthly for Services and Work properly performed, all in accordance with this Agreement.
- B. **General Payment, Retainage and Accounting Provisions.**
  1. **DFCM General Conditions Apply.** All applicable provisions of the DFCM General Conditions regarding payment, withholding of payment, retainage, certification of payment and other payment requirements and rights of DFCM and the CM/GC shall apply.
  2. **Retainage.** Retainage in the amount of 5% shall be withheld from each payment to the CM/GC for any Services or Work under this Agreement. The retainage, including any additional retainage imposed and the release of any retainage, shall be in accordance with Utah Code Ann. Sec. 13-8-5, as amended. The CM/GC shall also comply with the requirements of Utah Code Ann. Sec. 13-8-5, as amended, including restrictions of retainage regarding Subcontractors and the distribution of interest earned on the retention proceeds.
  3. **DFCM Not Responsible for CM/GC'S Retention Requirements.** The DFCM shall not be responsible for enforcing the CM/GC's obligations under Utah law in fulfilling the retention law requirements with Subcontractors at any tier.
  4. **Interest Bearing Account.** The CM/GC's retainage shall be held by DFCM, in an interest bearing account with said interest to accrue to the account of the CM/GC. Said interest shall be distributed by DFCM to the CM/GC upon release of retention funds.
  5. **DFCM'S Right to Withhold Certain Amount and Make Use Thereof.** DFCM may withhold from payment to the CM/GC such amount as, in DFCM's judgment, may be necessary to pay just claims against the CM/GC or Subcontractors at any tier for labor and services rendered and

materials furnished in and about the Work. The DFCM may apply such withheld amounts for the payment of such claims in DFCM's discretion. In so doing, the DFCM shall be deemed the agent of the CM/GC and payment so made by the DFCM shall be considered as payment made under this CM/GC's Agreement by the DFCM to the CM/GC. DFCM shall not be liable to the CM/GC for any such payment properly made. Such withholdings and payments may be made without prior approval of the CM/GC and may also be made prior to any determination as a result of any dispute, PRE, Claim or litigation. However, the CM/GC shall be notified prior to any such withholding and will be given an opportunity to inform DFCM as to any reason why the withholding shall not occur.

6. **Final Payment.** Before final payment is made, the CM/GC must submit evidence satisfactory to the DFCM that all payrolls, materials bills, subcontracts at any tier and outstanding indebtedness in connection with the Work have been properly paid. Final Payment will be made after receipt of said evidence, final acceptance of the Work by the DFCM as well as compliance with the applicable provisions of the DFCM General Conditions.
7. **CM/GC Respond to Financial Responsibility and Related Requests; Waivers, Releases, Bonds.** The CM/GC shall respond immediately to any inquiry in writing by DFCM as to any concern of financial responsibility and DFCM reserves the right to request any waivers, releases or bonds from the CM/GC in regard to any rights of Subcontractors (including suppliers) at any tier or any third-party prior to any payment by DFCM to the CM/GC.
8. **Reimbursement to DFCM.** Notwithstanding any other provision of this Agreement, the CM/GC shall reimburse DFCM for the portion of any expenses paid by DFCM to the CM/GC, which is attributable to the CM/GC's breach of its duties under this Agreement, including the breach of any duty by any Subcontractor or supplier at any tier or anyone for whom the CM/GC may be liable.

## ARTICLE 5. BASIC SERVICES

The CM/GC's Basic Services consist of the two phases described below and any other services included in this Agreement as Basic Services.

- A. **Preconstruction Phase.** The CM/GC shall perform the following:
  1. **Project Schedule.** Provide for DFCM's review and acceptance, and periodically update a Project critical path schedule that coordinates and integrates the CM/GC's services, the A/E's services and DFCM's responsibilities with anticipated construction schedules.
  2. **Detailed Estimate.** Prepare for DFCM's approval a detailed estimate of Construction Cost, as defined in Article 3 of this Agreement. Provide in CSI or other DFCM-approved format, including a square foot (SF) cost analysis of each trade. The CM/GC shall update and refine this estimate throughout the design and construction process, including working with the A/E during each of the A/E design phases, including Schematic Design, Design Development & Construction Document phases. The overall objective is for the CM/GC and the A/E to present a mutually agreed upon design and estimate that complies with the Project scope and FLCC requirements. Estimates shall be divided for the separate bid packages that are going to be used for bidding.

If the estimate exceeds the approved Fixed Limit of Construction Cost (FLCC) defined in Article 2 of this Agreement, then the CM/GC shall, as part of its basic preconstruction services, cooperate with the A/E to present to the DFCM a mutually agreed upon value-engineering of the Project back within the FLCC.

3. **Consultation with DFCM and A/E and Construction Document Review.** The CM/GC shall conduct a complete review and consult with DFCM and the A/E of all aspects and phases of the drawings and specifications. This review and consultation shall evaluate the following: constructability, budget issues, scheduling issues, safety concerns, errors and omissions. The CM/GC shall be responsible for being aware of site conditions, market conditions and all other customary information needed to review all aspects and phases of the drawings and specifications.
4. **Phases.** Advise on the separation of the Project into separate bid packages/phases for various categories of Work.
5. **Schedule of Purchases.** Investigate and recommend a schedule of all purchases, including State provided, of materials and equipment requiring long lead-time procurement, and coordinate this schedule with the early preparation of portions of the Contract Documents by the A/E. Expedite and coordinate delivery of these purchases.
6. **Bidding (including proposals) Services.**
  - a. "Bid" and "Proposal" Meaning. For purposes of this Agreement, the term "bid" and other terms based on that word used in the invitation to bid process shall be deemed to refer to "proposal" and the corollary words related to the request for proposal process, when the request for proposal process is used in lieu of an invitation for bids.
  - b. Prequalification Criteria. The CM/GC shall prepare, when appropriate, prequalification criteria for bidders. Subcontractors and suppliers at all tiers must be properly licensed in the State of Utah and must meet all qualification requirements of the specifications/Contract Documents.
  - c. Ensure Bids are Received. The CM/GC is responsible for the procurement of subcontractors and suppliers for the Project. The CM/GC shall develop Subcontractor interest to ensure bids are received.
  - d. Pre-Bid Conferences. The CM/GC shall conduct pre-bid conferences to familiarize potential bidders with the bidding documents. The CM/GC shall ensure that the Construction Documents are available to all potential bidders.
  - e. Procure Subcontractors Similarly as DFCM. All procurements recommended and conducted by the CM/GC shall be in accordance with one of the source selection methods provided for in the Utah Procurement Code, UCA 63-56, "Part 4, Source Selections and Contract Formation," and the applicable rules of the Utah State Building Board in Utah Administrative Code, Title R23, in the same manner as if the subcontract Work was procured directly by DFCM. This is met by compliance with the CM/GC Procurement Manual (located on the DFCM Website) in administering the selection process for the Subcontractors, which Manual is hereby incorporated by reference as part of this Agreement.

- f. Selection of Bidders. The CM/GC shall receive bids, prepare bid analyses and award subcontracts or reject bids. DFCM, the Using Agency and the A/E shall be consulted during this procurement process, however, the determination and responsibility for the procurement of the subcontractors and suppliers is that of the CM/GC. The CM/GC shall conduct pre-award conferences with bidders that have been recommended for award by any selection committee.
- g. Manage Scope to be within FLCC. The CM/GC shall consult with the A/E in order to suggest reasonable adjustments in the scope of the Project, and to suggest alternate bids in the Construction Documents as needed to adjust the Construction Cost, which shall not exceed the FLCC. If DFCM determines as a result of the bidding process that the FLCC is exceeded or will likely be exceeded, DFCM reserves the right, in its sole discretion to: (1) give written approval of an increase in FLCC, including applying the CM/GC's Contingency to such increase; (2) authorize re-bidding; (3) revise the scope of the Work; and/or (4) terminate the Project.
- h. Bidders Contract with CM/GC Only. There shall be no contractual relationship between the subcontractors/suppliers and the DFCM or A/E. The CM/GC shall prepare and execute the required subcontractor/supplier agreements. The CM/GC shall be fully responsible for the performance of its Subcontractors and suppliers at any tier similar to a General Contractor under the DFCM General Conditions.

**7. Self-Performed Work.**

- a. Per UCA 63-56-501(2) and applicable Utah law, the CM/GC may request that it be allowed to self-perform portions of the Work for the benefit of the Project. The self-performed Work may be allowed as follows:
  - i. When the proposal for the self-performed Work is approved by DFCM as part of the CM/GC selection process; or
  - ii. When the CM/GC has been selected for the self-performed Work through a selection process that is similar to the selection of subcontractors by DFCM.
- b. Savings in self-performed Work may be eligible for the incentive described in Article 3.D.

- 8. **Termination.** If it is reasonably determined by the DFCM Director or designee that the CM/GC has not provided satisfactory preconstruction services, the DFCM Director or designee may determine to terminate this Agreement upon ten (10) days notice to the CM/GC and may use another CM/GC to complete the preconstruction phase and/or perform the construction phase services. All items required to be transferred or delivered to DFCM under the DFCM General Conditions for a termination for cause shall be so transferred or delivered promptly by the CM/GC to DFCM. Upon such termination, the CM/GC sole remedy shall be payment for properly performed services up to the date of such termination. For instance, as a result of such termination under this paragraph, the CM/GC is not entitled to receive: (1) any fee related to Work not properly performed; (2) any fee related to Work not yet performed; or (3) any amount related to lost profits. The CM/GC shall be liable to DFCM for all damages and liabilities provided for in this Agreement, the DFCM General Conditions and the Contract Documents.

**B. Construction Phase.**

1. **Written Authorization to Commence Construction.** The CM/GC shall complete construction in accordance with Contract Documents prepared by the A/E and approved by DFCM. Upon receipt of a fully executed Change Order that includes a GMP for a specific Scope of Work, the CM/GC is authorized to commence the Construction Phase. All the requirements of this Article 5.B. shall be included as part of any approved GMP.
2. **Payment and Performance Bonds.** Concurrent with the authorization to proceed with the Construction Phase, the CM/GC shall provide 100% Payment and Performance Bonds for the amount of the Guaranteed Maximum Price (GMP) and meeting the requirements contained in the Contract Documents.
3. **Administrative and Management Services.** Provide administrative and management services as required to coordinate the Work of the Subcontractors with each other and the CM/GC, DFCM and the A/E.
4. **Team Members.** The CM/GC's team must be consistent with the team members designated in the CM/GC's proposal and such team must contain an adequate number of members and have the qualifications necessary to complete the project in accordance with this Agreement. No member of the CM/GC's Team submitted in the selection process of the CM/GC, shall be removed from the Project unless said team member shall leave the employ of the CM/GC or unless DFCM requests or approves the change. Any request to replace a team member shall be submitted to DFCM in writing and subject to approval of DFCM upon a showing that such replacement is consistent with the qualifications provided in the selection process of the CM/GC.
5. **Supervision.** The CM/GC shall provide competent supervision of the Work and shall cause the Work to be performed in accordance with the Contract Documents.
6. **Meetings.** The CM/GC shall schedule and conduct pre-construction, construction and progress meetings. The CM/GC shall prepare and promptly distribute minutes of all such meetings. Said minutes shall not be considered official minutes until approved by DFCM. At the beginning of each meeting, the minutes of the prior meeting shall be the first item on the agenda and the minutes shall be reviewed for editing or approval at that time.
7. **Critical Path Scheduling.** The CM/GC shall provide an updated critical path schedule prior to the commencement of the Work. This critical path schedule shall be further updated in a prompt manner to reflect any changes. The CM/GC shall comply with all scheduling requirements in the Contract Documents and the DFCM General Conditions.
8. **Construction Cost Management.** The CM/GC shall perform regular monitoring of the approved estimate of Construction Cost, including actual costs for activities in progress and estimates for uncompleted tasks. The CM/GC shall promptly identify in writing to the DFCM and A/E, variances between actual/estimated costs in regard to the budget for the FLCC. The CM/GC shall use its best efforts to work with the A/E as a team in an effort to have designs presented to the Owner be properly determined in advance by the CM/GC to meet the FLCC. The CM/GC shall:
  - a. Maintain cost accounting records on authorized Work performed under unit costs and Work performed on the basis of actual costs of labor and materials.

- b. Recommend necessary or desirable changes to DFCM, review requests for changes, review subcontractor pricing, and procure reasonable subcontractors' bids.
  - c. Develop and implement procedures for the review and processing of applications by Subcontractors for progress and final payments.
9. **Safety.** The CM/GC shall be responsible for the overall safety of the Project and shall review the safety programs developed by each of the subcontractors as required by the Contract Documents. The CM/GC shall fulfill the safety responsibilities provided for in the DFCM General Conditions.
  10. **Assist in Selection Processes.** If required by DFCM or the Contract Documents, the CM/GC shall assist DFCM in selecting and retaining the professional services of surveyors, special consultants and testing laboratories and coordinate their services.
  11. **Manage Subcontractors and the Work.** The CM/GC shall determine that the Work of each subcontractor is being performed in accordance with the Contract Documents. The CM/GC shall promptly remediate any defects or deficiencies in the Work. The CM/GC is solely responsible for the performance of all subcontractors at any tier. Subject to review by the A/E and DFCM, the CM/GC shall reject Work that does not conform to the requirements of the Contract Documents.
  12. **Inspections.** The CM/GC shall timely arrange for all code inspections, special inspections or testing needed to assure compliance with the Contract Documents.
  13. **Requests for Interpretations.** The CM/GC shall promptly submit to the A/E and DFCM, any subcontractor requests for interpretations of the drawings and specifications, and promptly assist in the resolution of such requests.
  14. **Forward Insurance Certificates.** The CM/GC shall receive Certificates of Insurance from the Subcontractors, and upon specific request by the DFCM Project Manager, forward such to DFCM.
  15. **Review of Submittals.** The CM/GC shall establish and implement procedures for expediting the processing and approval of shop drawings, product data, samples and other submittals. The CM/GC shall receive from the subcontractors all shop drawings, product data, samples and other submittals, and review such for conformance with the Contract Documents. After review by the CM/GC, the CM/GC shall deliver the submittals to the A/E for review.
  16. **Logs, Records.** The CM/GC shall keep a daily log containing a record of weather conditions, subcontractors' Work on the site, number of workers, Work accomplished, all necessary data for verification of subcontractor performance, including, but not limited to, unit quantities, problems encountered, and other data as DFCM may require. The CM/GC shall make the log available to DFCM and the A/E promptly upon request.

The CM/GC shall maintain at the Project site, on a current basis: a record copy, all of which shall be marked to record all changes made during construction, of all contracts, drawings, specifications, addenda, change orders and other Modifications; all shop drawings, product data; samples; submittals; purchases; materials; equipment; maintenance and operating manuals and instructions; as well as other related documents and revisions related to the Project. The CM/GC shall make all records promptly available to DFCM upon request.

17. **Operation and Maintenance (O&M) Records, Record Drawings.** At the completion of the Project, the CM/GC shall promptly submit to the A/E, all O & M manuals and as-built (record drawings). The A/E will review these submittals for accuracy and then promptly forward the submittals to DFCM.
18. **Manage DFCM-Purchased Items.** The CM/GC shall arrange for delivery, storage, protection/security for DFCM-purchased items that are delivered to the CM/GC.
19. **Assist with Commissioning.** With the DFCM's designated Commissioning Agent, the A/E and DFCM's maintenance personnel, the CM/GC shall observe the subcontractors' testing and operation of utilities, control systems and equipment.
20. **Substantial Completion.** The CM/GC shall notify the A/E when the Project, or a portion thereof, is ready for a Substantial Completion inspection. Upon Substantial Completion, the CM/GC shall promptly complete the punch list items as provided for in the DFCM General Conditions.

**ARTICLE 6.  
ADDITIONAL SERVICES/WORK**

- A. **In General.** It is understood and agreed by the parties hereto that no money will be paid to the CM/GC for additional labor or materials furnished unless a new contract in writing or a Modification hereof in accordance with the DFCM General Conditions and the Contract Documents for such additional labor or materials has been executed. The DFCM specifically reserves the right to modify or amend this Agreement and the total sum due hereunder, either by enlarging or restricting the scope of the Work (including services).
- B. **Specific Additional Services.** The following Additional Services shall be performed by the CM/GC upon authorization in advance and in writing from DFCM and shall be paid for as provided in this Agreement:
  1. **DFCM Provided Furnishings/Equipment.** Services related to DFCM-provided furnishings and equipment not specified in the Contract Documents.
  2. **Certain Replacement of Work.** To the extent not the fault of the CM/GC, consultation on replacement of Work damaged by fire or other cause during construction, and furnishing services in conjunction with the replacement of such Work.
  3. **Certain Post-Warranty Services.** To the extent not the fault of the CM/GC, inspections of, and services related to, the Project after the end of the warranty period.
  4. **DFCM-Approved Extras.** Other services that are not part of the CM/GC's basic services and not otherwise specified in this Agreement, upon advance written direction from DFCM.
  5. **Infringement of Copyright, Patents.** Other than for those matters caused by the fault or negligence of the CM/GC, royalties, damages for infringement of patents and costs of defending suits related thereto; all at the actual cost to the CM/GC. Advance authorization by DFCM is not needed for the CM/GC to be entitled to these costs.
  6. **Emergencies.** Other than for those matters caused by the fault or negligence of the CM/GC, actual costs incurred due to an emergency affecting the safety of persons and property. Advance authorization by DFCM is not needed for the CM/GC to be entitled to these costs.

7. **Mark-up for Subcontractor Additional Work.**

- a. **CM/GC Markup.** For additional Work performed by Subcontractors that was not part of the scope of Work related to the GMP, the CM/GC will be compensated 5% of the subcontract or material price in lieu of the markups otherwise provided for in the DFCM General Conditions. This compensation is for home office coordination as well as CM/GC overhead and profit.
- b. **Subcontractor Markup.** Subcontractors shall receive a markup for additional Work in accordance with the DFCM General Conditions.

**ARTICLE 7.  
TIME AND DELAY REMEDY**

- A. **Time of Essence, Standard of Care.** Time is of the essence for the performance required by this Agreement. The CM/GC shall perform basic and additional services in an expeditious manner and consistent with the Standard of Care requirements of this Agreement.
- B. **Completion Date.** At the time a bid date is set for a particular subcontract, the DFCM and CM/GC will jointly establish a completion date (or dates) for the Work of that subcontract, which shall be consistent with the DFCM-approved Project Schedule for the entire Project.
- C. **Liquidated Damages.** The CM/GC agrees to pay liquidated damages in the amount of \$ \_\_\_\_\_ per day for each day after expiration of the Contract Time until the CM/GC achieves Substantial Completion in accordance with the Contract Documents, if CM/GC's delay makes the damages applicable. This provision for liquidated damages: (a) is to compensate DFCM for delay only; (b) is provided for herein because actual damages can not be readily ascertained at the time of execution of this Agreement; (c) is not a penalty; and (d) shall not prevent DFCM from maintaining Claims for other non-delay damages, such as costs to complete or remedy defective Work.
- D. **Delay/Hindrance Claim Limitation.** No PRE, Claim or action shall be maintained by the CM/GC, Subcontractors or suppliers at any tier, against DFCM for damages or other claims due to losses attributable to hindrances or delays from any cause whatsoever, including acts and omissions of DFCM or its officers, employees or agents, except as expressly provided in the DFCM General Conditions.
- E. **Extensions of Time.** Extension of Time requests must comply with the DFCM General Conditions.

**ARTICLE 8.  
THE DFCM'S RESPONSIBILITIES**

- A. **DFCM-Provided Requirements.** The DFCM has provided the requirements for the Project in the Request for Proposals, which is part of the Contract Documents.
- B. **Budget.** DFCM has advised the CM/GC of the budget of the Project, which is the FLCC identified in this Agreement. DFCM is responsible for maintaining its own Owner's Contingency, which shall be used for unforeseen conditions, design omissions/errors and other matters that increase the cost of the Project to the extent any such costs are not due to the fault or responsibility of the CM/GC under the Contract Documents.

- C. **DFCM Representative.** The DFCM shall designate a representative authorized to act upon behalf of DFCM with respect to the Project. The DFCM shall examine documents submitted by the CM/GC and shall render decisions pertaining thereto in a timely manner in order to avoid unreasonable delay in the progress of the CM/GC's Work as indicated by the DFCM-approved critical path schedule.
- D. **DFCM-Provided Tests, Inspections, Reports.** The DFCM may furnish structural, mechanical, chemical and other laboratory tests, inspections and reports. The CM/GC shall cooperate with any such tests or inspections.
- E. **Audit Rights.** The DFCM may audit applications for payments or any other aspect of the Services and Work of the CM/GC and of the subcontractor or suppliers at any tier. The CM/GC shall cooperate with DFCM in providing all necessary information for any DFCM audit.
- F. **Provide Construction Documents.** The DFCM shall assure that the CM/GC is provided the Construction Documents in a digital format. The CM/GC shall be responsible for making any further copies of the Construction Documents, subject to the copyright requirements in the DFCM General Conditions.
- G. **Right to Perform.** The DFCM reserves the right to perform Work related to the Project with DFCM's own forces, and to award contracts to other entities in connection with the Project, which are not part of the CM/GC's responsibilities under this Agreement. The CM/GC shall coordinate the CM/GC's Work with work of DFCM's separate contractors as required by the Contract Documents. The CM/GC shall promptly notify DFCM in writing if any such independent action will in any way compromise the CM/GC's ability to meet the CM/GC's responsibilities under this Agreement.

**ARTICLE 9.  
INDEMNIFICATION**

The CM/GC shall comply with the indemnification provisions of the DFCM General Conditions.

**ARTICLE 10.  
TERMINATION, SUSPENSION OR ABANDONMENT**

This Agreement may be terminated, suspended or abandoned in accordance with the DFCM General Conditions.

**ARTICLE 11.  
DISPUTE RESOLUTION**

Any dispute, PRE or Claim between the parties shall be subject to the provisions of Article 7 of the DFCM General Conditions. DFCM reserves all rights to pursue its rights and remedies as provided in the DFCM General Conditions.

**ARTICLE 12.  
SUCCESSORS AND ASSIGNS**

The DFCM and CM/GC, respectively bind themselves, their partners, successors, assigns and legal representatives to the other party to this Agreement, and to partners, successors, assigns and legal representatives of such other party with respect to all covenants, provisions, rights and responsibilities of this Agreement. The CM/GC shall not assign this Agreement without the prior written consent of DFCM, nor shall the CM/GC assign any money due or to become due as well as any rights under this Agreement, without prior written consent of DFCM.

**ARTICLE 13.  
EXTENT OF AGREEMENT**

- A. Agreement Includes the Following.** This Agreement includes this Agreement, the Request for Proposals for this Project, including the Instructions to Proposers and the CM/GC's Proposal (including Management Plan) to the extent not in conflict with the other Contract Documents, said DFCM General Conditions, Supplemental General Conditions, final drawings, specifications, Addenda and Modifications as approved by DFCM for this Project, the CM/GC's Proposal for this Project, the CM/GC's bonds submitted to DFCM, and all the attachments (including schedules) and documents incorporated by reference into this Agreement; all of which are hereby incorporated by reference as a part of this Agreement and are also referred to as the "Contract Documents." This Agreement represents the entire and integrated Agreement between DFCM and the CM/GC and supersedes all prior negotiations, representations or agreements, either written or oral. This Agreement may be amended only by written instrument signed by both DFCM and the CM/GC.
- B. Hierarchy.** The following documents shall be read together with the provisions of this Agreement, and in case of irreconcilable conflict between any provisions of the various documents, the first mentioned document in the following list shall control: Modifications, Addendum to drawings and specifications, drawings and specifications (as approved by DFCM), this Agreement including the attachments to this Agreement, the CM/GC's Proposal for this Project (including Management Plan) as may be modified by DFCM and indicated in the attachment to this Agreement, the DFCM's Request for Proposal for this Project, and the DFCM General Conditions.

**ARTICLE 14.  
AUTHORITY TO EXECUTE AND PERFORM AGREEMENT**

The CM/GC and DFCM each represent that the execution of this Agreement and the performance thereunder is within their respective duly authorized powers. Each signatory below represents that he/she is duly authorized by their respective entity to execute this Agreement on behalf of their respective entity.

**ARTICLE 15.  
ATTORNEY FEES AND COSTS**

Except as otherwise provided in the dispute resolution provisions of the DFCM General Conditions, the prevailing party shall be entitled to reasonable attorney fees and costs incurred in any action in any court of competent jurisdiction and/or appellate body to enforce this Agreement or recover damages or any other action as a result of a breach thereof.

**ARTICLE 16.  
COST ESCALATION ALLOWANCE**

- A.** The project construction budget (FLCC) has been established at present estimated construction cost.
- B.** DFCM will hold a contingency, which is not part of the FLCC, which may be available to the Project by modification to the FLCC, to account for legitimate material and labor escalation costs as may be determined by the A/E and the CM/GC team until the results of a bid package is obtained for a particular scope of work.

- C. Following the results of the bid package, the CM/GC is solely responsible for any material and labor escalation costs.
- D. DFCM reserves the right to reject any bid package where the escalation is excessive in the sole opinion of DFCM, at which time scope reduction or value engineering will be considered by the CM/GC in cooperation with the A/E. This consideration of the CM/GC and the A/E will be submitted to DFCM for acceptance.
- E. The A/E and the CM/GC's fee will not be adjusted due to material or labor cost escalations experienced at any phase of this Project.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on the day and year first above written.

CM/GC: \_\_\_\_\_

\_\_\_\_\_  
Signature Date

Title: \_\_\_\_\_

State of \_\_\_\_\_ )  
County of \_\_\_\_\_ )

\_\_\_\_\_  
Please type/print name clearly

On this \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, personally appeared before me, \_\_\_\_\_, whose identity is personally known to me (or proved to me on the basis of satisfactory evidence) and who by me duly sworn (or affirmed), did say that he (she) is the \_\_\_\_\_ (title or office) of the firm and that said document was signed by him (her) in behalf of said firm.

\_\_\_\_\_  
Notary Public

(SEAL)

My Commission Expires \_\_\_\_\_

APPROVED AS TO FORM:  
ATTORNEY GENERAL  
January 24, 2008  
By Alan S. Bachman  
Asst Attorney General

**DIVISION OF FACILITIES  
CONSTRUCTION AND MANAGEMENT**

\_\_\_\_\_  
Lynn Hinrichs, Manager Date  
Capital Development

Approved for Expenditure:

Approved as to availability of funds:

\_\_\_\_\_  
Division of Finance Date

\_\_\_\_\_  
David D. Williams, Jr. Date  
DFCM Administrative Services Director





**Utah State Tax Commission**  
**Exemption Certificate**  
(Sales, Use, Tourism and Motor Vehicle Rental Tax)

**TC-721**  
Rev. 7/01

Name of business or institution claiming exemption (purchaser) <b>UTAH STATE UNIVERSITY</b>		Telephone Number <b>435+797-1033</b>	
Street Address <b>1330 East 700 North</b>	City <b>Logan</b>	State <b>UT</b>	Zip Code <b>84322-8300</b>
Authorized Signature <i>[Signature]</i>	Name (please print) <b>J.B. Covington</b>	Title <b>Purchasing Director</b>	
		Date <b>October 1, 2001</b>	

The person signing this certificate **MUST** check the applicable box showing the basis for which the exemption is being claimed. Questions should be directed (preferably in writing) to Taxpayer Services, Utah State Tax Commission, 210 N 1950 W, SLC Utah 84134. Telephone (801) 297-2208, or toll free 1-800-862-4335.

**DO NOT SEND THIS CERTIFICATE TO THE TAX COMMISSION**

Keep it with your records in case of an audit.

Sales tax account numbers with an "H" prefix are not to be used for tax-free purchases for resale.

- RESALE OR RE-LEASE** Sales Tax License No. \_\_\_\_\_  
I certify that I am a dealer in tangible personal property or services and that the tangible personal property or services purchased are for resale or re-lease. If I use or consume any tangible personal property or services that I purchase tax free for resale, or if my sales are of food, beverages, dairy products and similar confections dispensed from vending machines (see Rule R865-19S-74), I will report and pay sales tax on the proper cost thereof directly to the Tax Commission on my next regular sales and use tax return.
- AGRICULTURAL PRODUCER**  
I certify that the items purchased will be used primarily and directly in a commercial farming operation and qualify for the Utah sales and use tax exemption. Failure to report these sales on the informational lines of the vendor's sales and use tax return may subject the seller to a penalty equal to the lesser of \$1000 or 10% of the sales and use tax that would have been imposed if the exemption had not applied.
- BUILDING MATERIALS USED OUTSIDE UTAH**  
I certify that the building materials and equipment purchased will be incorporated into real property outside the State of Utah, and that the state of use will not allow credit for sales or use tax paid to Utah.  
Vendor invoice number: \_\_\_\_\_ Date: \_\_\_\_\_  
Location of job outside Utah: \_\_\_\_\_
- COMMERCIAL AIRLINES**  
I certify that the food and beverages purchased are by a commercial airline for in-flight consumption; or, any parts or equipment purchased are for use in aircraft operated by common carriers in interstate or foreign commerce.
- COMMERCIALS, FILMS, AUDIO-AND VIDEO TAPES**  
I certify that purchases of commercials, films, prerecorded video tapes, prerecorded audio program tapes or records are for sale or distribution to motion picture exhibitors, or commercial television or radio broadcasters. If I subsequently resell items to any other customer, or use or consume any of these items, I will report any tax liability directly to the Tax Commission.
- CONSTRUCTION MATERIALS PURCHASED FOR SCHOOLS OR RELIGIOUS AND CHARITABLE ORGANIZATIONS**  
I certify that the construction materials purchased are purchased on behalf of a public elementary or secondary school or religious or charitable organization. I further certify that the purchased construction materials will be installed or converted into real property owned by the school or religious or charitable organization.  
Name of school or religious or charitable organization: \_\_\_\_\_  
Name of project: \_\_\_\_\_
- FUELS, GAS, ELECTRICITY** Sales Tax License No. \_\_\_\_\_  
I certify that all gas, electricity, coal, coke, and other fuel purchased will be used for industrial use only and not for residential or commercial purposes. Include the business Standard Industrial Code, and state the predominant use of the fuel covered by the exemption.  
Standard Industrial Code: \_\_\_\_\_ Use of the fuel: \_\_\_\_\_
- HOME MEDICAL EQUIPMENT**  
I certify that the medical equipment purchased is eligible for payment under Title 18 or Title 19 of the federal Social Security Act, is prescribed or authorized by a licensed physician for the treatment of a medical illness or injury or as necessary to mitigate an impairment resulting from illness or injury, and will be used exclusively by the person for whom it was prescribed. **SALES OF SPAS OR SAUNAS ARE TAXABLE.**
- LEASEBACKS**  
I certify that the tangible personal property leased satisfies the following conditions: (1) the property is part of a sale-leaseback transaction; (2) sales or use tax was paid on the initial purchase of the property; and, (3) the leased property will be capitalized and the lease payments will be accounted for as payments made under a financing arrangement.
- STEEL MILL EXEMPTION**  
I certify that the rolls, rollers, refractory brick, electric motors or other replacement parts will be used in the furnaces, mills or ovens of a steel mill as described in SIC code 3312.

**MANUFACTURING MACHINERY AND EQUIPMENT EXEMPTION FOR NEW OR EXPANDING OPERATIONS, NORMAL OPERATING REPLACEMENTS, OR SCRAP RECYCLING** Sales Tax License No. \_\_\_\_\_

I certify that the manufacturing machinery or equipment purchased is for use in new or expanding operations or for normal operating replacements in a Utah manufacturing facility described within the SIC Codes of 2000-3999 or in a qualifying scrap recycling operation. This exemption does not apply to parts or services for repairs or maintenance. A SEPARATE EXEMPTION CERTIFICATE MUST BE PRESENTED FOR EACH SUBSEQUENT PURCHASE, AT THE TIME OF PURCHASE. Failure to report these purchases on the informational lines of the manufacturer's or scrap recycler's sales and use tax return may subject the manufacturer or scrap recycler to a penalty equal to the lesser of \$1000 or 10% of the sales and use tax that would have been imposed if the exemption had not applied.

**SEMICONDUCTOR FABRICATING OR PROCESSING MATERIAL EXEMPTION**

I certify that the fabricating or processing material purchased is for use in manufacturing or fabricating semiconductors. Beginning on July 1, 2001 through June 30, 2002, 10% of the sale is exempt. Beginning July 1, 2002 through June 30, 2003, 50% of the sale is exempt. Beginning July 1, 2003 through June 30, 2004, the entire amount of the sale is exempt. Failure to report these purchases on the information line of the semiconductor manufacturer's sales and use tax return may subject the semiconductor manufacturer to a penalty equal to the lesser of \$1,000 or 10% of the sales and use tax that would have been imposed if the exemption had not applied.

**MUNICIPAL ENERGY SALES AND USE TAX EXEMPTION**

I certify that the natural gas or electricity purchased: is for resale; is prohibited from taxation by federal law, the U.S. Constitution, or the Utah Constitution; is for use in compounding or producing taxable energy; is subject to tax under the Motor and Special Fuel Tax Act; is used for a purpose other than as a fuel; is used by an entity exempted by municipal ordinance; or is for use outside a municipality imposing a municipal energy sales and use tax. The normal sales tax exemptions under Utah Code Section 59-12-104 do not apply to the Municipal Energy Sales and Use Tax.

**POLLUTION CONTROL FACILITY** Sales Tax License No. \_\_\_\_\_

I certify that our company has been granted a "Certification of Facilities" as provided for by Utah Code Ann. Sections 19-2-123 through 19-2-127 and as explained in Sales Tax Rule R865-19S-83 by either the Air Quality Board or the Water Quality Board. I further certify that each item of tangible personal property purchased under this exemption is qualifying machinery or equipment for this purpose.

**RELIGIOUS OR CHARITABLE INSTITUTION** Sales Tax Exemption No. \_\_\_\_\_

I certify that the tangible personal property or services purchased will be used or consumed for essential religious or charitable purposes. This exemption can only be used on purchases totaling \$1,000 or more, unless the sale is pursuant to a contract between the vendor and purchaser. CAUTION: The normal charitable and religious exemption does not apply to purchases of Olympic merchandise unless the exempt entity is purchasing Olympic merchandise for resale. I certify that any Olympic merchandise purchased under this exemption will be resold and that I have obtained a Utah sales and use tax account number for this purpose.

**SKI RESORT EXEMPTION** Sales Tax License No. \_\_\_\_\_

I certify that the snowmaking equipment, ski slope grooming equipment or passenger ropeways purchased are to be paid directly with funds from the ski resort noted on the front page of this form. Failure to report these purchases on the informational lines of the ski resort's sales and use tax return may subject the ski resort to a penalty equal to the lesser of \$1000 or 10% of the sales and use tax that would have been imposed if the exemption had not applied.

**TOURISM/MOTOR VEHICLE RENTAL TAX EXEMPTION**

I certify that the motor vehicle being leased or rented will be temporarily used to replace a motor vehicle that is being repaired pursuant to a repair or an insurance agreement; that the lease will exceed 30 days; that the motor vehicle being leased or rented is registered for a gross laden weight of 12,001 pounds or more; or, that the motor vehicle is being rented or leased as a personal household goods moving van. This exemption applies only to the tourism tax (up to 7 percent) and the short-term motor vehicle rental tax (Transportation Corridor Funding - 2.5 percent) - not to the state, local, transit, zoo, hospital, highways, county option or resort sales tax.

**UNITED STATES GOVERNMENTAL OR NATIVE AMERICAN TRIBAL EXEMPTION**

I certify that the tangible personal property or services purchased are to be paid directly with funds from the entity noted on the front page of this form and will be used in the exercise of essential governmental or tribal functions. "Directly" does not include per diem, entity advances, or similar indirect payments.

**UTAH STATE AND LOCAL GOVERNMENTS AND PUBLIC ELEMENTARY AND SECONDARY SCHOOLS** Sales Tax License No. 50245

I certify that the tangible personal property or services purchased are to be paid directly with funds from the entity noted on the front page of this form and will be used in the exercise of that entity's essential functions. If the purchaser noted on the front page of this form is a Utah state or local government, I certify that these construction materials will be installed or converted into real property by employees of this government entity. If the purchaser noted on the front page of this form is a public elementary or secondary school, I certify that these construction materials will be installed or converted into real property owned by this school. "Directly" does not include per diem, entity advances, or similar indirect payments. CAUTION: This exemption does not apply to government or educational entities of any other states.

To be valid this certificate must be filled in completely, including a check mark in the proper box. Please sign, date and, if applicable, include your license or exemption number.

NOTE TO VENDOR - Keep this certificate on file since it must be available for audit review.

NOTE TO PURCHASER - Keep a copy of this certificate for your records. You are responsible to notify the vendor of cancellation, modification, or limitation of the exemption you have claimed.

If you need an accommodation under the Americans with Disabilities Act, contact the Tax Commission at (801) 297-3811 or TDD (801) 297-3819. Please allow three working days for a response.

**DO NOT SEND THIS CERTIFICATE TO THE TAX COMMISSION**

Keep it with your records in case of an audit.





**PERFORMANCE BOND**  
(Title 63, Chapter 56, U. C. A. 1953, as Amended)

That \_\_\_\_\_ hereinafter referred to as the "Principal" and \_\_\_\_\_, a corporation organized and existing under the laws of the State of \_\_\_\_\_, with its principal office in the City of \_\_\_\_\_ and authorized to transact business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah, hereinafter referred to as the "Obligee," in the amount of \_\_\_\_\_ DOLLARS (\$ \_\_\_\_\_) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Obligee, dated the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, to construct \_\_\_\_\_ in the County of \_\_\_\_\_, State of Utah, Project No. \_\_\_\_\_, for the approximate sum of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_), which Contract is hereby incorporated by reference herein.

NOW, THEREFORE, the condition of this obligation is such that if the said Principal shall faithfully perform the Contract in accordance with the Contract Documents including, but not limited to, the Plans, Specifications and conditions thereof, the one year performance warranty, and the terms of the Contract as said Contract may be subject to Modifications or changes, then this obligation shall be void; otherwise it shall remain in full force and effect.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the state named herein or the heirs, executors, administrators or successors of the Owner.

The parties agree that the dispute provisions provided in the Contract Documents apply and shall constitute the sole dispute procedures of the parties.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the Provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

WITNESS OR ATTESTATION:

\_\_\_\_\_

PRINCIPAL:

\_\_\_\_\_

By: \_\_\_\_\_ (Seal)

Title: \_\_\_\_\_

WITNESS OR ATTESTATION:

\_\_\_\_\_

SURETY:

\_\_\_\_\_

By: \_\_\_\_\_ (Seal)  
Attorney-in-Fact

STATE OF \_\_\_\_\_ )  
 ) ss.  
COUNTY OF \_\_\_\_\_ )

On this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, personally appeared before me \_\_\_\_\_, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney in-fact of the above-named Surety Company and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

My commission expires: \_\_\_\_\_  
Resides at: \_\_\_\_\_

\_\_\_\_\_  
NOTARY PUBLIC

Agency:	_____
Agent:	_____
Address:	_____
Phone:	_____

Approved As To Form: May 25, 2005  
By Alan S. Bachman, Asst Attorney General



**PAYMENT BOND**

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

**KNOW ALL PERSONS BY THESE PRESENTS:**

That \_\_\_\_\_ hereinafter referred to as the "Principal," and \_\_\_\_\_ a corporation organized and existing under the laws of the State of \_\_\_\_\_ authorized to do business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); with its principal office in the City of \_\_\_\_\_, hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah hereinafter referred to as the "Obligee," in the amount of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS**, the Principal has entered into a certain written Contract with the Obligee, dated the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, to construct \_\_\_\_\_ in the County of \_\_\_\_\_, State of Utah, Project No. \_\_\_\_\_ for the approximate sum of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_), which contract is hereby incorporated by reference herein.

**NOW, THEREFORE**, the condition of this obligation is such that if the said Principal shall pay all claimants supplying labor or materials to Principal or Principal's Subcontractors in compliance with the provisions of Title 63, Chapter 56, of Utah Code Annotated, 1953, as amended, and in the prosecution of the Work provided for in said Contract, then, this obligation shall be void; otherwise it shall remain in full force and effect.

That said Surety to this Bond, for value received, hereby stipulates and agrees that no changes, extensions of time, alterations or additions to the terms of the Contract or to the Work to be performed thereunder, or the specifications or drawings accompanying same shall in any way affect its obligation on this Bond, and does hereby waive notice of any such changes, extensions of time, alterations or additions to the terms of the Contract or to the Work or to the specifications or drawings and agrees that they shall become part of the Contract Documents.

**PROVIDED, HOWEVER**, that this Bond is executed pursuant to the provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

**IN WITNESS WHEREOF**, the said Principal and Surety have signed and sealed this instrument this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

**WITNESS OR ATTESTATION:**

\_\_\_\_\_

**PRINCIPAL:**

\_\_\_\_\_

By: \_\_\_\_\_ (Seal)

Title: \_\_\_\_\_

**WITNESS OR ATTESTATION:**

\_\_\_\_\_

**SURETY:**

\_\_\_\_\_

By: \_\_\_\_\_ (Seal)  
Attorney-in-Fact

STATE OF \_\_\_\_\_ )  
 ) ss.  
COUNTY OF \_\_\_\_\_ )

On this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, personally appeared before me \_\_\_\_\_, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.  
My commission expires: \_\_\_\_\_  
Resides at: \_\_\_\_\_

NOTARY PUBLIC

Agency: \_\_\_\_\_  
Agent: \_\_\_\_\_  
Address: \_\_\_\_\_  
Phone: \_\_\_\_\_

Approved As To Form: May 25, 2005  
By Alan S. Bachman, Asst Attorney General





# GENERAL CONDITIONS

May 25, 2005

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# GENERAL CONDITIONS

May 25, 2005

## ARTICLE 1. GENERAL PROVISIONS.

### 1.1 BASIC DEFINITIONS.

**A/E** (including all design professionals). "A/E" means the person lawfully licensed to practice architecture or engineering or an entity lawfully practicing architecture or engineering identified as such in the A/E's Agreement and is referred to throughout the Contract Documents as if singular in number. The term "A/E" also means the A/E's representative and its subconsultants. When these General Conditions are part of a Contract in which the design professional is an interior designer, landscape subconsultant or other design professional, the term "A/E" as used in these General Conditions shall be deemed to refer to such design professional. A license is not required when the type of design professional is one which is not subject to a professional license, but such professional must meet the prevailing standards in the State of Utah for such practice. For projects where there is no A/E hired by DFCM, the references in the General Conditions to A/E shall be deemed to refer to DFCM as may be practicably applied.

**ADDENDA.** "Addenda" means the written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the bidding documents or the Contract Documents.

**ASI.** "ASI" shall mean a Supplemental Instruction issued by the A/E to the Contractor which may result in clarifications or minor changes in the Work and does not affect the contract time or the contract amount.

**BID.** "Bid" means the offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

**BONDS.** "Bonds" mean the bid bond, performance and payment bonds and other instruments of security.

**CHANGE ORDER.** "Change Order" means a written instrument signed by the DFCM and Contractor, stating their agreement for changes of the Contract as specified on the required DFCM's change order form.

**CLAIM.** "Claim" means a dispute, demand, assertion or other matter submitted by the Contractor, including a Subcontractor at any tier subject to the provisions of these General Conditions. The claimant may seek, as a matter of right, modification, adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. A request for Preliminary Resolution Effort (PRE) shall not be considered a "Claim." A requested amendment, requested change order, or a Construction Change Directive (CCD) is not a PRE or Claim unless agreement cannot be reached and the procedures of these General Conditions are followed.

**CONSTRUCTION CHANGE DIRECTIVE.** A "Construction Change Directive" means a written order signed by the DFCM, directing a change in the Work and stating a proposed basis for adjustment, if any, in the Contract Sum or Contract Time, or both. The DFCM may by Construction Change Directive, without

invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions; even if it may impact the Contract Sum and Contract Time.

**CONTRACT.** The Contract Documents form the Contract for Construction. The term "Contract" represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the A/E and Contractor, (2) between the DFCM and a Subcontractor or (3) between any persons or entities other than the DFCM and Contractor.

**CONTRACT DOCUMENTS.** The term "Contract Documents" means the Contractor's Agreement between the DFCM and Contractor (hereinafter referred to as "Contractor's Agreement"), the Conditions of the Contract (General, Supplementary and other Conditions), the Drawings, Specifications, Addenda, other documents listed in the Contractor's Agreement and Modifications issued after execution of the Contractor's Agreement. The Contract Documents shall also include the bidding/proposal documents, including the Instructions to Bidders/Proposers, Notice to Contractors and the Bid/Proposal Form, to the extent not in conflict with the other above-stated Contract Documents and other documents and oral presentations as part of the Selection which are documented as an attachment to the Contract.

**CONTRACT SUM.** The term "Contract Sum" means the Contract Sum as stated in the Contractor's Agreement and, including authorized and signed adjustments to this agreement (modifications), is the total amount payable by the DFCM to the Contractor for performance of the Work under the Contract Documents.

**CONTRACT TIME.** "Contract Time", unless otherwise provided in the Contract Documents, means the period of time, including authorized and signed adjustments (modifications), stated in the Contract Documents for Substantial Completion of the Work.

**CONTRACTOR.** The Contractor is the person or entity identified as such in the DFCM Contractor's Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Contractor" means the Contractor or the Contractor's authorized representative. When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case, shall mean the Contractor who executes each separate DFCM Contractor Agreement.

**CONTRACTOR'S AGREEMENT.**

"Contractor's Agreement" means, unless the context requires otherwise, the agreement executed by the Contractor and DFCM for the Project.

**DAY.** The term "day" or "days" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

**DEFECTIVE.** "Defective" is an adjective which when modifying the word "Work" refers to Work that does not conform to the Contract Documents, or does not meet the requirements of any inspection, referenced standard, code, test or approval referred to in the Contract Documents, or has been damaged.

**DFCM REPRESENTATIVE.**

"DFCM Representative" means the Division of Facilities Construction and Management person directly assigned to work with the Contractor on a regular basis. Unless the context requires otherwise, the "DFCM Representative" is the "Owner's Representative."

**DIRECTOR.** "Director" means the Director of the Division of Facilities Construction and Management unless the context requires otherwise. Director may include a designee selected by the Director for the particular function referred to in the General Conditions.

**DFCM.** "DFCM" means the Division of Facilities Construction and Management established pursuant to Utah Code Annotated Section 63A-5-201 et seq. Unless the context requires otherwise, DFCM is the "Owner" as that term is commonly referred to in the construction industry.

**DRAWINGS.** The "Drawings" are the graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing the design, location and dimensions of the Work, and generally include the drawings, elevations, sections, details, schedules and diagrams.

**EXECUTIVE DIRECTOR.**

"Executive Director" means the Executive Director of the Department of Administrative Services, including unless otherwise stated, his/her duly authorized designee.

**INSPECTION.** The word "inspection" or its derivatives shall mean a review of the Project, including but not limited to a visual review of the Work completed to date to ascertain if the Work is in accordance with the Contract Documents, including all applicable building codes and construction standards.

**MODIFICATION.** A "Modification" is (1) a Change Order (2) Construction Change Directive or (3) ASI. The Contract may be amended or modified only by (1) a written amendment executed by both the DFCM and Contractor, or (2) by a Modification.

**NOTICE TO PROCEED.** A "Notice to Proceed" is a document prepared by the DFCM and by its terms authorizes the Contractor to commence Work on the Project. It is deemed issued upon being sent by the DFCM to the Contractor's specified address within the bid or proposal.

**PARTIAL USE.** "Partial Use" means placing a portion of the Work in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion for all the Work. This partial use does not constitute "substantial completion".

**PRELIMINARY RESOLUTION EFFORT.** "Preliminary Resolution Effort" or "PRE" means the processing of a request for preliminary resolution or any similar notice about a problem that could potentially lead to a Claim and is prior to reaching the status of a Claim.

**PRODUCT DATA.** "Product Data" means illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

**PROJECT.** The "Project" means the total construction of the Work performed under the Contract Documents.

**PROJECT MANUAL (FOR CONSTRUCTION).** The "Project Manual" is the volume assembled for the Work and may include the bidding/proposal requirements, sample forms, General or Supplementary Conditions of the Contract and Specifications.

**PROPOSAL REQUEST OR "PR."**

A "Proposal Request" or "PR" is a proposal request filed with the Contractor for the purposes of seeking a proposal in order to resolve an issue as part of the Change Order or Contract Modification process.

**PROPOSED CHANGE ORDER.** A "Proposed Change Order" ("PCO"), is an informal request by the Contractor filed with the DFCM Representative, in an effort to commence the Contract Modification Process. It shall not be considered a "PRE" or a "Claim." The PCO may be related to any potential, or actual delay, disruption, unforeseen condition or materials or any other matter in which the Contractor intends to seek additional monies or time.

**REQUEST FOR INFORMATION or RFI.** A "Request for Information" or "RFI" is a request filed by the Contractor with the A/E regarding any request for information, direction or clarification related to the Contract Documents, plans or specifications.

**RESOLUTION OF THE CLAIM.** "Resolution of the Claim" means the final resolution of the Claim by the Director, but does not include any administrative appeal, judicial review or judicial appeal thereafter.

**RULE.** "Rule," unless the context requires otherwise, shall mean a Rule of the Utah Administrative Code.

**SALES TAX and/or USE TAX.** Sales Tax and/or Use Tax, unless the context requires otherwise, shall mean the sales tax and/or use tax collected or to be collected by the Utah State Tax Commission and shall include any sales and/or use tax that the Utah State Tax Commission collects on behalf of any special district, local government or political subdivision.

**SAMPLES.** "Samples" mean physical examples, which illustrate materials, equipment or workmanship and establishes standards by which the Work will be judged.

**SHOP DRAWINGS.** "Shop Drawings" means drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

**SPECIFICATIONS.** The "Specifications" are that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards, installation and workmanship for the Work, and performance of related systems and services.

**SUBCONTRACTOR.** "Subcontractor" means the person or entity that has a direct contract with the Contractor, including any trade contractor or specialty contractor, or with another Subcontractor at any tier to provide labor or materials for the work but does not include suppliers who provide only materials, equipment or supplies to a contractor or subcontractor. Notwithstanding the foregoing, the text in which the term is used may provide for the exclusion of Subcontractors of other Subcontractors or the exclusion of suppliers. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or authorized representative of the Subcontractor. The Term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

**SUBSTANTIAL COMPLETION.** "Substantial Completion" is the date certified in accordance with Article 9.2 and means the date the Work or designated portion thereof is sufficiently complete,

and any lack of completion or performance does not reasonably interfere with the DFCM's intended use of the Project, in accordance with the Contract Documents so that the DFCM can occupy and use the Work for its intended use. DFCM's "intended use" or "occupy" as used in this definition, shall include any intended use or occupation by any agency or entity for which DFCM has intended to so occupy the Project.

## **SUPPLEMENTARY CONDITIONS OR SUPPLEMENTARY GENERAL**

**CONDITIONS.** "Supplementary Conditions" or "Supplementary General Conditions" means the part of the Contract Documents which amends or supplements these General Conditions.

**WORK.** The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all labor, materials, equipment and services provided, or to be provided, by the Contractor to fulfill the Contractor's obligations.

## **ARTICLE 2. DFCM.**

### **2.1 INFORMATION AND SERVICES REQUIRED OF THE DFCM.**

#### **2.1.1 DFCM'S REPRESENTATIVE.**

The DFCM shall designate a DFCM Representative authorized to act in the DFCM's behalf with respect to the Project. The DFCM or such authorized representative shall render decisions within a reasonable time pertaining to documents submitted by the A/E and/or Contractor in order to avoid a compensable delay in the orderly and sequential progress of the Project.

#### **2.1.2 SPECIALISTS AND**

**INSPECTORS.** The DFCM will provide certified building inspection services in accordance with the adopted Building Codes. This includes 'routine' and 'special' inspections unless otherwise noted in the A/E Agreement. The DFCM may assign an inspector or specialist to note deviations from, or necessary adjustments to, the Contract Documents or to report deficiencies or defects in the Work. The inspector or specialist's activities in no way relieves the

Contractor of the responsibilities set forth in the Contract Documents.

### **2.1.3 SURVEYS AND LEGAL**

**DESCRIPTION.** The DFCM shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall review this information, including the surveys and any provided soils tests, and compare such information with observable physical conditions and the Contract Documents.

**2.1.4 PROMPT INFORMATION AND SERVICES.** Upon receipt of a written request from the Contractor, the DFCM shall furnish information or services under the DFCM's control with reasonable promptness to avoid delay in the orderly progress of the Work.

### **2.1.5 COPIES OF DRAWINGS AND PROJECT MANUALS**

**(FOR CONSTRUCTION).** Unless otherwise provided in the Contract Documents, the Contractor will be furnished, free of charge, such copies of Drawings and Project Manuals (for construction) as are reasonably necessary for execution of the Work. DFCM's Web Page may also provide referenced documents for the Project.

**2.1.6 OTHER DUTIES.** The foregoing is in addition to other duties and responsibilities of the DFCM enumerated herein and especially those in respect to Article 2.2 (Construction by DFCM or by Separate Contractors), Article 8 (Payments and Completion) and Article 10 (Insurance and Bonds).

## **2.2 CONSTRUCTION BY DFCM OR BY SEPARATE CONTRACTORS**

### **2.2.1 DFCM'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS.**

**(1) IN GENERAL.** The DFCM reserves the right to perform construction or operations related to the Project with the DFCM's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or

substantially similar to these including those portions related to insurance and waiver of subrogation.

### **(2) COORDINATION AND REVISIONS.**

The DFCM shall provide for coordination of the activities of the DFCM's own forces and of each separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the DFCM in reviewing their construction schedules when directed to do so. The Contractor shall make any revisions to the construction schedule and Contract Sum deemed necessary after a joint review and agreement by the DFCM. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the DFCM until subsequently revised.

### **2.2.2 MUTUAL RESPONSIBILITY.**

**(1) CONTRACTOR COORDINATION.** The Contractor shall afford the DFCM and separate contractor(s) a reasonable opportunity for delivery and storage of their materials and equipment and performance of their activities and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

**(2) REPORTING PROBLEMS TO DFCM.** If part of the Contractor's Work depends on work by the DFCM or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report in writing to the DFCM apparent defects in workmanship that would render it unsuitable for proper execution. Failure of the Contractor to make said report shall constitute an acknowledgment that the DFCM's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects in workmanship not then reasonably discoverable.

**(3) COSTS.** Costs caused by delays or by improperly timed activities or defective construction shall be borne by the responsible party in accordance with the procedures and provisions of the Contract Documents.

**(4) CONTRACTOR**

**REMEDIAL WORK.** The Contractor shall promptly remedy damage caused by the Contractor to completed or partially completed Work or to property of the DFCM or separate contractors and subcontractors as provided in Article 6.

**ARTICLE 3. A/E.**

**3.1 A/E'S ADMINISTRATION OF THE CONTRACT.**

**3.1.1 IN GENERAL.** The A/E assists the DFCM with the administration of the Contract as described in the Contract Documents. The A/E shall have the authority to act on behalf of the DFCM only to the extent provided in the Contract Documents or A/E's Agreement.

**3.1.2 SITE VISITS.**

(1) Site visits or inspections by the A/E, the DFCM or any DFCM representative shall in no way limit or affect the Contractor's responsibility to comply with all the requirements and the overall design concept of the Contract Documents as well as all applicable laws, statutes, ordinances, resolutions, codes, rules, regulations, orders and decrees.

**(2) WRITTEN REPORT.**

The A/E shall promptly submit to the DFCM a written report subsequent to each site visit.

**3.1.3 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION.**

Except as authorized by the DFCM Representative or as otherwise provided in the Contract Documents, including these General Conditions, the A/E and Contractor shall communicate through the DFCM Representative on issues regarding the timing of the Work, cost of the Work or scope of the Work. Contractor shall comply with communication policies agreed upon at any pre-construction meeting with the DFCM. Communications by and with the A/E subconsultants shall be through the A/E. Communications by and with Subcontractors shall be through the Contractor. Communications

by and with separate contractors shall be through the DFCM.

**3.1.4 A/E MAY REJECT WORK, ORDER INSPECTION, TESTS.** The A/E shall have the responsibility and authority to reject Work which, based upon the A/E's knowledge or what may be reasonably inferred from the A/E's site observations and review of data, does not conform to the Contract Documents. Whenever the A/E considers it necessary or advisable for implementation of the intent of the Contract Documents, the A/E shall have the responsibility and authority to require additional inspections or testing of the Work in accordance with the provisions of the Contract Documents, whether or not such Work is fabricated, installed or completed, provided, however, the A/E must obtain the DFCM's prior written approval of any such additional inspections or testing. However, neither this authority of the A/E nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the A/E to the Contractor, Subcontractors, their agents or employees or other persons performing portions of the Work, including separate contractors. If the Contractor disputes the rejection of any Work and the correction thereof shall involve additional cost or time, it shall be the DFCM's option to accept such Work whether it be conforming or nonconforming.

**3.1.5 A/E REVIEW CONTRACTOR'S SUBMITTALS.**

(1) Contractor shall submit shop drawings, product data, and samples and other submittals required by the Contract Documents to the A/E as required by the approved submittal schedule.

(2) The A/E shall review and approve or take other appropriate action upon Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the purpose of checking for conformance with the information and design concepts expressed in the Contract Documents. A/E action taken on a submittal shall not constitute a Modification of this Agreement.

(3) The A/E's action shall be taken no later than 15 days following A/E's receipt of the submittal, unless agreed to otherwise by Contractor and DFCM, in order to avoid a delay in the Work of the Contractor or of separate contractors while allowing sufficient time in the A/E's professional judgment to permit adequate review.

(4) Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents.

(5) The A/E's review of the Contractor's submittals shall not relieve the Contractor of the obligations under the Contract Documents.

(6) The A/E's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the A/E, of any construction means, methods, techniques, sequences or procedures.

(7) The A/E's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

(8) When professional certification of performance characteristics of materials, systems or equipment is required by the Contract Documents, the A/E shall be entitled to rely upon such certifications to establish that the materials systems or equipment will meet the performance criteria required by the Contract Documents.

**3.2 OWNERSHIP AND USE OF A/E'S DRAWINGS, SPECIFICATIONS AND OTHER DOCUMENTS.** All Drawings, Specifications and other documents prepared by the A/E are and shall remain the property of the DFCM, and DFCM shall retain all common law, statutory and other reserved rights with respect thereto. Said documents were prepared and are intended for use as an integrated set for the Project which is the subject of this Contractor's

Agreement. The Contractor shall not modify or use Contract Documents on any other project without the prior written consent of the DFCM and A/E. Any such non-permissive use or modification, by Contractor, the Contractor's Subcontractors at any tier or anyone for whose acts the Contractor is liable, shall be at Contractor's sole risk. Contractor shall hold harmless and indemnify the DFCM from and against any and all claims, actions, suits, costs, damages, loss, expenses and attorney fees arising out of such non-permissive use or modification by the Contractor. The Contractor and Subcontractors are granted a limited license to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the A/E appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this license shall bear the statutory copyright notice, if any, shown on the Drawings, Specifications and other documents prepared by the A/E. Submittals or distributions necessary to meet official regulatory requirements or for other purposes relating to completion of the Project are not to be construed as a publication in derogation of the DFCM's copyright or other reserved rights.

## **ARTICLE 4. CONTRACTOR**

### **4.1 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR.**

**4.1.1 REVIEWING CONTRACT DOCUMENTS, INFORMATION, REPORTING ERRORS, INCONSISTENCIES OR OMISSIONS.** The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the DFCM pursuant to Article 2.1 hereinabove and shall at once report to the DFCM and A/E errors, inconsistencies or omissions discovered. The Contractor shall not be liable to the DFCM or A/E for damage resulting from errors, inconsistencies or omission in the Contract Documents, unless the Contractor recognized such error, inconsistency or omission or a Contractor of ordinary skill and expertise for the type of Work involved would have readily so recognized such error, inconsistency or omission, and the Contractor

failed to report such to the DFCM and A/E. If the Contractor performs any construction activity without such notice to the DFCM and A/E and prior to the resolution of the error, inconsistency or omission, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

**4.1.2 FIELD CONDITIONS.** The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor, or information which a Contractor of ordinary skill and expertise for the type of Work involved would have known, before commencing activities. Errors, inconsistencies or omissions discovered shall be reported to the DFCM and A/E at once. If the Contractor performs any construction activity without such notice to the DFCM and A/E and prior to the resolution of the error, inconsistency or omission, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

**4.1.3 PERFORM IN ACCORDANCE WITH CONTRACT DOCUMENTS AND SUBMITTALS.** The Contractor shall perform the Work in accordance with the Contract Documents and submittals approved in accordance with the Contract Documents

**4.1.4 PERFORMANCE TO PRODUCE THE COMPLETE SYSTEM AND INTENDED RESULTS.** Performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable from the Contract Documents as being necessary to allow the system to function within its intended use.

**4.1.5 INTENT AND HIERARCHY.** The Contract Documents should be read as a whole and wherever possible, the provisions should be construed in order that all provisions are operable. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are

complimentary, and what is required by one Document or provisions thereof shall be as binding as if required by all the Documents or provisions thereof. In case of an irreconcilable conflict between provisions within a Contract Document or between Contract Documents, the following priorities shall govern as listed below:

(1) A particular Modification shall govern over all Contract Document provisions or Modifications issued prior to said particular Modification.

(2) Attachments to the Contractor's Agreement resulting from the Selection process including any management plan or documented interview information shall govern over addenda, the General Conditions, plans and specifications.

(3) A particular Addendum shall govern over all other Contract Document provisions issued prior to said particular Addendum. Subsequent Addenda shall govern over all prior Addenda.

(4) The Supplementary General Conditions shall govern over the General Conditions.

(5) These General Conditions shall govern over all other Contract Documents except for the Supplementary General Conditions, Addenda, Modifications and Attachments resulting from the selection process.

(6) The drawings and specifications shall not govern over any of the documents listed above.

(7) In case of a conflict or ambiguity within the same level of hierarchy of described documents, DFCM reserves the right to select the most stringent requirement unless the preponderance of the contract indicates the less stringent requirement.

**4.1.6 DIVIDING WORK AND CONTRACTOR REPRESENTATION.** Organization of the specifications into divisions, sections and articles, and arrangement of Drawings, shall not control the Contractor in

dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Contractor represents that the Subcontractors, Sub-subcontractors, manufacturers and suppliers engaged or to be engaged by it are and will be familiar with the requirements for performance by them of their obligations.

#### **4.1.7 PLANNING AND PRIORITY.**

The Contractor shall plan and schedule its work to facilitate the Project and shall maintain a work schedule to place proper priority to sequence work to complete the project timely.

### **4.2 SUPERVISION AND CONSTRUCTION PROCEDURES.**

#### **4.2.1 SUPERVISION AND**

**CONTROL.** The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over the construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, except to the extent that the Contract Documents expressly and specifically state otherwise.

#### **4.2.2 RESPONSIBILITY.**

The Contractor shall be responsible to the State of Utah and DFCM for acts and omissions of the Contractor's employees, Subcontractors, and their agents and employees, and other persons performing portions of the Work under a contract with the Contractor or on behalf of the Contractor.

#### **4.2.3 NOT RELIEVED OF**

**OBLIGATIONS.** The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the DFCM or its agents in the DFCM's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor or for those that the Contractor is liable.

#### **4.2.4 INSPECTIONS AND APPROVALS.**

(1) The Contractor is responsible for requesting inspections for various

stages and portions of the Work required under the Contract Documents in a timely manner.

(2) If any of the Work is required to be inspected or approved by the terms of the Contract Documents by any public authority, the Contractor shall timely request such inspection or approval to be performed in accordance with Article 9. Except as provided in Article 9, work shall not proceed without any required inspection and the associated authorization to proceed. Contractor shall promptly notify DFCM if the inspector fails to appear at the site.

### **4.3 LABOR AND MATERIALS.**

#### **4.3.1 PAYMENT BY CONTRACTOR.**

Except to the extent it is otherwise stated in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipments, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities, supplies, consumables and services necessary for the proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

#### **4.3.2 DISCIPLINE AND**

**COMPETENCE.** The Contractor shall enforce strict discipline and good order among the Contractor's employees, its Subcontractors, agents, representatives and other persons performing under the Contract Documents. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

#### **4.4 TAXES AND OTHER PAYMENTS TO GOVERNMENT.**

The Contractor shall pay sales, consumer, use, employment-related and similar taxes related to the Work or portions thereof provided by the Contractor which are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect. The Contractor shall comply with the laws and regulations regarding the payment of Sales and/or Use Tax and any exemptions. The procurement documents may have a provision regarding specific items which are exempt from State of Utah Sales Tax and/or Use Tax. Any such

exemption shall be used only for the items and the project specified in the procurement documents. Any such exemption does not apply to taxes levied by the federal government or any taxing entity outside of the State of Utah. If a Contractor properly relies upon a provision(s) of the bidding or proposal documents, and if State of Utah Sales and/or Use Tax subsequently becomes due, then the Contractor shall be paid such tax amount not included in the bid/proposal amount due to the reliance upon such provision.

#### **4.5 PERMITS, FEES, NOTICES, LABOR AND MATERIALS.**

**4.5.1 PERMITS AND FEES.** Unless required in the Supplementary General Conditions or an Addendum, it will not be necessary for the Contractor to obtain or pay for local building permits, plan check fees, electrical permits, plumbing permits, connection fees, or impact fees, nor will it be necessary to pay fees for inspections pertaining thereto.

**4.5.2 COMPLIANCE WITH PUBLIC AUTHORITIES, NOTICES.** The Contractor shall comply with and give notices required by laws, ordinances, resolutions, rules, regulations and lawful orders of public authorities bearing on the performance of the Work.

**4.5.3 CORRELATION OF CONTRACT DOCUMENTS AND ENACTMENTS.** It is not the Contractor's responsibility to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, resolutions, building codes, and rules and regulations. Notwithstanding this, if the Contractor observes, or if such is readily observable to a Contractor of ordinary skill and expertise for the type of Work involved, that a portion of the Contract Documents is at variance therewith, the Contractor shall promptly notify the A/E and DFCM in writing, and necessary changes shall be accomplished by appropriate Modification.

**4.5.4 FAILURE TO GIVE NOTICE.** If the Contractor, or any Subcontractor thereof performs Work without complying with the requirements of this Article 4.5 hereinabove, the Contractor shall assume appropriate responsibility

for such Work and shall bear the appropriate amount of the attributable costs.

**4.6 SUPERINTENDENT.** The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor. Important communications shall be confirmed in writing. Other communications shall be similarly confirmed on written request in each case.

#### **4.7 TIME AND CONTRACTOR'S CONSTRUCTION SCHEDULES.**

##### **4.7.1 PROGRESS AND COMPLETION.**

(1) **TIME IS OF THE ESSENCE; COMPLETE WITHIN CONTRACT TIME.** Time is of the essence. By executing the Contractor's Agreement, the Contractor confirms that the Contract Time is adequate to perform the Work. The Contractor shall proceed expeditiously with adequate forces to achieve Substantial Completion within the Contract Time.

(2) **NOTICE TO PROCEED AND INSURANCE.** The Contractor shall not prematurely commence operations on the site or elsewhere prior to the issuance of a Notice to Proceed by the DFCM or prior to the effective date of insurance required by Article 10 to be furnished by the Contractor, whichever is the latter.

**4.7.2 SCHEDULE PREPARATION.** The Contractor, promptly after being awarded the Contract, shall prepare and submit for the DFCM's and A/E's review, a reasonably detailed CPM schedule for the Work. The schedule shall indicate the order, sequence, and interdependence of all items known to be necessary to complete the Work including construction, procurement, fabrication, and delivery of materials and equipment, submittals and approvals of samples, shop drawings, procedures, or other documents. Work items of the DFCM, other Contractors, utilities and other third parties that may affect or

be affected by the Contractor shall be included. If the DFCM is required, by the Contract Documents, to furnish any materials, equipment, or the like, to be incorporated into the Work by the Contractor, Contractor shall submit, with the first schedule submittal, a letter clearly indicating the dates that such items are required at the Project Site. The critical path should be identified, including the critical paths for interim completion dates and milestones. The CPM schedule shall be developed using Primavera, MS Project, or Suretrack unless otherwise authorized by the DFCM Representative. The Contractor's schedule shall be updated at least once a month and submitted with each pay request.

#### **4.7.3 INITIAL CONTRACT TIME.**

Unless otherwise specified in the bidding documents, the initial Contract Time is the time identified in the Contractor's Agreement.

#### **4.7.4 INTERIM COMPLETION**

**DATES AND MILESTONES.** The schedule must include contractually specified interim completion dates and milestones. The milestone completion dates indicated are considered essential to the satisfactory performance of this Contract and to the coordination of all Work on the Project. The milestone dates listed are not intended to be a complete listing of all Work under this Contract or of interfaces with other Project Contractors.

#### **4.7.5 SCHEDULE CONTENT**

**REQUIREMENTS.** The schedule shall indicate an early completion date for the Project that is no later than the Project's required completion date. The schedule, including all activity duration's shall be given in calendar days. The Schedule shall also indicate all of the following:

- (1) Interfaces with the work of outside contractors (e.g., utilities, power and with any separate Contractor);
- (2) Description of activity including activity number/numbers;
- (3) Estimated duration time for each activity;

(4) Early start, late start, early finish, late finish date, and predecessor/successors including stop-start relationships with lead and lag time for each activity;

(5) Float available to each path of activities;

(6) Actual start date for each activity begun;

(7) Actual finish date for each activity completed;

(8) The percentage complete of each activity in progress or completed;

(9) Identification of all critical path activities;

(10) The critical path for the Project, with said path of activities being clearly and easily recognizable on the time-scaled network diagram. The path(s) with the least amount of float must be identified. Unless otherwise authorized by the DFCM Representative, no more than 40% of all activities may be identified as critical path items. The relationship between non-critical activities and activities on the critical path shall be clearly shown on the network diagram;

(11) Unless otherwise authorized by the DFCM Representative, all activities on the schedule representing construction on the site may not have a duration longer than 14 days. Construction items that require more than 14 days to complete must be broken into identifiable activities on the schedule with durations less than 14 days. The sum of these activities represents the total length required to complete that construction item; and

(12) Additional requirements as specified in the Supplemental General Conditions.

**4.7.6 DFCM'S RIGHT TO TAKE EXCEPTIONS.** The DFCM reserves the right to take reasonable exception to activity duration, activity placement, construction logic or time frame for any element of the Work to be scheduled.

**4.7.7 FLOAT TIME.** Float or slack time is defined as the amount of time between the earliest start date and the latest start date or between the earliest finish date and the latest finish date of a chain of activities on the Schedule. By a proposal request or modification delivered to the Contractor, the DFCM has the right to use the float time for non-critical path activities until the Contractor has reallocated such time on a newly submitted schedule.

**4.7.8 INITIAL SCHEDULE SUBMISSION.** No progress payments will be approved until the Contractor has submitted a Project detailed CPM schedule covering the first 90 days of the Work with a general CPM schedule for the entire project. The detailed schedule for the entire project is to be completed prior to the second pay request unless otherwise authorized in writing by the DFCM Representative.

**4.7.9 UPDATES.** Prior to any approval of a pay request, the DFCM, A/E and Contractor shall review the Contractor's schedule compared to the Work completed. The DFCM approves the amount of Work completed as supported by the schedule of values and as verified by the determination of Work completed. If necessary, the Contractor shall then update and submit to the DFCM the schedule with the pay request; all of which in accordance with the DFCM's approval. All updates shall be provided in electronic and hard copy formats. At each scheduled meeting with the DFCM Representative, the Contractor shall provide a "three week look ahead" with long lead items identified.

**4.7.10 SCHEDULE OF SUBMITTALS.** The Contractor shall prepare and keep current, for the A/E's and DFCM's review, a schedule of submittals required under the Contract Documents which is coordinated with the Contractor's construction schedule and allows the A/E a reasonable time to review the submittals. This submittal schedule is to be included as part of the construction schedule. Submittals requiring expedited review must be clearly identified as such in the schedule of submittals.

**4.7.11 SCHEDULE RECOVERY.** If the Work represented by the critical path falls behind

more than 7 days, the project schedule shall be redone within 14 days showing how the Contractor shall recover the time. A narrative that addresses the changes in the schedule from the previously submitted schedule shall be submitted along with the schedule in both hard copy (appropriate report formats to be determined by the DFCM Representative) and electronic copy. The Contractor shall comply with the most recent schedules.

#### **4.7.12 SCHEDULE CHANGES AND MODIFICATIONS.**

(1) **CONTRACT TIME CHANGE REQUIRES MODIFICATION.** The Contract Time may only be shortened or extended by a written modification fully executed by the DFCM.

(2) **CONTRACTOR REORDERING, RESEQUENCING AND CHANGING ACTIVITY DURATIONS.** Should the Contractor, after approval of the complete detailed construction schedule, desire to change his plan of construction, he shall submit his requested revisions to the DFCM and the A/E along with a written statement of the revisions including a description of the sequence and duration changes for rescheduling the work, methods of maintaining adherence to intermediate milestones and the contract completion date and the reasons for the revisions. If the requested changes are acceptable to the DFCM, which acceptance shall not be unreasonably withheld, they will be incorporated into the Schedule in the next reporting period. If after submitting a request for change in the Contract Schedule, the DFCM does not agree with the request, the DFCM will schedule a meeting with the Contractor to discuss the differences.

(3) **CHANGES IN CONTRACT TIME.** The critical path schedule as the term is used in the provisions herein shall be based on the current version of the Contractor's schedule for the Project and accepted by the DFCM just prior to the commencement of the modification, asserted delay, suspension or interruption. If the Contractor believes it is entitled to an extension of Contract Time under the Contract Documents, the Contractor shall submit a

PCO in accordance with Article 7.2 to the A/E and the DFCM Representative accompanied by an analysis ("Requested Time Adjustment Schedule") in accordance with the Contract Documents for time extensions. The "Requested Time Adjustment Schedule" shall include "fragnets" that represent the added or changed work to the Schedule. The impact on unchanged activities caused by the changes and/or delays being analyzed shall be included in these fragnets.

A "fragnet" as used in these General Conditions and when used in the context of project scheduling is a subset of project activities that are inter-related by predecessor and successor relationships that are tied into the main schedule with identified start and completion points. Each fragnet may or may not be on the critical path. An entire schedule consists of a series of inter-related fragnets.

#### 4.7.13 EXCUSABLE DELAY.

(1) **IN GENERAL.** If the Contractor is delayed at any time in the progress of the Work on the critical path schedule by an act or neglect of the DFCM or other causes beyond the Contractor's control or by other causes which the DFCM determines may justify delay, then the Contract Time shall be extended by Change Order. The Contractor shall immediately take all steps reasonably possible to lessen the adverse impact of such delay. Notwithstanding the above, to the extent any of the causes for delay were caused by the Contractor, reasonably foreseeable by the Contractor or avoidable by the Contractor, then to such extent the delay shall not be cause for extension of the Contract Time. For purposes of this paragraph, Contractors shall include all subcontractors and others under the responsibility of the Contractor.

The determination of the total number of days extension will be based upon the current construction schedule in effect at the inception of the change and/or delay and upon all data relevant to the extension as it exists in the project record. Once approved, such data shall be incorporated in the next monthly update of the schedule.

Contractor acknowledges and agrees that delays in work items which, according to the schedule analysis, do not affect any milestone dates or the

Contract completion dates shown on the CPM at the time of the delay, will not be the basis for a contract extension.

(2) **WEATHER-RELATED EXCUSABLE DELAYS.** Completion time will not be extended for normal bad weather or any weather that is reasonably foreseeable at the time of entering into the contract. The time for completion as stated in the contract documents includes due allowance for calendar days on which Work cannot be performed out of doors. The Contractor acknowledges that it may lose days due to weather conditions. Contract time may be extended at no cost to the DFCM if all of the following are met which must be established by the Contractor:

(a) That the weather prevented Work from occurring that is on the critical path for the project based upon a critical path schedule previously submitted to the DFCM and to the extent accepted by the DFCM;

(b) There are no concurrent delays attributed to the Contractor;

(c) The Contractor took all reasonable steps to alleviate the impact of the weather and took reasonable attempts to prevent the delay and despite such reasonable actions of Contractor, the weather impacted the critical path as described above; and

(d) One of the following occurred:

1. The weather was catastrophic, such as a tornado, hurricane, severe wind storm, severe hail storm; or

2. Based on the full history of information published from the closest station as indicated from the Western Regional Climate Center (Desert Research Institute 2215 Raggio Parkway Reno, Nevada 89512, and as may be described on the website at <http://www.wrcc.dri.edu/summary/>), one or more of the following occurred:

a. For any day between November 1 and March 31, the

minimum temperature fell below the average minimum temperature plus the extreme low temperature recorded for the month divided by 2.

b. For any day between November 1 and March 31, the maximum temperature fell below the monthly average for the minimum temperature.

c. The daily precipitation exceeded 75% of the historical one day maximum for the month.

d. The snowfall for the month exceeded 175% of the historical average snow fall for the month.

#### **4.7.14 COMPENSABLE DELAY, SUSPENSION OR INTERRUPTION.**

##### **(1) BASIC CONDITIONS.**

In addition to the other requirements of the Contract Documents, a compensable delay, suspension or interruption of the work occurs only when the following are met:

(a) Is wholly unanticipated by the parties at the time of execution of the Contractor's Agreement or is caused by the breach of a fundamental obligation of the Contract Documents attributable to the DFCM; and

(b) The Contractor delivers a written notice to A/E and DFCM within seven (7) days that the Contractor knows or should have known of the condition giving rise to the purported compensable delay, disruption, suspension or interruption, and said continuation affects the Contract Time as indicated by the last submitted and reasonable critical path schedule.

(2) **COMPENSABLE DELAY FORMULA.** To the extent of the compensable delay, the Contractor's total entitlement for all compensable delay damages is the computed result of the following formula: Contract Sum divided by Contract Time (in calendar days); the result of which is then multiplied by 0.05; and the result of which is multiplied by the number of calendar days of compensable days allowed under these General Conditions that are beyond the Contract

Time. Notwithstanding any other provision of these General Conditions or the Contract Documents, to the extent the Contractor is entitled to receive the 10% or 15% markup under Article 7.4, this provision shall be inapplicable and the markup shall be deemed to include all the compensable delay damages provided by this paragraph.

(3) **PERIOD OF COMPENSABLE DELAY, SUSPENSION OR INTERRUPTION.** The length and extent of compensable delay, shall be determined, with the use of the Project's critical path schedule, by ascertaining the number of additional days to the Contract Time that are needed in order to perform the Work in accordance with the Contract Documents as a result of the continuation of the aforesaid delay, disruption, suspension or interruption after receipt of the written notice received by the A/E and DFCM under Section 4.7.14(1)(b) above.

(4) **CONCURRENT DELAY.** Notwithstanding any other provision of these General Conditions, to the extent a non-compensable delay occurs at the same time as a compensable delay, the DFCM shall not be responsible for any compensation for the period of the non-compensable delay.

**4.7.15 TIME EXTENSION REQUESTS.** Any time extension shall be requested within 21 days after the Contractor knew or should have known about the delay and shall be supported by the critical path schedule analysis.

#### **4.7.16 LIQUIDATED DAMAGES.**

(1) **IN GENERAL.** Should the Contractor fail to complete the Work within the Contract Time, there shall be deducted from any amount due or that may become due the Contractor, the sum as stated in the Contractor's Agreement. Such sum is fixed and agreed upon by the DFCM and Contractor as liquidated damages due the DFCM by reason of the inconvenience and added costs of administration, engineering, supervision and other costs resulting from the Contractor's default, and not as a penalty. Actual damages related to delay can not be ascertained at

the time of execution of the Contract. To the extent that the liquidated damages exceed any amounts that would otherwise be due the Contractor, the Contractor shall be liable for such excess to the DFCM. DFCM may seek enforcement of such obligation by legal action, and if such is necessary, shall recover the related costs and attorney fees. Notwithstanding any other provision of these General Conditions, the availability of liquidated damages to the DFCM shall not limit the DFCM's right to seek damages or other remedies available under law or equity to the extent such damages or remedies are not based upon delay.

**(2) NO WAIVER OF DFCM'S RIGHTS.** Permitting the Contractor to continue any part of the Work after the time fixed for completion or beyond any authorized extension thereof, shall in no way operate as a waiver or estoppel on the part of the DFCM of any of its rights under the Contract Documents, including the right to liquidated damages or any other remedies or compensation.

**4.8 DOCUMENTS AND SAMPLES AT THE SITE, CERTIFYING "AS-BUILTS".** The Contractor shall maintain at the site for the DFCM, one record copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked weekly to record changes and selections made during construction, as well as approved Shop Drawings, Product Data, Samples and similar submittals. These aforesaid items shall be available to the A/E and shall be delivered to the A/E for submittal to the DFCM upon completion of the Work, signed by the Contractor, certifying that they show complete and exact "as-built" conditions, stating sizes, kind of materials, vital piping, conduit locations and similar matters. All notes of encountered or changed conditions shall be included.

#### **4.9 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.**

**4.9.1 NOT CONTRACT DOCUMENTS.** Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The submittal shall demonstrate, for those portions of the Work for which the submittal is required,

the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

**4.9.2 PROMPTNESS.** The Contractor shall review, approve and submit to the A/E, Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work, or the activities of the DFCM or separate contractors.

**4.9.3 NOT PERFORM UNTIL A/E APPROVES.** The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved in writing by the A/E. Such Work shall be in accordance with the approved submittals.

**4.9.4 REPRESENTATIONS BY CONTRACTOR.** By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

**4.9.5 CONTRACTOR'S LIABILITY.** The Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the A/E's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the A/E in writing of such deviation at the time of the submittal and the A/E has given written approval to the specific deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the A/E's review and comment.

**4.9.6 DIRECT SPECIFIC ATTENTION TO REVISIONS.** The Contractor shall direct specific attention in writing to all revisions on resubmitted Shop Drawings, Product Data, Samples or similar submittals, except those

requested by the A/E and indicated on previous submittals.

#### **4.9.7 INFORMATIONAL**

**SUBMITTALS.** Informational submittals upon which the A/E is not expected to take responsive action may be so identified in the Contract Documents.

#### **4.9.8 RELIANCE ON**

**PROFESSIONAL CERTIFICATION.** When professional certification of performance criteria of materials, systems or equipment is required by the Contract Documents, the DFCM and A/E shall be entitled to rely upon the accuracy and completeness of such calculations and certifications. If a professional stamp is required, the professional shall be licensed in the State of Utah unless otherwise approved by the DFCM in writing. Likewise, the Contractor is entitled to rely upon the accuracy and completeness of the calculations made by the A/E in developing the Contract Documents, unless a Contractor of ordinary skill and expertise for the type of Work involved would know that such is inaccurate or incomplete and therefore must immediately notify the DFCM in writing.

#### **4.10 USE OF SITE.**

**4.10.1 IN GENERAL.** The Contractor shall confine operations at the site to areas permitted by the Contract Documents, law, ordinances, resolutions, rules and regulations, and permits and shall not unreasonably encumber the site with materials or equipment. Contractor shall take all reasonable means to secure the site, protect the site and protect the Work from any damage. The site shall be left free and clear of refuse, equipment, materials, etc. and the site shall not be subject to spilled liquids and chemicals, toxic or otherwise. Should such an incident occur while the Contractor has control of the site, the Contractor shall be responsible to clean the site and pay all associated costs, fines and penalties. Notwithstanding this, Contractor is not responsible for any damage to the site or the Work to the extent caused by the DFCM or the DFCM's agents.

**4.10.2 ACCESS TO NEIGHBORING PROPERTIES.** The Contractor shall not, except

as provided in the Contract Documents or with the DFCM's advance written consent when necessary to perform the Work, interfere with access to properties neighboring the Project site by the owners of such properties and their respective tenants, agents, invitees and guests.

**4.11 ACCESS TO WORK.** The Contractor shall provide the DFCM and A/E access to the Work in preparation and progress, wherever located.

**4.12 ROYALTIES AND PATENTS.** The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of patent rights and shall hold the DFCM and A/E harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the DFCM in writing.

#### **4.13 INDEMNIFICATION.**

##### **4.13.1 IN GENERAL.**

(1) To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the State of Utah, the State of Utah's institutions, agencies, departments, divisions, authorities, and instrumentalities, boards, commissions, elected or appointed officers, employees, agents, authorized volunteers (hereinafter the above listing of entities and persons is referred to as "indemnities") from and against every kind and character of claims, damages, losses and expenses, including but not limited to attorneys' fees, and including those events covered under the blanket Contractual Liability Coverage required under the Contract Documents, arising out of or resulting from any act or omission in the performance of the Work including the work of all the Subcontractors and their employees, provided that any such claim, damage, loss or expense is caused in whole or in part by the negligent or wrongful act or omission

of the Contractor, any Subcontractor, and their employees, provided that any such claim, damage loss or expense is caused in whole or in part by the negligent or intentional act or omission of the Contractor, any Subcontractor, or anyone directly or indirectly employed or the agent of any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder. The Contractor shall defend all actions brought upon such matters to be indemnified hereunder and pay all costs and expenses incidental thereto, but the State of Utah shall have the right, at its option, to participate in the defense of any such action without relieving the Contractor of any obligation hereunder. Notwithstanding any of the above, to the extent the Contractor is complying with a written directive from the DFCM, that is not based on the Contractor's recommendation, the Contractor shall not be held liable under the indemnification provision of this Agreement if the Contractor has promptly disagreed with the written directive by delivering such objection to the DFCM in writing.

(2) Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person under Contract Documents.

(3) In claims against any person or entity indemnified under this Article 4.13 by an employee of the Contractor, Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Article 3.13 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or Subcontractor under workers' or workmen's compensation acts, disability benefits acts or other employee benefit acts.

## **ARTICLE 5. SUBCONTRACTORS.**

### **5.1 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK.**

#### **5.1.1 APPROVAL REQUIRED.**

(1) Listing of Subcontractors shall be as required by U.C.A. 63A-5-208 as amended and/or as stated in the Contract Documents, including but not limited to the "DFCM Subcontractors List Form".

(2) The Contractor shall not contract with a proposed person or entity to whom the DFCM has made a reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

**5.1.2 BUSINESS AND LICENSING REQUIREMENTS.** All Subcontractors used by the Contractor shall comply with all applicable business and licensing requirements.

**5.1.3 SUBSEQUENT CHANGES.** After the lapse of twenty-four (24) hours from the bid opening, the Contractor may change its listed Subcontractors only in accordance with Rule R 23-1 and the Contract Documents and with written approval of the Director of the Division of Facilities Construction and Management.

(1) DFCM will pay the additional costs for a DFCM requested change in subcontractor if all of the following are met:

(a) If the DFCM in writing requests the change of a subcontractor;

(b) The original subcontractor is a responsible subcontractor that meets the requirements of the Contract Documents; and

(c) The original subcontractor did not withdraw as a subcontractor on the project.

(2) In all other circumstances, the Contractor shall pay the additional cost for a change in a subcontractor.

**5.1.4 BONDING OF SUBCONTRACTORS.** Subcontractors as identified by DFCM in the procurement documents, may be required to submit

performance and payment bonds to cover the full extent of their portion of the Work. This provision does not in any way limit the right of the Contractor to have subcontractors at any tier be required to have a performance and/or payment bond.

## **5.2 SUBCONTRACTUAL RELATIONS.**

**5.2.1 COMPLY WITH CONTRACT DOCUMENTS.** By appropriate enforceable agreement, and to the extent it can be practically applied, the Contractor shall require each Subcontractor to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes towards the DFCM and A/E.

**5.2.2 RIGHTS.** Each Subcontractor agreement shall preserve and protect the rights of the DFCM and A/E under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the Subcontractor agreement, the benefit of all rights and remedies against the Contractor that the Contractor, by the Contract Documents, has against the DFCM.

**5.2.3 SUB-SUBCONTRACTORS.** The Contractor shall require each Subcontractor to enter into similar agreements with its Subcontractors which complies with the requirements of Paragraphs 5.2.1 and 5.2.2 hereinabove.

**5.2.4 DOCUMENT COPIES.** The Contractor shall make available to each proposed Subcontractor, prior to execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound. Subcontractors shall similarly make copies of applicable portions of the Contract Documents available to their respective proposed Subcontractors.

## **5.3 CONTINGENT ASSIGNMENT OF SUBCONTRACTS.**

**5.3.1 CONDITIONS FOR ASSIGNMENT TO DFCM.** Each subcontract agreement for a subcontractor at any tier for a portion of the Work is assigned by the Contractor to the DFCM provided that the assignment is effective only after termination of the Contract by the DFCM for cause pursuant to Article 12.2 or stoppage of the Work by DFCM pursuant to Article 12.5, and only for those subcontract agreements which the DFCM accepts by notifying the Subcontractor in writing. The subcontract shall be equitably adjusted to meet the new conditions of the work.

## **ARTICLE 6. PROTECTION OF PERSONS AND PROPERTY.**

### **6.1 SAFETY OF PERSONS AND PROPERTY.**

**6.1.1 CONTRACTOR RESPONSIBILITY.** The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take all reasonable precautions for the safety of, and shall provide reasonable protection to prevent damage, injury or loss to:

(1) Employees on the Work and other persons who may be affected thereby;

(2) The Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or a Subcontractor; and

(3) Other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

**6.1.2 SAFETY PROGRAM, PRECAUTIONS.** The Contractor shall institute a safety program at the start of construction to minimize accidents. Said program shall continue to the final completion of the Project and conform to applicable laws and regulations including the Utah Occupational Safety and Health Rules and

Regulations as published by the Utah Industrial Commission - UOSH Division. The Contractor shall post signs, erect barriers, and provide those items necessary to implement the safety program. As soon as the Contractor proceeds with the Work, the Contractor shall have all workers and all visitors on the site wear safety hard hats, as well as all other appropriate safety apparel such as safety glasses and shoes, and obey all safety rules and regulations and statutes. The Contractor shall post a sign in a conspicuous location indicating the necessity of wearing hard hats and the Contractor shall loan such hats to visitors.

#### **6.1.3 COMPLIANCE WITH LAWS.**

The Contractor shall give notices and comply with applicable laws, ordinances, rules, regulations and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss. In particular, the Contractor shall comply with all applicable provisions of Federal, State and municipal safety laws, rules and regulations as well as building codes to prevent accidents or injury to persons on, about, or adjacent to the premises where the Work is being performed.

**6.1.4 ERECT AND MAINTAIN SAFEGUARDS.** The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including effective fences, posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

**6.1.5 UTMOST CARE.** When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

**6.1.6 PROMPT REMEDY.** The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Paragraph 6.1.1 of these General Conditions caused in whole or in part by the Contractor, a Subcontractor, or anyone directly or indirectly employed by any of them, or by

anyone for whose acts they may be liable and for which the Contractor is responsible under said Paragraph 6.1.1, except to the extent such damage or loss is directly due to errors in the Contract Documents or caused by agents or employees of the A/E or DFCM. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under the Contract Documents.

**6.1.7 SAFETY DESIGNEE.** The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents, damage, injury or loss. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the DFCM and A/E.

**6.1.8 LOAD SAFETY.** The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.

**6.1.9 OFF-SITE RESPONSIBILITY.** In addition to its other obligations under this Article 6, the Contractor shall, at its sole cost and expense, promptly repair any damage or disturbance to walls, utilities, streets, ways, sidewalks, curbs and the property of the State and third parties (including municipalities and other governmental agencies) resulting from the performance of the Work, whether by it or by its Subcontractors at any tier. The Contractor shall not cause materials, including soil and debris, to be placed or left on streets or ways.

**6.1.10 EMERGENCIES.** In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Contractor shall promptly notify the DFCM Representative of the action taken.

**6.2 HAZARDOUS MATERIALS.** In the event the Contractor encounters on the site material reasonably believed to be asbestos or polychlorinated biphenyl (PCB) or any other hazardous waste or substance which may endanger the health of those persons performing the Work or being on the site, the Contractor shall immediately stop Work in the area affected and

immediately report the condition to the DFCM Representative and A/E by phone with a follow-up document in writing. The Work in the affected area shall be resumed when written direction is provided by the DFCM Representative. Except to the extent provided otherwise in the Contract Documents or if the presence of hazardous materials is due to the fault of the Contractor, the Contractor shall not be required to perform without the Contractor's consent, any Work relating to asbestos, polychlorinated biphenyl (PCB) or any other hazardous waste or substance.

DFCM shall procure a licensed abatement contractor qualified to remove the hazardous material. The abatement contractor shall submit notification of demolition to the Utah Division of Air Quality. Abatement contractor shall pay the notification fee. A copy of the hazardous material survey report shall be available to all persons who have access to the construction site.

### **6.3 HISTORICAL AND**

**ARCHEOLOGICAL CONSIDERATIONS.** In the event the Contractor knows or should have known of any cultural, historical or archeological material that is either recognized as an item to be protected under Federal, State, or local law or regulation, or is an item of obvious value to the State of Utah, the Contractor shall cease any work that would interfere with such discovery and immediately report the condition to the DFCM Representative and A/E by phone with a follow-up document in writing. Work shall resume based upon the direction of the DFCM Representative. Contractor cooperation with any DFCM recognized archaeologist or other cultural/historical expert is required.

**6.4 CONTRACTOR LIABILITY.** If the Contractor fails in any of its obligations in Articles 6.1 through 6.3 above, the Contractor shall be liable to any damages to DFCM, the State of Utah or any third party resulting from such noncompliance. The Contractor shall also be liable for any mitigation or restoration effort resulting from such noncompliance. To the extent all the following is met, the Contractor may treat the discovery of such material similarly to an unforeseen condition:

6.4.1 The discovery of such material is reasonably unforeseeable given the site conditions that the Contractor should have been aware;

6.4.2 The presence of such material was not identified in any part of the Contract Documents;

6.4.3 The Contractor has undertaken all proper action to mitigate any impact of such discovery on the critical path or monies related to the Project;

6.4.4 The discovery affects the critical path or contract price from that which was contemplated by the Contract Documents; and

6.4.5 The requirements of 7.1.5 and the Contract documents are met.

## **ARTICLE 7. MODIFICATIONS, REQUEST FOR INFORMATION, PROPOSED CHANGE ORDER, PRELIMINARY RESOLUTION EFFORTS AND CLAIMS PROCESS.**

### **7.1 MODIFICATIONS: IN GENERAL.**

**7.1.1 TYPES OF MODIFICATIONS AND LIMITATIONS.** Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or ASI, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents. The Contractor must have a written Modification executed by DFCM under this Article 7 prior to proceeding with any Work sought to be an extra.

**7.1.2 BY WHOM ISSUED.** A Change Order or Construction Change Directive shall be issued by the DFCM Representative. An ASI is issued by the A/E or by the DFCM Representative.

The A/E shall prepare Change Orders and Construction Change Directives with specific documentation and data for the DFCM's approval and execution in accordance with the Contract Documents, and may issue ASIs not involving an adjustment in the contract sum or an extension of the Contract Time which are not

inconsistent with the intent of the Contract Documents.

**7.1.3 CONTRACTOR TO PROCEED UNLESS OTHERWISE STATED.**

Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or ASI.

**7.1.4 ADJUSTING UNIT PRICES.** If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order or Construction Change Directive that application of such unit prices to quantities of Work proposed will cause a substantial inequity to the DFCM or Contractor, the applicable unit prices may be equitably adjusted.

**7.1.5 SPECIAL NOTICES REQUIRED IN ORDER TO BE ELIGIBLE FOR ANY CONTRACT MODIFICATION.** In order to be eligible for any Modification under this Article 7, the Contractor must have met the following special notice requirements:

(1) **CONCEALED OR UNKNOWN CONDITIONS.** The Contractor must file a written notice with the DFCM Representative within seven (7) calendar days of that the Contractor knew or should have known of a site condition described below or the Contractor shall be deemed to waive any right to file any PCO, PRE or Claim for additional monies or time related to such condition:

(a) If the Contractor encounters unknown and reasonably unforeseeable subsurface or otherwise concealed physical conditions, including hazardous or historical/cultural materials under Article 6, which differ materially from those indicated by the Contract Documents or a site inspection; or

(b) If the Contractor encounters unknown physical conditions of an unusual nature which differ materially from those ordinarily found to exist and generally recognized

as inherent in construction activities of the character provided for in the Contract Documents.

(2) **INCREASE IN CONTRACT TIME.** If the Contractor encounters a situation in which the Contractor knows or should have known that such situation would cause a delay, disruption, interruption, suspension or the like to the Project, the Contractor must file a notice with the DFCM Representative within seven (7) working days of when the Contractor knew or should have known of such circumstance or the Contractor shall be deemed to waive any right to file any PCO, PRE or Claim for additional monies or time related to such circumstance. To the extent the DFCM and/or the State of Utah is damaged by the failure of the Contractor to provide such notice after the Contractor knows or should have known of such circumstance, the Contractor shall be liable for liquidated damages attributable thereto, as well as any damages to the State of Utah and/or DFCM that are allowable in addition to liquidated damages.

**7.2 CONTRACTOR INITIATED REQUESTS.**

**7.2.1 THE REQUEST FOR INFORMATION, RFI, PROCESS AND TIME TO FILE.** The Contractor may file an RFI with the A/E regarding any concern which will assist the Contractor in the proper completion of the Work including, but not limited to issues related to the Contract Documents, plans and specifications. The RFI shall be filed with the A/E in a timely manner so as not to prejudice the DFCM as to the quality, time or money related to the Work.

**7.2.2 PROPOSED CHANGE ORDER ("PCO").** Within twenty-one (21) days after the Contractor knows or should have known of a situation or concern where the Contractor is going to request additional monies or time, the Contractor must file a Proposed Change Order ("PCO") with the DFCM Representative, or the Contractor shall be deemed to waive any right to claim additional monies or time related to such situation or concern. The PCO shall include all available documentation supporting the PCO available to the Contractor at the time of filing and the Contractor shall thereafter diligently pursue the

supplementation(s) of such documentation and promptly deliver such supplementation(s) to the DFCM Representative.

(1) **DFCM**

**REPRESENTATIVE RESPONSE.** One of the following may occur after a PCO is filed with the DFCM Representative:

(a) The DFCM Representative, after considering any input by the A/E, may reach an agreement with the Contractor and issue a Change Order.

(b) The DFCM, after considering any input by the A/E, may issue a Construction Change Directive.

(c) If the DFCM Representative, after considering any input by the A/E, disagrees with the Contractor's PCO, the DFCM representative may seek additional information or verification from the Contractor, the A/E or other sources, may negotiate with the Contractor, may issue a Change Order upon such later agreement, may retract the PR, or may issue a Construction Change Directive.

(d) If a Construction Change Directive is issued which identifies the DFCM Representative's position in regard to the subject contract sum and/or time adjustment or if the PCO is denied by the DFCM Representative, the Contractor must file a PRE under Article 7.7 below no later than twenty-one (21) days after the Contractor's receipt of the Construction Change Directive or such denial of the PCO. Failure to file a PRE in these instances shall be deemed to waive any right to additional time or money related to the PCO, Construction Change Directive or denial of the PCO. Such waiver shall entitle the DFCM to convert the Construction Change Directive into a Change Order, whether or not executed by the Contractor.

If the Construction Change Directive leaves open the determination of additional time or money related to the directed change, then the time period for commencement of filing the PRE shall not accrue until such time as the DFCM has conveyed to the Contractor a position as to the time and money owing as a result of the directed change.

The A/E must continually work with the DFCM in providing data, documentation and efforts to resolve the issues related to the PR.

**7.3 PROPOSAL REQUEST INITIATED BY DFCM.** DFCM may file a Proposal Request with the Contractor seeking information, data and/or pricing relating to a change in the contract time and or monies owing for particular scope changes or other modifications to the Contract Documents. The PR shall provide a time limit for the Contractor to file a response with the A/E and the DFCM Representative. If a proposal is not timely provided by the Contractor, DFCM may calculate the Change Order under Article 7.4.2 below. Upon such timely receipt of the proposal, one of the following shall occur:

**7.3.1 IF AGREEMENT, CHANGE ORDER ISSUED.** The DFCM Representative, after considering any input by the A/E, may reach an agreement with the Contractor and issue a Change Order.

**7.3.2 IF DISAGREEMENT.** If the DFCM Representative disagrees with the Contractor's proposal, after considering any input from the A/E, the DFCM representative may seek additional information or verification from the Contractor or other sources, may negotiate with the Contractor, may issue a Change Order upon such later agreement, may retract the PR, or may issue a Construction Change Directive. If a Construction Change Directive is issued which identifies the DFCM representative's position in regard to the subject contract sum and/or time adjustment, the Contractor must file a PRE within twenty-one (21) days of the Contractor's receipt of the Construction Change Directive, or the Contractor shall be deemed to waive any such request for additional time or money as a result of the issuance of the Construction Change Directive. Such waiver shall entitle the DFCM to convert the Construction Change Directive into a Change Order, whether or not executed by the Contractor. If the Construction Change Directive leaves open the determination of additional time or money related to the directed change, then the time period for commencement of filing the PRE shall not accrue until such time as the DFCM has conveyed

to the Contractor a position as to the time and money owing as a result of the directed change.

#### **7.4 EVALUATION OF PROPOSAL FOR ISSUING CHANGE ORDERS.**

**7.4.1 ADJUSTING SUM BASED UPON AGREEMENT.** If the Change Order provides for an adjustment to the Contract Sum, the adjustment shall be based on the mutual agreement of the Contractor and DFCM, including any terms mandated by unit price agreements or other terms of the Contract Documents.

**7.4.2 DFCM RESOLUTION OF SUM AND STANDARDS IN THE ABSENCE OF AN AGREEMENT UNDER PARAGRAPH 7.4.1.** In the absence of an agreement under Paragraph 7.4.1 above, the adjustment shall be based on an itemized accounting of costs and savings supported by appropriate data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Paragraph shall be limited to the following:

- (1) All direct and indirect costs of labor; including workers compensation insurance, social security and other federal and state payroll based taxes, and payroll based fringe benefits paid by Contractor so long as they are reasonable and no higher than that charged to other clients;
- (2) Costs of materials, on-site temporary facilities, supplies and equipment (except hand tools) required for or incorporated into the work;
- (3) Rental costs of machinery, equipment, tools (except hand tools), and on-site temporary facilities, whether rented from the Contractor or others;
- (4) Costs of permits and other fees, sales, use or similar taxes related to the Work;
- (5) Additional costs of field supervision and field office personnel directly attributable to the change; and

(6) Overhead and profit by the following liquidated formula which is not a penalty but a reasonable calculation agreed upon at the time of execution of the Contractor's Agreement, and provided by formula herein due to the fact that the actual amount due for said overhead and profit cannot easily be ascertained at the time of such execution. The markups in 7.4.2(6)(a) and (b) below are to cover the Contractor's additional payment and performance bond premiums, insurance premiums not specified under Paragraph 7.4.2(1), home office and on-site overhead and profit. Overhead and profit includes, but is not limited to the Contractor's Project Manager and Cost Estimator. Each request for pricing shall stand on its own and not be combined with other requests for pricing in determining the allowed markup described below. A particular request for pricing shall include all items reasonably related together and determinable at the time of the request. If several unrelated requests for pricing are grouped together in a single Change Order, each request for pricing will be considered separately for purposes of calculating the markup under the following formula:

(a) A markup of 15% shall be applied to the cost of each individual charge up to \$20,000 in cost, but in no case shall the markup be less than \$150;

(b) A markup of 10% shall be applied to the portion of the cost of each individual charge in excess of \$20,000;

(c) Subcontractors at any tier shall be entitled to markup their costs related to a Change Order with the same percentages as specified in Paragraphs 7.4.2(6)(a) and (b) above, except that the minimum markup shall be \$50 for any individual change.

**7.4.3 CREDITS.** The amount of credit to be allowed by the Contractor to the DFCM for a deletion or change which results in a net decrease in the Contract Sum shall be actual net cost as confirmed to DFCM based upon corroboration by an appropriate source.

## **7.5 CONSTRUCTION CHANGE DIRECTIVES.**

**7.5.1 WHEN USED AND CONTRACTOR'S RIGHT TO CHALLENGE.** A Construction Change Directive may be issued by the DFCM Representative in the case of a need for the Work to commence. If the Construction Change Directive leaves open the determination of additional time or money related to the directed change, then the Construction Change Directive shall indicate the timeframe(s) in which further information is to be provided to resolve the matter. At any time that the DFCM and the Contractor agree upon the time and money related to a Construction Change Directive, a Change Order shall be executed by the parties. Additionally, the Construction Change Directive may be converted to a Change Order under Paragraph 7.2.2 or Article 7.3 above.

**7.5.2 PROCEED WITH WORK AND NOTIFY DFCM ABOUT ADJUSTMENT METHOD.** Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved.

**7.5.3 INTERIM PAYMENTS BY DFCM.** Pending the final determination of the total cost of the Construction Change Directive, DFCM shall pay any undisputed amount to the Contractor.

**7.6 A/E'S SUPPLEMENTAL INSTRUCTION (Commonly referred to as an "ASI").** The A/E may at any time that is consistent with maintaining the quality, safety, time, budget and function of the Work, issue to the Contractor a supplemental instruction ("ASI") after approval from the DFCM Representative is obtained. The Contractor must file with the DFCM Representative a PCO under Paragraph 7.2.2 above, within 21 calendar days of the Contractor's receipt of the ASI, or the Contractor shall be deemed to have waived any right to additional time or monies as a result of such ASI.

## **7.7 PROCEDURE FOR PRELIMINARY RESOLUTION EFFORTS.**

**7.7.1 REQUEST FOR PRELIMINARY RESOLUTION EFFORT (PRE).** A Contractor raising an issue related to a breach of contract or an issue concerning time or money shall file a PRE as a prerequisite for any consideration of the issue by the DFCM. The labeling of the notice or request shall not preclude the consideration of the issue by the DFCM.

**7.7.2 TIME FOR FILING.** The PRE must be filed in writing with the DFCM Representative within twenty-one (21) days of any of the following:

(1) Issuance of a Construction Change Directive that defines the time and sum due the Contractor but the Contractor disagrees with such assessment;

(2) Issuance of DFCM's position in regard to a Construction Change Directive that originally left open the time and/or sum due to the Contractor;

(3) Issuance of a denial of a PCO by DFCM;

(4) In the case of a Subcontractor, after the expiration of the time period for the Contractor/Subcontractor PRE process under Paragraph 7.7.5 below; or

(5) When the Contractor knows or should have known about any other issue where the Contractor seeks additional monies, time or other relief from the State of Utah or DFCM.

**7.7.3 CONTENT REQUIREMENT.** The PRE shall be required to include in writing to the extent information is reasonably available at the time of such filing:

(1) A description of the issue;

(2) The potential impact on cost and time or other breach of contract; and

(3) An indication of the relief sought.

#### 7.7.4 SUPPLEMENTATION.

Additional detail of the content requirement under Paragraph 7.7.3 above shall be provided later if the detail is not yet available at the initial filing as follows:

(1) While the issue is continuing or the impact is being determined, the Contractor shall provide a written updated status report every 30 days or as otherwise reasonably requested by the DFCM Representative; and

(2) After the scope of work or other factors addressing the issue are completed, the complete information, including any impacts on time, cost or other relief requested, must be provided to the DFCM Representative within twenty-one (21) days of such completion.

#### 7.7.5 SUBCONTRACTORS.

(1) Under no circumstances shall any provision of these Contract Documents be intended or construed to create any contractual relationship between the DFCM and any Subcontractor.

(2) The Contractor must include the provisions of this Paragraph 7.7.5 in its contract with the first tier Subcontractor, and each Subcontractor must do likewise. At the Contractor's discretion, the Contractor may allow a Subcontractor at the 2<sup>nd</sup> tier and beyond to submit the PRE directly with the Contractor.

(3) In order for a Subcontractor at any tier to be involved with the PRE of the DFCM, the following conditions and process shall apply:

(a) The Subcontractor must have attempted to resolve the issue with the Contractor including the submission of a PRE with the Contractor.

(b) The Subcontractor must file a copy of the PRE with the DFCM Representative;

(c) The PRE to the Contractor must meet the time, content and supplementation requirements of Paragraphs 7.7.2, 7.7.3 and 7.7.4. The triggering event for a

Subcontractor to file a PRE shall be the time at which the issue cannot be resolved through the normal business practices associated with the contract, excluding arbitration and litigation;

(d) The PRE submitted to the Contractor shall only be eligible for consideration in the DFCM's PRE process to the extent the issue is reasonably related to the performance of the DFCM or an entity for which the DFCM is liable;

(e) The Contractor shall resolve the PRE to the satisfaction of the Subcontractor within sixty (60) days of its submittal to the Contractor or such other time period as subsequently agreed to by the Subcontractor in writing. If the Contractor fails to resolve the PRE with the Subcontractor within such required time period, the Subcontractor may submit in writing the PRE with the Contractor and the DFCM. In order to be eligible for DFCM consideration of the PRE, the Subcontractor must submit the PRE within twenty-one (21) days of the expiration of the time period for the Contractor/Subcontractor PRE process. The DFCM shall consider the PRE as being submitted by the Contractor on behalf of the Subcontractor;

(f) Upon such PRE being submitted, the Contractor shall cooperate with the DFCM Representative in reviewing the issue;

(g) The DFCM shall not be obligated to consider any submission which is not in accordance with any provision of this Article 7.7;

(h) The Subcontractor may accompany the Contractor in participating with the DFCM regarding the PRE raised by the Subcontractor. The DFCM is not precluded from meeting with the Contractor separately and it shall be the responsibility of the Contractor to keep the Subcontractor informed of any such meetings; and

(i) Notwithstanding any provision of this Paragraph 7.7.5, a Subcontractor shall be entitled to pursue a payment bond claim.

**7.7.6 PRE RESOLUTION PROCEDURE.** The DFCM Representative may request additional information and may meet with the parties involved with the issue.

**7.7.7 CONTRACTOR REQUIRED TO CONTINUE PERFORMANCE.** Pending the final resolution of the issue, unless otherwise agreed upon in writing by the DFCM Representative, the Contractor shall proceed diligently with performance of the Contract and the DFCM shall continue to make payments in accordance with the Contract Documents.

**7.7.8 DECISION.** The DFCM shall issue to the Contractor, and any other party brought into the process by the DFCM Representative as being liable to the DFCM, a written decision providing the basis for the decision on the issues presented by all of the parties within thirty (30) days of receipt of all the information required under Paragraphs 7.7.3 and 7.7.4.

**7.7.9 DECISION FINAL UNLESS CLAIM SUBMITTED.** The decision by the DFCM shall be final, and not subject to any further administrative or judicial review (not including judicial enforcement) unless a Claim is submitted in accordance with these General Conditions.

**7.7.10 EXTENSION REQUIRES MUTUAL AGREEMENT.** Any time period specified in this Article 7.7 may be extended by mutual agreement of the Contractor and the DFCM.

**7.7.11 IF DECISION NOT ISSUED.** If the decision is not issued within the thirty (30) day period, including any agreed to extensions, the issue may be pursued as a Claim.

**7.7.12 PAYMENT FOR PERFORMANCE.**

(1) Except as otherwise provided in the Contract Documents, any final decision where the DFCM is to pay additional monies to the Contractor, shall not be delayed by any PRE, Claim or appeal by another party.

(2) Payment to the Contractor of any final decision shall be made by the DFCM in accordance with the contract for the completed work.

(3) Notwithstanding any other provision of the Contract Documents, payment to the Contractor shall be subject to any set-off, claims or counterclaims of the DFCM.

(4) Payment to the Contractor for a Subcontractor issue submitted by the Contractor shall be paid by the Contractor to the Subcontractor in accordance with the contract between the Contractor and the Subcontractor.

(5) Any payment or performance determined owing by the Contractor to the DFCM shall be made in accordance with the Contract Documents.

## **7.8. RESOLUTION OF CLAIM.**

**7.8.1 CLAIM.** If the decision on the PRE is not issued within the required timeframe or if the Contractor is not satisfied with the decision, the Contractor or other party brought into the process by the DFCM, may submit a Claim in accordance with this Article 7.8 as a prerequisite for any further consideration by the DFCM or the right to any judicial review of the issue giving rise to the claim.

**7.8.2 SUBCONTRACTORS.** In order for a Subcontractor to have its issue considered in the Claim process by the DFCM, the Subcontractor that had its issue considered under Paragraph 7.7.5 may submit the issue as a Claim by filing it with the Contractor and the DFCM within the same timeframe and with the same content requirements as required of a Claim submitted by the Contractor under this rule. The DFCM shall consider the Claim as being submitted by the Contractor on behalf of the Subcontractor. Under no circumstances shall any provision of these General Conditions or the Contract Documents be intended or construed so as to create any contractual relationship between the DFCM and any Subcontractor.

(1) Upon such Claim being submitted, the Contractor shall fully cooperate

with the Director, the person(s) evaluating the claim and any subsequent reviewing authority.

(2) The Director shall not be obligated to consider any submission which is not in accordance with this Paragraph 7.8.2.

(3) The Subcontractor may accompany the Contractor in participating with the Director, the person(s) evaluating the Claim and any subsequent reviewing authority regarding the Claim. The Director, the person(s) evaluating the Claim and any subsequent reviewing authority is not precluded from meeting with the Contractor separately, and it shall be the responsibility of the Contractor to keep the Subcontractor informed of any such meetings and matters discussed.

(4) Notwithstanding any provision of this Article 7.8, a Subcontractor shall be entitled to pursue a payment bond claim.

**7.8.3 TIME FOR FILING.** The Claim must be filed in writing promptly with the Director, but in no case more than twenty-one (21) days after the decision is issued on the PRE under Paragraph 7.7.8 or no more than twenty-one (21) days after the thirty (30) day period under Paragraph 7.7.11 has expired with a decision not issued, whichever is later.

**7.8.4 CONTENT REQUIREMENT.** The written Claim shall include:

(1) A description of the issues in dispute;

(2) The basis for the Claim, including documentation and analysis required by the contract and applicable law and rules that allow for the proper determination of the Claim;

(3) A detailed cost estimate for any amount sought, including copies of any related invoices; and

(4) A specific identification of the relief sought.

**7.8.5 EXTENSION OF TIME TO SUBMIT DOCUMENTATION.** The time period for submitting documentation and any

analysis to support a Claim may be extended by the Director upon written request of the claimant showing just cause for such extension, which request must be included in the initial Claim submittal.

**7.8.6 CONTRACTOR REQUIRED TO CONTINUE PERFORMANCE.** Pending the final determination of the Claim, including any judicial review or appeal process, and unless otherwise agreed upon in writing by the Director, the Contractor shall proceed diligently with performance of the Contract and the DFCM shall continue to make payments in accordance with the Contract Documents.

**7.8.7 AGREEMENT OF CLAIMANT ON METHOD AND PERSON(S) EVALUATING THE CLAIM.** The Director shall first attempt to reach agreement with the claimant on the method and person(s) to evaluate the Claim. If such agreement cannot be made within fourteen (14) days of filing of the Claim, the Director shall select the method and person(s), considering the purposes described in Rule R23-26-1. Unless agreed to by the Director and the claimant, any selected person shall not have a conflict of interest or appearance of impropriety. Any party and the person(s) evaluating the Claim has a duty to promptly raise any circumstances regarding a conflict of interest or appearance of impropriety. If such a reasonable objection is raised, and unless otherwise agreed to by the Director and the claimant, the Director shall take appropriate action to eliminate the conflict of interest or appearance of impropriety. The dispute resolution methods and person(s) may include any of the following:

(1) A single expert and/or hearing officer qualified in the field that is the subject of the Claim;

(2) An expert panel, consisting of members that are qualified in a field that is the subject of the Claim;

(3) An arbitration process which may be binding if agreed to by the parties to the Claim;

(4) A mediator; or

(5) Any other method that best accomplishes the purposes set forth in Rule R23-26-1.

**7.8.8 THE EVALUATION PROCESS, TIMEFRAMES OF EVALUATOR(S), DIRECTOR'S DETERMINATION, ADMINISTRATIVE APPEAL TO THE EXECUTIVE DIRECTOR AND JUDICIAL REVIEW.** The Claim shall be evaluated, the timeframe for specific events related to the person(s) evaluating the Claim, the Director's determination, any appeal to the Executive Director and any judicial review shall be subject to the provisions of Rule R23-26-5(8), R23-26-5(9), R23-26-6 and R23-26-8. A copy of these Administrative Rules are available at DFCM.

**7.8.9 APPEAL PROCESS PREREQUISITE FOR FURTHER CONSIDERATION OR JUDICIAL REVIEW.** The administrative appeal to the Executive Director is a prerequisite for any further consideration by the State of Utah, or to judicial review of the issue giving rise to the Claim. It shall be considered that the Contractor, or another party brought into the process by the DFCM, has not exhausted its administrative remedies if such an administrative appeal is not undertaken.

## **7.9 PAYMENT OF CLAIM.**

7.9.1 When a stand alone component of a Claim has received a final determination, and is no longer subject to review or appeal, that amount shall be paid in accordance with the payment provisions of the Contract Documents or judicial order.

7.9.2 When the entire Claim has received a final determination, and is no longer subject to review or appeal, the full amount shall be paid within fourteen (14) days of the date of the final determination unless the work or services has not been completed, in which case the amount shall be paid in accordance with the payment provisions of the Contract Documents to the point that the work or services is completed.

7.9.3 The final determination date is the earlier of the date upon which the claimant accepted the settlement in writing with an

executed customary release document and waived its rights of appeal, or the expiration of the appeal period, with no appeal filed, or the determination made resulting from the final appeal.

7.9.4 Any final determination where the Division is to pay additional monies to the Contractor shall not be delayed by any appeal or request for judicial review by another party brought into the process by the Division as being liable to the DFCM.

7.9.5 Notwithstanding any other provision of the Contract Documents, payment of all or part of a Claim is subject to any set-off, claims or counterclaims of the DFCM.

7.9.6 Payment to the Contractor for a Subcontractor issue (Claim) deemed filed by the Contractor, shall be paid by the Contractor to the Subcontractor in accordance with the contract between the Contractor and the Subcontractor.

7.9.7 The execution of a customary release document related to any payment may be required as a condition of making the payment.

## **7.10 ALLOCATION OF COSTS OF CLAIM RESOLUTION PROCESS.**

7.10.1 In order to file a Claim, a claimant must pay a \$1500 filing fee to the DFCM. When the Claim is a pass-through from a Subcontractor in accordance with Paragraph 7.7.5, the payment of the fee shall be made by the Subcontractor.

7.10.2 Unless otherwise agreed to by the parties to the Claim, the costs of resolving the Claim shall be allocated among the parties on the same proportionate basis as the determination of financial responsibility for the Claim.

7.10.3 The costs of resolving the Claim that are subject to allocation include the claimant's filing fee, the costs of any person(s) evaluating the Claim, the costs of making any required record of the process, and any additional testing or inspection procured to investigate and/or evaluate the Claim.

7.10.4 Each party is responsible for its own attorney fees.

**7.11 ALTERNATIVE PROCEDURES.** To the extent otherwise permitted by law, if all parties to a Claim agree in writing, a protocol for resolving a Claim may be used that differs from the process described in this Article 7.

**7.12 IMPACT ON FUTURE SELECTIONS.**

7.12.1 The presentation of a good faith and non-frivolous issue or Claim shall not be considered by the DFCM's selection process for a future award of contract; and

7.12.2 The submission of a bad faith and frivolous issue or Claim, or the failure by a Contractor to facilitate resolution of a Claim, may be considered in the DFCM's evaluation of performance.

**7.13 REPORT TO BUILDING BOARD.** The DFCM may report on the claim to the Utah State Building Board.

**7.14 DFCM'S RIGHT TO HAVE ISSUES, DISPUTES OR CLAIMS CONSIDERED.** As stated in Rule R23-26-1(6), Articles 7.7 through 7.13 above do not limit the right of DFCM to have any of its issues, disputes or claims considered. DFCM reserves all rights to pursue its issues, disputes or claims in law or equity including, but not limited to, any or all of the following: damages, delay damages and impacts, losses, liability, patent or latent defects, or failure to perform under the Contract Documents. If the Director appoints an expert or a panel to consider any such issue(s), dispute(s) or claim(s) of DFCM, the Contractor shall cooperate with such expert or panel process.

**ARTICLE 8. PAYMENTS AND COMPLETION.**

**8.1 SCHEDULE OF VALUES.** With the first Application for Payment, the Contractor shall submit to the A/E and the DFCM Representative a schedule of values allocated to all the various portions of the Work. The Schedule of Values shall be submitted on the form approved and provided by DFCM. The A/E shall make recommendations to the DFCM Representative

regarding the Schedule of Values including any suggested modifications. When approved, including any approved modifications, by the DFCM Representative, it shall be the basis for future Contractor Applications for Payments. The Contractor shall not be entitled to payment until receipt and acceptance of the Schedule of Values.

**8.2 APPLICATIONS FOR PAYMENT.**

**8.2.1 IN GENERAL.** The following general requirements shall be met:

(1) The Contractor shall submit to the A/E an itemized Application for Payment for Work completed in accordance with the schedule of values and that reflects retainage as provided for in the Contractor's Agreement. The Application for Payment shall be on a special form approved and provided by DFCM.

(2) Such application shall be supported by such data substantiating the Contractor's right to payment as the DFCM or A/E may require. Said data may include, but is not limited to, copies of requisitions from Subcontractors.

(3) Such applications may include requests for payment pursuant to approved Change Orders or Construction Change Directives.

(4) Such applications may not include requests for payment for portions of the Work performed by a subcontractor when the Contractor does not intend to pay to a Subcontractor because of a dispute or other reason.

(5) In executing the Application for Payment, the Contractor shall attest that subcontractors involved with prior applications for payment have been paid, unless the Contractor provides a detailed explanation why such payment may not have occurred. DFCM reserves the right to require the Contractor to submit a payment waiver from one or more subcontractors.

**8.2.2 PAYMENT FOR MATERIAL AND EQUIPMENT.** Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment

delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the DFCM and A/E, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the DFCM to establish the DFCM's title to such materials and equipment or otherwise protect the DFCM's interest, and shall include applicable insurance, storage and transportation to the site for such materials and equipment stored off the site. The DFCM may require copies of invoices or other suitable documentation.

**8.2.3 WARRANTY OF TITLE.** The Contractor warrants that title to all Work covered by an Application for Payment will pass to the DFCM no later than the time for payment. The Contractor further warrants that upon submittal of an Application for Payment, all Work for which Certificates for Payment have been previously issued and payments received from the DFCM shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, or other persons or entities making a claim by reason of having provided labor, materials and/or equipment relating to the Work.

**8.2.4 HOLDBACK BY DFCM.** Notwithstanding anything to the contrary contained in the Contract Documents, the DFCM may, as a result of the claims resolution process, withhold any payment to the Contractor hereunder if and for so long as the Contractor fails to perform any of its obligations hereunder or otherwise is in default under any of the Contract Documents.

### **8.3 CERTIFICATES FOR PAYMENT.**

**8.3.1 ISSUED BY A/E.** The A/E shall within ten (10) days after receipt of the Contractor's Application for Payment, either issue to the DFCM a Certificate for Payment, with a copy to the Contractor, for such amount as the A/E determines due, or notify the Contractor and DFCM in writing of the A/E's reasons for withholding certification in whole or in part as

provided in Paragraph 8.4.1. If the A/E fails to act within said ten (10) day period, the Contractor may file the Application for Payment directly with the DFCM Representative and the DFCM will thereafter have twenty (20) days from the date of the DFCM's receipt to resolve the amount to be paid and to pay the undisputed amount. The accuracy of the Contractor's Applications for Payment shall be Contractor's responsibility, not A/E's.

**8.3.2 A/E'S REPRESENTATIONS.** The A/E's issuance of a Certificate for Payment shall constitute a representation to the DFCM that to the best of the A/E's knowledge, information and belief, based upon the A/E's observations at the site, the data comprising the Application for Payment, and what is reasonably inferable from the observations and data, that the Work has progressed to the point indicated in the Application and that the quality of the work is in accordance with the Contract Documents. The foregoing representations are subject to minor deviations from the Contract Documents correctable prior to completion and to specific qualifications expressed by the A/E. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment shall not be a representation that the A/E has (a) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (b) reviewed construction means, methods, techniques, sequences or procedures, (c) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the DFCM to substantiate the Contractor's right to payment, (d) ascertained how or for what purpose the Contractor used money previously paid on account of Contract Sum, or (e) any duty to make such inquiries.

### **8.4 DECISIONS TO WITHHOLD CERTIFICATION.**

**8.4.1 WHEN WITHHELD.** The A/E may decide not to certify payment and may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the DFCM, if in the A/E's judgment the representations to the DFCM required in

Paragraph 8.3.2 above can not be made. If the A/E is unable to certify payment in the amount of the Application, the A/E shall notify the Contractor and DFCM as provided in Paragraph 8.3.1 above. If the Contractor and A/E can not agree on a revised amount, the A/E shall promptly issue a Certificate for Payment for the amount to which the A/E makes such representations to the DFCM. The A/E may also decide not to certify payment or, because of subsequently discovered evidence or observations, may nullify the whole or part of a Certificate for Payment previously issued, to such extent as may be necessary in the A/E's opinion to protect the DFCM from loss because of:

(1) Defective Work not remedied;

(2) Third party claims filed or reasonable evidence indicating probable filing of such claims;

(3) Failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;

(4) Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

(5) Damage to the DFCM or another contractor;

(6) Reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or

(7) Failure to carry out the Work in accordance with the Contract Documents.

**8.4.2 CERTIFICATION ISSUED WHEN REASONS FOR WITHHOLDING REMOVED.** When the reasons stated in Paragraph 8.4.1 for withholding certification are removed, certification will be made for such related amounts.

**8.4.3 CONTINUE WORK EVEN IF CONTRACTOR DISPUTES A/E'S DETERMINATION.** If the Contractor disputes

any determination by the A/E or the result of the claims resolution process with regard to any Certification of Payment, the Contractor nevertheless shall expeditiously continue to prosecute the Work.

**8.4.4 DFCM NOT IN BREACH.** The DFCM shall not be deemed to be in breach of this Contract by reason of the withholding of any payment pursuant to any provision of the Contract Documents provided the DFCM's action or such withholding is consistent with the results of the dispute resolution process.

## **8.5 PROGRESS PAYMENTS.**

### **8.5.1 IN GENERAL, INTEREST OR LATE PAYMENTS.**

(1) Except as provided in Paragraph 8.3.1, the DFCM shall pay any undisputed amount within thirty (30) days of the date that the application for payment was submitted to the A/E. In no event shall DFCM be required to pay any disputed amount.

(2) Except as otherwise provided by law, if any payment is late based upon the provisions of the Contract Documents, the Contractor shall be paid interest in an amount equal to the published Wall Street Journal prime rate plus 2%. The published Wall Street Journal Prime Rate shall be determined using such rate that is published closest to the 1<sup>st</sup> of the month for each month of the late period. The amount of payment of interest shall be apportioned using such rate(s) for the late period.

**8.5.2 CONTRACTOR AND SUBCONTRACTOR RESPONSIBILITY.** The Contractor shall promptly pay each Subcontractor, upon receipt of payment from the DFCM, out of the amount paid to the Contractor on account of such Subcontractor's portion of the Work, the amount to which said Subcontractor is entitled. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payment to its Subcontractors in a similar manner.

**8.5.3 INFORMATION FURNISHED BY A/E OR DFCM TO SUBCONTRACTOR.**

The A/E or DFCM shall, on request, furnish to the Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the A/E and DFCM on account of portions of the Work done by such Subcontractor.

**8.5.4 DFCM AND A/E NOT LIABLE.**

Neither the DFCM or A/E shall have an obligation to pay, monitor or enforce the payment of money to a Subcontractor, except to the extent as may otherwise be required by law.

**8.5.5 CERTIFICATE, PAYMENT OR USE NOT ACCEPTANCE OF IMPROPER WORK.**

A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the DFCM shall not constitute acceptance of Work that is not in accordance with the Contract Documents.

**8.6 PAYMENT UPON SUBSTANTIAL COMPLETION.**

Upon Substantial Completion of the Work or designated portion thereof and upon application by the Contractor and certification by the A/E, the DFCM shall make payment, reflecting adjustment in retainage, if any, for such Work or portion thereof as provided in the Contract Documents. To the extent allowed by law, the DFCM may retain up to 200% of the fair market value of the work that has not been completed in accordance with the Contract Documents.

**8.7 PARTIAL OCCUPANCY OR USE.**

**8.7.1 IN GENERAL.** The DFCM may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, and authorized by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is Substantially Complete, provided the DFCM and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the

Work and commencement of the warranties required by the Contract Documents. When the Contractor considers a portion to be substantially complete, the Contractor shall prepare and submit a list to the A/E as previously provided for herein. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. Contractor shall have continuing responsibility to protect the site and the Work during such partial occupancy and shall be responsible for damage except to the extent caused solely by the DFCM during such partial occupancy or use.

The stage of progress of the Work shall be determined by written agreement between the DFCM and Contractor.

**8.7.2 INSPECTION.** Immediately prior to such partial occupancy or use, the DFCM, Contractor and A/E shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

**8.7.3 NOT CONSTITUTE ACCEPTANCE.** Except to the extent it is agreed upon in writing by the DFCM, partial occupancy or use of a portion or portion of the Work shall not constitute acceptance of Work not complying with the requirement of the Contract Documents.

**8.8 FINAL PAYMENT.**

**8.8.1 CERTIFICATE FOR PAYMENT.** The A/E's final Certificate for Payment shall constitute a further representation that the conditions listed in Paragraph 8.8.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

**8.8.2 CONDITIONS FOR FINAL PAYMENT.** Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the A/E the following to the extent required by the DFCM Representative:

(1) An affidavit that payrolls, bills for material and equipment, and other indebtedness connected with the Work for which the DFCM or the State of Utah's property might be responsible or encumbered (less amounts

withheld by DFCM) have been paid or otherwise satisfied;

(2) A current or additional certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days prior written notice, by certified mail, return receipt requested, has been given to the DFCM;

(3) A written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents;

(4) If requested by surety in a timely manner or by DFCM, consent of surety, to final payment;

(5) Receipt of Record Drawings, Specifications, Addenda, Change Orders and other Modifications maintained at the site; the warranties, instructions, operation and maintenance manuals, and training videos required to be furnished by the Contract Documents;

(6) Other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the DFCM. If a Subcontractor refuses to furnish a release or waiver required by the DFCM, the DFCM may require consent of Surety to the final payment. If such liens, claims, security interests or encumbrances remain unsatisfied after payments are made, the Contractor shall refund to the DFCM all money that the DFCM may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees; and

(7) A written statement demonstrating how the Contractor will distribute interest earned on retention to Subcontractors as required by Section 13.8.5, U.C.A.

**8.8.3 WAIVER OF CLAIMS: FINAL PAYMENT.** The making of final payment shall constitute a waiver of Claims by the-DFCM except those arising from:

(1) Liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;

(2) Failure of the Work to comply with the requirements of the Contract Documents;

(3) Terms of warranties required by the Contract Documents; or

(4) The one-year guaranty period and any corrected Work.

**8.8.4 DELAYS NOT CONTRACTOR'S FAULT.** If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, the DFCM shall, upon application by the Contractor and certification by the A/E, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims. Unless otherwise stated by the DFCM in writing, the making of final payment shall constitute a waiver of claims by the DFCM as provided in Paragraph 8.8.3 for that portion of that Work fully completed and accepted by the DFCM.

**8.8.5 WAIVER BY ACCEPTING FINAL PAYMENT.** Acceptance of final payment by the Contractor or a Subcontractor shall constitute a waiver of Claims by that payee except those Claims previously made in writing and identified by that payee as unsettled at the time of final Application for Payment. Such waivers shall be in addition to the waiver described in Paragraph 8.8.3.

**ARTICLE 9. TESTS AND INSPECTIONS, SUBSTANTIAL AND FINAL COMPLETION, UNCOVERING, CORRECTION OF WORK AND GUARANTY PERIOD.**

**9.1 TESTS AND INSPECTIONS.**

**9.1.1 IN GENERAL.** Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations, resolutions or orders of public authorities having jurisdiction shall be made at an appropriate time. Unless otherwise specifically set forth in the Contract Documents or agreed to by the DFCM in writing, the DFCM shall contract for such tests, inspections and approvals with an independent entity, or with the appropriate public authority, and the DFCM shall bear all related costs of tests, inspections and approvals except as provided below. If any of the Work is required to be inspected or approved by the terms of the Contract Documents or by any public authority, the Contractor shall, at least two working days prior to the time of the desired inspection, and following the procedures established by the DFCM, request such inspection or approval to be performed. The Contractor shall give the A/E timely notice of when and where tests and inspections are to be made so that the A/E may observe such procedures.

**9.1.2 FAILURE OF AN INSPECTOR TO APPEAR.** Work shall not proceed without any required inspection and the associated authorization by DFCM to proceed unless the following procedures and requirements have been met:

(1) The inspection or approval was requested in a timely manner as provided in Paragraph 9.1.1;

(2) The Contractor received written confirmation from the inspection entity that the inspection was scheduled;

(3) The Contractor has contacted or attempted to contact the inspector to confirm that the inspector is unable to perform the inspection as scheduled;

(4) If the inspector has confirmed that it is unable to perform the inspection as scheduled or if the Contractor is unable to contact the inspector, the contractor shall attempt to contact the State Building Official or DFCM Representative for instruction; and

(5) The Contractor has documented the condition of the work prior to being covered through photos or other means.

**9.1.3 NONCONFORMING WORK.** If such procedures for testing, inspection or approval under Paragraph 9.1.1 reveal failure of portions of the Work to comply with the requirements established by the Contract Documents, the Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for the DFCM's expenses, including the cost of retesting for verification of compliance if necessary, until the DFCM accepts the Work in question as complying with the requirements of the Contract Documents.

**9.1.4 CERTIFICATES.** Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the A/E.

**9.1.5 A/E OBSERVING.** If the A/E is to observe tests, inspections or approvals required by the Contract Documents, the A/E shall do so with reasonable promptness and, where practicable, at the normal place of testing.

**9.1.6 PROMPTNESS.** Tests, inspections and arrangements for approvals conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

## **9.2 INSPECTIONS: SUBSTANTIAL AND FINAL.**

**9.2.1 SUBSTANTIAL COMPLETION INSPECTION.** Prior to requesting a substantial completion inspection, the Contractor shall prepare a comprehensive initial punchlist, including unresolved items from prior inspections, for review by the DFCM and A/E to determine if the Project is ready for a substantial completion inspection. If the DFCM determines that the initial punchlist indicates that the Project is not substantially complete, the initial punchlist will be returned to the Contractor with written comments. If the DFCM determines that the initial punchlist indicates that the Project may be substantially complete, the A/E shall promptly organize and

perform a Substantial Completion inspection in the presence of the DFCM and all appropriate authorities.

(1) If the A/E reasonably determines that the initial punchlist prepared by the Contractor substantially understates the amount of the Work remaining to be completed and the Project is not substantially complete, the A/E shall report this promptly to the DFCM, and upon concurrence of the DFCM, the Contractor will be assessed the costs of the inspection and punchlist preparation incurred by the A/E and the DFCM.

(2) When the Work or designated portion thereof is Substantially Complete, the A/E shall prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion; shall establish responsibilities of the DFCM and Contractor for security, maintenance, heat, utilities, damage to the work and insurance; and shall fix the time within which the Contractor shall finish all items on the punchlist accompanying the Certificate. The Certificate of Substantial Completion shall require approval by the DFCM Representative. If there is a punchlist, the Contractor shall proceed promptly to complete and correct items on the list. Failure to include an item on the punchlist does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

(3) Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof except to the extent as provided otherwise in the Contract Documents or if such warranty is related to an item where the work is not complete. Such warranty documents shall state the length of the warranty, which must comply with the Contract Documents.

(4) The Certificate of Substantial Completion shall be submitted by the A/E to the DFCM and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.

(5) Except to the extent the DFCM Representative otherwise approves in

advance and in writing, the Contractor shall submit the following documents in order to achieve Substantial Completion: written warranties, guarantees, operation and maintenance manuals, and all complete as-built drawings. The Contractor must also provide or obtain any required approvals for occupancy. The Contractor is responsible for the guaranty of all Work, whether performed by it or by its Subcontractors at any tier.

**9.2.2 FINAL COMPLETION INSPECTION.** Prior to requesting a final inspection, the Contractor shall verify all punchlist items are corrected/completed. Once all punchlist items are corrected/completed the Contractor shall notify the DFCM and request a final inspection. The DFCM shall notify the A/E and perform a final inspection. Two final inspections may be allowed due to required weather changes required to complete some items. When all punchlist items are completed a final pay request will be provided by the Contractor, authorized by the A/E and processed by the DFCM.

### **9.3 UNCOVERING OF WORK.**

**9.3.1 UNCOVER UNINSPECTED WORK.** Except as provided in Paragraph 9.3.3, if a portion of the Work is covered prior to an Inspector's approval to proceed, it must, be uncovered for the Inspector's inspection and be replaced at the Contractor's expense without change in the Contract Time.

**9.3.2 OBSERVATION PRIOR TO COVERING.** Except as provided in Paragraph 9.3.3, if the DFCM or the A/E has requested in writing to observe conditions prior to any Work being covered or if such observation is specified in the Contract Documents, and the Work is covered without such observation, the Contractor shall be required to uncover and appropriately replace the Work at the Contractor's expense without change in the Contract Time. If the Contractor requests an inspection and the DFCM or A/E, including any inspector of each, does not appear, the Contractor shall immediately notify the DFCM of such lack of appearance, but shall not cover the Work without such inspection.

**9.3.3 WHEN AN INSPECTOR FAILS TO APPEAR OR A/E OR DFCM DID NOT MAKE PRIOR REQUEST.**

If Work is performed by the Contractor without an inspection as provided in Paragraph 9.1.2 or if a portion of the Work has been covered which the A/E or DFCM has not specifically requested to observe prior to its being covered or such observation is not specified by the Contract Documents, the A/E or DFCM may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement, shall, by appropriate Change Order, be charged to the DFCM. If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs unless the condition was caused by the DFCM or a separate contractor in which event the DFCM shall be responsible for payment of such costs.

**9.4 CORRECTION OF WORK AND GUARANTY PERIOD.**

**9.4.1 CONTRACTOR CORRECT THE WORK.** The Contractor shall correct Work rejected by the A/E, Inspector or DFCM, or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Contractor shall bear the costs of correcting such rejected Work, including additional testing and inspections and compensation for the A/E's and Inspector's services and expenses made necessary thereby.

**9.4.2 GUARANTY AND CORRECTION AFTER SUBSTANTIAL COMPLETION.** If within one year after the date of Substantial Completion of the Work or designated portion thereof, or after the date for commencement of warranties established under Paragraph 9.2.1 or by terms of an applicable special warranty or guaranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, including failure to perform for its intended purpose, the Contractor shall correct it promptly after receipt of written notice from the DFCM to do so unless the DFCM has previously given the Contractor a written acceptance of such condition. The period of one

year shall be extended with respect to portions of the Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work. This obligation of the Contractor under this Paragraph 9.4.2 shall be operative notwithstanding the acceptance of the Work under the Contract, the final certificate of payment, partial or total occupancy and/or termination of the Contract. The DFCM shall give notice of observed defects with reasonable promptness, however, failure to give such notice shall not relieve the Contractor of its obligation to correct the Work at the cost that the Contractor would have incurred if the DFCM did so report with reasonable promptness. All corrected Work shall be subject to a one-year guaranty period the same in all respects as the original Work, except that such guaranty period shall commence from the time of Substantial Completion of the corrected Work. This guaranty period does not affect the DFCM's right to pursue any available remedies against Contractor.

**9.4.3 REMOVAL OF WORK.**

(1) The Contractor shall promptly remove from the premises all Work that the DFCM and/or the A/E determines as being in nonconformance with the Contract Documents, whether incorporated or not.

(2) The Contractor shall promptly replace and re-execute the Work in accordance with the Contract Documents and without expense to the DFCM.

(3) The Contractor shall bear the expense of correcting destroyed or damaged construction, whether completed or partially completed, of the DFCM or of other contractors destroyed or damaged by such removal or replacement.

(4) If the Contractor does not remove such rejected Work within a reasonable time, fixed by written notice, the DFCM may have the materials removed and stored at the expense of the Contractor.

(5) If the Contractor does not correct the nonconforming Work within a

reasonable time, fixed by written notice, the DFCM may correct it in accordance with Paragraph 12.2.2 of these General Conditions.

#### **9.4.4 NOT LIMIT OTHER**

**OBLIGATIONS.** Nothing contained in this Article 9.4 shall be construed to establish a period of limitation with respect to other obligations which the Contractor may have under the Contract Documents. Establishment of the time period of one year as described in Paragraph 9.4.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

#### **9.5 ADDITIONAL WARRANTIES.**

**9.5.1 IN GENERAL.** In addition to any other provisions of this Article 9, the following warranties shall apply:

(1) The Contractor warrants to the DFCM that materials and equipment furnished under the Contract will be of good quality and new, except to the extent otherwise required or expressly permitted by the Contract Documents.

(2) The Contractor also warrants to the DFCM that the Work will be free from defects not inherent in the quality required or permitted and that the Work will conform with the requirements of the Contract Documents. Work not conforming to said requirements, including substitutions not properly approved and authorized, may be considered defective at the DFCM's option.

**9.5.2 EXCLUSION.** Unless due to the negligent or intentional act or omission of the Contractor or those under the Contractor's control, or as otherwise stated in the Contract Documents, the Contractor's guaranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.

**9.5.3 FURNISH EVIDENCE ON REQUEST.** If requested by the A/E or DFCM, the Contractor shall furnish satisfactory evidence as to the type and quality of materials and equipment.

**9.6 ACCEPTANCE OF NONCONFORMING WORK.** If the DFCM prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the DFCM may do so in writing instead of requiring its removal and correction, in which case the Contract Sum shall be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

### **ARTICLE 10. INSURANCE AND BONDS.**

#### **10.1 LIABILITY INSURANCE.**

**10.1.1 IN GENERAL.** To protect against liability, loss and/or expense arising from damage to property or injury or death of any person or persons incurred in any way out of, in connection with or resulting from the Work provided hereunder, Contractor shall obtain and maintain in force during the entire period of this Contract without interruption, at its own expense, the following insurance from insurance companies authorized to do business in the State of Utah in a form and content satisfactory to the DFCM and rated "A-" or better with a financial size category of (a) Class X or larger where the Contract Sum is \$1,000,000 or greater or (b) Class VII or larger where the Contract Sum is under \$1,000,000. Said rating and financial size category shall be as published by A.M. Best Company at the time the Contract is executed.

(1) Workers' Compensation Insurance and Employers' Liability Insurance. Worker's Compensation Insurance shall cover full liability under the Worker's Compensation Laws of the jurisdiction in which the Project is located at the statutory limits required by said jurisdiction's laws. Employer's Liability Insurance shall provide the following limits of liability: \$100,000 for each accident; \$500,000 for Disease-Policy Limit; and \$100,000 for Disease-Each Employee. The Contractor shall require all Subcontractors to take

and maintain similar policies of Workers' Compensation Insurance.

(2) Commercial General Liability Insurance.

a. Commercial General Liability Insurance, on an "occurrence basis," including insurance for operations, independent contractors, subcontractors at any tier, products/completed operations and contractual liability specifically designating the Indemnity provisions of these General Conditions as an insured contract on the Certificate of Insurance. Such Commercial General Liability Insurance must be endorsed with a Broad Form Property Damage Endorsement (including Completed Operations) and afford coverage for explosion, collapse and underground hazards. Such Commercial General Liability Insurance shall be in limits not less than the following:

\$2,000,000 General Aggregate, plus:

i. If the Construction Value is \$25,000,000 or more, an additional \$5,000,000 umbrella policy (which covers aggregate and per occurrence) is required; or

ii. if the Construction Value is \$10,000,000 or more but less than \$25,000,000, an additional \$2,000,000 umbrella policy (which covers aggregate and per occurrence) is required.

\$1,000,000 Products-Completed Operations Aggregate  
\$1,000,000 Personal and Advertising Injury  
\$1,000,000 Each Occurrence

b. For purposes of this subparagraph 2(a), Construction Value means:

i. the Contract Sum if the work is being performed under a Standard Construction Contractor's Agreement;

ii. the Fixed Limit of Construction Costs if the work is being performed under a Construction Manager/General Contractor Agreement; or

iii. the Guaranteed Fixed contract Amount if the work is to be performed under a Design/Build Agreement.

(3) Automobile liability insurance for claims arising from the ownership, maintenance, or use of a motor vehicle. The insurance shall cover all owned, non-owned, and hired automobiles used in connection with the Work, with the following minimum limits of liability:

\$1,000,000 Combined Single Limit Bodily Injury and Property Damage Per Occurrence

(4) Aircraft Use. Contractor using its own aircraft, or employing aircraft in connection with the Work performed under this Agreement shall maintain Aircraft Liability Insurance with a combined single limit of not less than \$1,000,000 per occurrence. Said certificate shall state that the policy required by this paragraph has been endorsed to name the State of Utah as Additional Insureds.

(5) Unless otherwise provided by the procurement documents, the insurance requirements in 10.1.1(1) through (4) above do not apply to subcontractors or suppliers at any tier under the Contractor and any insurance requirements of subcontractors and suppliers at any tier is a matter between the General Contractor and such subcontractor or supplier.

**10.1.2 CONFIGURATIONS.** Any policy required by this Article may be arranged under a single policy for the full limit required, or by a combination of underlying policies with the balance provided by an Excess or Umbrella Liability Policy.

**10.1.3 CONTRACTOR LIABILITY.** Irrespective of the requirements as to insurance to be carried by Contractor as provided herein; insolvency, bankruptcy or failure of any insurance company to pay all claims accruing, shall not be held to relieve Contractor of any obligations hereunder.

**10.1.4 CERTIFICATE, NOTICE REQUIREMENTS, ADDITIONAL INSURED.** Before the Contract Agreement is executed,

certificates evidencing coverages as specified above are in effect, shall be furnished to the DFCM. Such insurance certificates shall contain provisions that no cancellation, material change therein or non-renewal shall become effective except upon thirty (30) days prior written notice to the DFCM as evidenced by return receipt, certified mail sent to DFCM. The Contractor shall notify the DFCM within thirty (30) days of any claim(s) against the Contractor, and if such claim(s) exceed 20% of the applicable required insured limits, the DFCM may require the Contractor to re-instate the policy to provide full protection at the original limits. For any risk not covered by the Worker's Compensation Policy, the State of Utah shall be named as additional insured parties. All insurance policies provided shall be primary and non-contributing with, and not in excess of, any other insurance or self-insurance available to the State of Utah.

#### **10.1.5 DEDUCTIBLE LIABILITY.**

Any and all deductibles in the above described policies shall be assumed by, for the account of, and at sole risk of Contractor. The allowable deductible for any of the policies required by these General Conditions shall be no more than \$1,000 or 0.1 percent of the Contract Amount, whichever is greater. When there is an FLCC, the FLCC shall be the Contract Amount for purposes of calculating the allowable deductible.

#### **10.1.6 ADDITIONAL REQUIREMENTS:**

(1) Any type of insurance or any increase of limits of liability not described in this Agreement which the Contractor requires for its own protection or on account of any statute, rule or regulation, shall be its own responsibility and at its own expense.

(2) The carrying of any insurance required by this Agreement shall in no way be interpreted as relieving the Contractor or Subcontractors of any other responsibility or liability under this Agreement or any applicable law, statute, rule, regulation or order.

(3) Contractor shall not violate or knowingly permit to be violated any of the

provisions of the policies on insurance required under these General Conditions.

### **10.2 "BUILDER'S RISK" PROPERTY INSURANCE.**

**10.2.1 IN GENERAL.** The State shall provide "Builder's Risk" property insurance to protect the State, as well as all Contractors and Subcontractors, and include them as insureds, with respect to Work performed hereunder at the State's own cost and expense, according to the policies and forms currently in force with insurance carriers selected by the State's Risk Manager or issued by the State of Utah Risk Management Fund. The State of Utah's Risk Manager shall furnish, upon request, all parties in interest with copies of said policies authenticated by authorized agents of the insurers or the State of Utah's Risk Management Fund.

**10.2.2 INSPECTIONS, RECOMMENDATIONS.** DFCM, the Division of Risk Management and the Builder's Risk insurers shall have the right to inspect the Work. The Contractor shall comply with reasonable risk control recommendations made by insurers or the Division of Risk Management. Such inspections or recommendations do not relieve the Contractor of any of its responsibilities under the Contract Documents.

**10.2.3 DEDUCTIBLE.** The above described "Builders Risk" policies shall be subject to a total deductible of \$5,000 per loss occurrence, which shall be assumed by all Contractors or Subcontractors, in proportion to their share of the total amount of an insured loss occurrence.

**10.2.4 ADJUSTED WITH AND PAYABLE TO RISK MANAGER AS TRUSTEE.** Any insured property loss is to be adjusted with the State of Utah Risk Manager, and made payable to the State of Utah Risk Manager as trustee for the Contractor and Subcontractors, as their interests may appear, subject to the requirements of any applicable loss payable clause.

**10.2.5 WAIVER.** Contractor, including all Subcontractors, and DFCM hereby waive all rights against each other for damages caused by

perils insured against under the "Builder's Risk" insurance provided by DFCM, except such rights as Contractor may have to the proceeds of such insurance held by the State of Utah's Risk Manager as trustee. The DFCM and the Contractor each shall require similar waivers from their contractors, subcontractors, subconsultants and agents, at any tier.

**10.2.6 SPECIAL HAZARDS.** DFCM shall bear the risk of loss, delay and/or damage due to earthquake and/or flood and may either insure or self-insure that risk. If the Contractor requests in writing that insurance for other special hazards be included in the "Builder's Risk" policy, the State of Utah's Risk Manager shall, if possible, include such insurance in the policy and the cost thereof shall be charged to the Contractor by Change Order.

**10.3 PERFORMANCE BOND AND PAYMENT BOND.** The Contractor shall submit and maintain in full force and effect as required by law and the Contract Documents, at its own expense, on forms provided by the Division of Facilities Construction and Management, and include as part of the quoted total all costs involved in securing and furnishing, the bonds listed below, based on the completed cost of the Contract and effective upon execution of the Contract. Said bonds shall be from surety companies which are authorized to do business in the State of Utah, listed in the U. S. Department of Treasury Circular 570, Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies, and acting within the limitation listed therein.

10.3.1 A full 100 percent performance bond covering the faithful execution of the Contract in accordance with the Contract Documents; and

10.3.2 A full 100 percent payment bond covering payment of all obligations arising under the Contract Documents, for the protection of each person supplying labor, service, equipment, or material for the performance of the Work.

10.3.3 Any required insurance required under the U.S. Terrorism Risk Insurance Act of

2002, any similar applicable law, or as such Act may be amended.

## **ARTICLE 11. MISCELLANEOUS PROVISIONS.**

### **11.1 A/E'S RESPONSIBILITIES.**

These General Conditions are not intended to provide an exhaustive or complete list of the A/E's responsibilities. A separate agreement between the DFCM and A/E incorporates these General Conditions by reference and includes additional Design responsibilities.

**11.2 SUCCESSORS AND ASSIGNS.** The DFCM and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in the Contract Documents. The Contractor shall not assign the Contract without the prior written consent of the DFCM, nor shall the Contractor assign any amount due or to become due as well as any rights under the Contract, without prior written consent of the DFCM.

### **11.3 WRITTEN NOTICE.**

**11.3.1 PERSONAL DELIVERY AND REGISTERED OR CERTIFIED MAIL.** Written notice shall be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended, or if delivered at or sent by registered or certified mail, return receipt requested, to the last business address known to the party giving notice.

**11.3.2 FAX.** Notwithstanding any other provision of these General Conditions, written notice shall also be deemed to have been duly served by verified use of a FAX system by using the known and operative calling number. Service by use of the FAX system is encouraged when timely notice will benefit the DFCM, A/E or Contractor. Notice shall be considered complete and verified upon the sending and confirmation of delivery using the FAX system, if on the same day notice is also sent by registered or certified mail,

return receipt requested, to the last business address known to the party giving notice, confirming the FAX delivery.

#### **11.4 RIGHTS AND REMEDIES.**

**11.4.1 NOT LIMIT.** Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

**11.4.2 NOT WAIVER.** Except as expressly provided elsewhere in the Contract Documents, no action or failure to act by the DFCM, A/E or Contractor shall constitute a waiver of a right or duty afforded them under the Contract Documents, nor shall such action or failure to act constitute approval or acquiescence in a breach thereunder, except as any of the above may be specifically agreed to in writing. In no case shall the Contractor or any Subcontractors be entitled to rely upon any waiver of any of these General Conditions unless agreed to in writing by the DFCM.

#### **11.5 COMMENCEMENT OF STATUTORY LIMITATION PERIOD.**

**11.5.1 BEFORE SUBSTANTIAL COMPLETION.** Except as provided in 11.5.4 below, as to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion.

#### **11.5.2 BETWEEN SUBSTANTIAL COMPLETION AND FINAL CERTIFICATION FOR PAYMENT.**

Except as provided in Paragraph 11.5.4 below, as to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certification for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certification for Payment.

#### **11.5.3 AFTER FINAL CERTIFICATION FOR PAYMENT.**

Except as provided in Paragraph 11.5.4 below, as to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any guaranty provided under Article 9 the date of any correction of the Work or failure to correct the Work by the Contractor under Paragraph 9.4.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or DFCM, whichever occurs last.

**11.5.4 EXCEPTION.** Notwithstanding any other provision of this Article 11.5 to the contrary, no applicable statute of limitations shall be deemed to have commenced with respect to any portion of the Work which is not in accordance with the requirements of the Contract Documents, which would not be visible or apparent upon conducting a reasonable investigation, and which is not discovered by the DFCM until after the date which, but for this Paragraph 11.5.4, would be the date of commencement of the applicable statute of limitations; the applicable statute of limitations instead shall be deemed to have commenced on the date of such discovery by the DFCM.

**11.6 NOT DISCRIMINATE, NO SEXUAL HARASSMENT.** Pursuant to the laws of the State of Utah, the Contractor, Subcontractors, or anyone for whose act any of them may be liable, will take affirmative action to not discriminate against any employee or applicant for employment because of race, creed, color, sex, religion, ancestry or national origin. To the extent applicable, said persons will comply with all provisions of Executive Order No. 11246 dated September 24, 1965 and rules, regulations, orders, instructions, designations and other directives promulgated pursuant thereto. Contractor, Subcontractors, or anyone for whose act any of them may be liable, shall not act in any manner as would violate the laws, regulations and policies of the United States or the State of Utah prohibiting sexual harassment.

**11.7 APPLICABLE LAWS.** The applicable laws and regulations of the State of Utah, as well as any applicable local laws and regulations not superseded or exempted by State law, shall govern the execution of the Work embodied in the Contract Documents as well as the interpretation of the Contract Documents.

**11.8 INTERPRETATION.** In the interest of brevity, the Contract Documents frequently omit modifying words such as “all” and “any” and articles such as “the” and “an”, but the fact that a modification or an article is absent from the statement and appears in another is not intended to affect the interpretation of either statement.

**11.9 VENUE.** In case of any dispute, which may arise under the Contract Documents, the place of venue shall be in the County of Salt Lake, Utah, unless otherwise agreed to by all the parties in writing.

**11.10 SEVERABILITY.** The invalidity of any part, paragraph, subparagraph, phase, provision or aspect of the Contract documents shall not impair or affect in any manner the validity, enforceability or effect of the remainder of the Contract Documents.

**11.11 CONSTRUCTION OF WORDS.** Unless otherwise stated in the Contract Documents, words, which have well-known technical or construction industry meanings, shall be construed as having such recognized meanings. Unless the context requires otherwise, all other technical words shall be construed in accordance with the meaning normally established by the particular, applicable profession or industry. All other words, unless the context requires otherwise, shall be construed with an ordinary, plain meaning.

**11.12 NO THIRD PARTY RIGHTS.** These General Conditions create rights and duties only as between DFCM and Contractor, and DFCM and A/E. Nothing contained herein shall be deemed as creating third party beneficiary contract rights or other actionable rights or duties as between Contractor and A/E, or as between DFCM, Contractor, or A/E on the one hand, and any other person or entity.

## **ARTICLE 12. TERMINATION OR SUSPENSION OF THE CONTRACT.**

### **12.1 TERMINATION BY CONTRACTOR.**

**12.1.1 IN GENERAL.** If the Work is stopped for a period of sixty (60) days through no act or fault of the Contractor or a Subcontractor, or their agents or employees or any other persons performing portions of the Work under contract with any of the above, the Contractor, may terminate the Contract in accordance with 12.1.2 hereinbelow for any of the following reasons:

(1) Because the DFCM has persistently failed to fulfill fundamental DFCM's obligations under the Contract Documents with respect to matters important to the progress of the Work;

(2) Issuance of an order of a court or other public authority having jurisdiction which necessitates such termination, except that where the Contractor has standing, the Contractor must cooperate in efforts to stay and/or appeal such order;

(3) An act of government, such as a declaration of national emergency, making material unavailable; or

(4) Unavoidable casualties or other similar causes as listed in Paragraph 12.2.2(2) hereinbelow.

**12.1.2 NOTICE.** If one of the reasons for termination in Paragraph 12.1.1 hereinabove exist, the Contractor may, upon ten (10) additional days' written notice to the DFCM and A/E, and such condition giving cause for termination still not cured, terminate the Contract and recover from the DFCM payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead, profit and damages associated only with work completed prior to the notice of termination.

### **12.2 TERMINATION BY THE DFCM FOR CAUSE.**

**12.2.1 IN GENERAL.** The DFCM Director or Designee may terminate the Contract if the Contractor fails to cure any of the following within a period of ten (10) days (or longer if the DFCM so approves in writing) after receipt of notice from the DFCM specifying the cause for termination:

(1) The Contractor persistently or repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

(2) The Contractor fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

(3) The Contractor persistently disregards laws, ordinances, or rules, regulations, resolutions or orders of a public authority having jurisdiction; or

(4) The Contractor fails to perform the Work within the time specified in the Contract Documents or any authorized extension thereof or the Contractor fails to make progress with the Work as to endanger such compliance;

(5) The Contractor fails to perform the Work or is otherwise in breach of a material provision of the Contract Documents;

(6) The Contractor fails to respond promptly to the financial responsibility inquiry under the Contractor's Agreement;

(7) As permissible by law for a reason to terminate, the Contractor is adjudged bankrupt;

(8) As permissible by law for a reason to terminate, the Contractor should make a general assignment for the benefit to creditors;

(9) As permissible by law for a reason to terminate, the Contractor should have a receiver appointed on account of the Contractor's insolvency; or

(10) The Contractor fails to follow the material safety requirements and precautions either as expressly provided in the

Contract Documents or as consistent with the customary practices in the industry.

### **12.2.2 DFCM'S RIGHT TO CARRY OUT THE WORK.**

(1) If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten (10) day period (or longer if approved by the DFCM in writing) after receipt of written notice from the DFCM to cure such default or neglect, the DFCM may without prejudice to other remedies the DFCM may have, correct such deficiencies, including taking over the Work and prosecuting the same to completion, by contract or otherwise, and may take possession of, and utilize in completing the Work, such materials, appliances, and facilities as may be on the site of the Work as well as the site as necessary for its proper completion. In such case, the DFCM shall offset from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the A/E, DFCM's staff and legal counsel's additional services and expenses made necessary by such default, neglect or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the DFCM. The Contractor shall continue performance of the Contract to the extent not terminated.

(2) Except with respect to defaults of Subcontractors, the Contractor shall not be liable for any excess costs if the failure to perform the Contract arises out of causes beyond the control and without the fault or negligence of the Contractor or anyone for whom the Contractor may be liable. Such causes may include, but are not limited to, acts of God or of the public enemy, acts of the State of Utah or federal government in either their sovereign or contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather; but in every case the failure to perform must be beyond the control and without the fault or negligence of the Contractor or anyone for whom the Contractor may be liable. If the failure to perform is caused by the default of a Subcontractor, and if such default arises out of causes beyond the control of both the Contractor

and the Subcontractor, and without the fault or negligence of either of them or anyone for whom either may be liable, the Contractor shall not be liable for any excess costs for failure to perform unless the supplies or services to be furnished by the Subcontractor were obtainable from other sources in sufficient time to permit the Contractor to meet the required delivery or completion schedule.

**12.2.3 ITEMS REQUIRED TO BE TRANSFERRED OR DELIVERED.** The DFCM may require the Contractor to transfer title and deliver to the DFCM, in the manner and to the extent directed by the DFCM:

(1) Any completed portion of the Work; and

(2) Any partially completed portion of the Work and any parts, tools, dies, jigs, fixtures, drawings, information, and contract rights (hereinafter called "construction materials") as the Contractor has specifically produced or specifically acquired for the performance of such part of this Contract as has been terminated; and the Contractor shall, upon direction of the DFCM, protect and preserve property in the possession of the Contractor in which the DFCM has an interest.

**12.2.4 PAYMENT.** When the DFCM terminates the Contract for one or more of the reasons stated in Paragraph 12.2.1, the DFCM may withhold payment and/or pursue all available remedies.

**12.2.5 DFCM PROTECTION IF LIENABLE.** When the subject property is lienable, the DFCM may withhold from amounts otherwise due the Contractor for such completed Work or construction materials such sum as the DFCM determines to be necessary to protect the State against loss because of outstanding liens or claims for former lien holders.

**12.2.6 CREDITS AND DEFICITS.** If the unpaid balance of the Contract Sum exceeds the full cost of finishing the Work, including compensation for the A/E's services and expenses made necessary thereby, such excess shall be paid to the Contractor. If such cost exceeds the unpaid balance, the Contractor shall pay the difference to

the DFCM this obligation for payment shall survive the termination of the Contract.

**12.2.7 IF CONTRACTOR FOUND NOT IN DEFAULT OR EXCUSABLE.** If, after notice of termination of the Contract under the provisions of this Article, it is determined for any reason that the Contractor was not in default under the provisions of this Article, or that the default was excusable under the provisions of this Article, the rights and obligations of the parties shall be the same as if the notice of termination had been issued pursuant to the termination for convenience provisions.

**12.2.8 RIGHTS AND REMEDIES NOT EXCLUSIVE.** The rights and remedies of the DFCM provided in this Article 12.2 shall not be exclusive and are in addition to any other rights and remedies provided by law or under this Contract.

**12.3 SUSPENSION, DELAY OR INTERRUPTION OF WORK BY THE DFCM FOR CONVENIENCE.**

**12.3.1 BY DFCM IN WRITING.** The DFCM may in writing and without cause, order the Contractor to suspend, delay or interrupt the Work in whole or in part for such period of time as the DFCM may determine to be appropriate for the convenience of the DFCM.

**12.3.2 TIME PERIOD FOR CLAIMS.** Any PRE by the Contractor for adjustment under this Article 12.3 must be asserted by the Contractor, in writing, within twenty-one (21) days from the date of termination of such suspension, delay or interruption; provided that the DFCM may, in its sole discretion, receive and act upon any such PRE asserted at any time prior to final payment under this Contract.

**12.3.3 ADJUSTMENTS.** Any adjustment in Contract Sum and Time shall be in accordance with Articles 3, 4, and 7.

**12.4 TERMINATION FOR CONVENIENCE OF THE DFCM.**

**12.4.1 IN GENERAL.**

The performance of Work under this Contract may be terminated by the DFCM in accordance with this Article 12.4 in whole, or from time to time, in part, whenever the DFCM shall determine that such termination is in the best interest of the DFCM or any person for whom the DFCM is acting under this Contract. Any such termination shall be effected by delivery to the Contractor of a notice of termination specifying the extent to which performance of Work under the Contract is terminated, and the date upon which such termination becomes effective.

#### 12.4.2 CONTRACTOR

**OBLIGATIONS.** After receipt of a notice of termination, and except as otherwise directed by the DFCM in writing, the Contractor shall:

(1) Stop work under the Contract on the date and to the extent specified in the notice of termination;

(2) Place no further orders or subcontracts for materials, services or facilities, except as may be necessary for completion of such portion of the Work under the Contract as is not terminated;

(3) Terminate all orders and subcontracts to the extent that they relate to performance of Work terminated by the notice of termination;

(4) Assign to the DFCM in the manner, at the times, and to the extent directed by the DFCM, all of the right, title and interest of the Contractor under the orders and subcontracts so terminated, in which case the DFCM shall have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts;

(5) Settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts, with the approval or ratification of the DFCM, which approval or ratification shall be final for all the purposes of this Article 12.4;

(6) Transfer title and deliver to the DFCM in the manner, at the times, and to the extent, if any, directed by the DFCM:

(a) The fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced as a part of, or acquired in connection with the performance of the Work terminated by the notice of termination; and

(b) The completed or partially completed drawings, information, and other property which, if the Contract had been completed, would have been required to be furnished to the DFCM;

(7) Use best efforts to sell, in the manner, at the times, to the extent, and at the price or prices directed or authorized by the DFCM, any property of the types referred to in Paragraph 12.4.2(6) above; provided, however, that the Contractor:

(a) Shall not be required to extend credit to any purchaser; and

(b) May acquire any such property under the conditions prescribed by and at a price or prices approved by the DFCM; and provided further that the proceeds of any such transfer of or disposition shall be applied in reduction of any payments to be made by the DFCM to the Contractor under this Contract or shall otherwise be credited to the price or cost of the Work covered by this Contract or paid in such other manner as the DFCM may direct;

(8) Complete performance of such part of the Work as shall not have been terminated by the notice of termination; and

(9) Take such action as may be necessary, or as the DFCM may direct, for the protection and preservation of the property related to this Contract which is in the possession of the Contractor in which the State has or may acquire an interest.

#### 12.4.3 TERMINATION CLAIM.

After receipt of a notice of termination, the Contractor may submit to the DFCM a PRE, in the form and with certification prescribed by the DFCM. Such PRE shall be submitted promptly

but in no event not later than sixty (60) days from the effective date of termination.

**12.4.4 AGREED UPON PAYMENT.**

Subject to the provisions of Paragraph 12.4.3 above, the Contractor and the DFCM may agree upon the amount to be paid to the Contractor by reason of the total or partial termination of Work pursuant to this Article 12.4.

**12.4.5 PAYMENT NOT AGREED UPON.**

In the event of the failure of the Contractor and the DFCM to agree, as provided in Paragraph 12.4.4, upon the whole amount to be paid to the Contractor by reason of the termination of Work pursuant to this Article 12.4, the DFCM shall pay to the Contractor the amounts determined by the DFCM as follows, but without duplication of any amounts agreed upon in accordance with Paragraph 12.4.4:

(1) With respect to all Contract Work performed prior to effective date of the notice of termination, the total (without duplication of any items) of:

(a) The cost of such Work including undisputed Claim amounts;

(b) The cost of terminating, settling and paying claims arising out of the termination of Work under subcontracts or orders as provided in Paragraph 12.4.2(5) above, exclusive of the amounts paid or payable on account of supplies or materials delivered or services furnished by Subcontractors prior to the effective date of the notice of termination under this Contract, which amounts shall be included in the cost on account of which payment is made under Paragraph 12.4.5(1)(a) above;

(c) A sum, as overhead and profit on Paragraph 12.4.5(1)(a) above, determined by the DFCM to be fair and reasonable;

(d) The reasonable cost of the preservation and protection of property incurred pursuant to Paragraph 12.4.2(9); and any other reasonable cost incidental to termination of Work under this Contract, including expenses incidental to the determination of the amount due

to the Contractor as the result of the termination of Work under this Contract.

(2) The total sum to be paid to the Contractor under Paragraph 12.4.5(1) above shall not exceed the total Contract Sum as reduced by the amount of payments otherwise made and as further reduced by the Contract price of work not terminated. Except for normal spoilage, and except to the extent that the DFCM shall have otherwise expressly assumed the risk of loss in writing, there shall be excluded from the amounts payable to the Contractor under Paragraph 12.4.5(1) above, the fair value of property which is destroyed, lost, stolen, or damaged so as to become undeliverable to the DFCM, or to a buyer pursuant to Paragraph 12.4.2(7).

**12.4.6 DEDUCTIONS.** In arriving at the amount due the Contractor under this Article 12.4, there shall be deducted:

(1) All unliquidated advance or other payments on account theretofore made to the Contractor, applicable to the terminated portion of this Contract;

(2) Any Claim which the State may have against the Contractor in connection with this Contract; and

(3) The agreed price for, or the proceeds of sale of, any materials, supplies, or other things acquired by the Contractor or sold, pursuant to the provisions of this Article 13.4, and not otherwise recovered by or credited to the DFCM.

**12.4.7 PARTIAL TERMINATION.** If the termination is partial, the Contractor may file with the DFCM a PRE for the amounts specified in the Contract relating to the continued portion of the Contract and such equitable adjustment as may be agreed upon shall be made in such amounts. Any PRE under this Paragraph 12.4.7 must be filed within twenty-one (21) days from the effective date of the notice of termination.

**12.4.8 PARTIAL PAYMENTS.** The DFCM may, from time to time, under such terms and conditions as it may prescribe, make partial payments and payments on account against costs

incurred by the Contractor in connection with the terminated portion of this Contract whenever, in the opinion of the DFCM the aggregate of such payments shall be within the amount to which the Contractor will be entitled hereunder. If the total of such payments is in excess of the amount finally agreed or determined to be due under this Article 12.4, such excess shall be payable by the Contractor to the DFCM upon demand, together with interest at a rate equal to the average rate at the time being received from the investment of state funds, as determined by the State Treasurer, for the period until the date such excess is repaid to the DFCM; provided, however, that no interest shall be charged with respect to any such excess payment attributable to a reduction in the Contractor's claim by reason of retention or other disposition of termination inventory until ten (10) days after the date of such retention or disposition, or such later date as determined by the DFCM by reason of the circumstances.

**12.4.9 PRESERVE AND MAKE AVAILABLE RECORDS.** Unless otherwise provided for in this Contract, or by applicable law, the Contractor shall, from the effective date of termination until the expiration of three years after final settlement under this Contract, preserve and make available to the DFCM at all reasonable times at the office of the Contractor, but without direct charge to the DFCM, all books, records, documents and other evidence bearing on the costs and expenses of the Contractor under this Contract and relating to the Work terminated hereunder, or, to the extent approved by the DFCM Representative, photographs, micrographs, or other authentic reproductions thereof.

**12.5 DFCM'S RIGHT TO STOP THE WORK.** If the Contractor fails to correct Work or fails to carry out Work, as required by the Contract Documents or fails to comply with all required and customary safety precautions; the DFCM, by written order signed personally or by an agent specifically so empowered by the DFCM in writing, may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the DFCM to stop the Work shall not give rise to a duty on the part of the DFCM to exercise this right for the benefit of the Contractor or any other person or entity.



**Form A Design Review Checklist**

**Project Name: USU USTAR BUILDING**

**Project Information**

<b>Architect:</b> ajc architects/Payette
<b>Mechanical Engineer:</b> Van Boerum Frank and Associates
<b>Electrical Engineer:</b> Envision Engineering
<b>Landscape Architect:</b> Landmark Design
<b>Contractor:</b> Gramoll Construction
<b>Commissioning Agent:</b> E-Cube

Design Development Submittal 12-09-08

**Design Review Checklist**

This is a preliminary checklist and meant to be used as a tool for evaluating the status of the project and should be submitted with or prior to the submission of Construction Documents. Most measures require inspection and verification during the construction phase. Points will be awarded at the end of construction. Additional forms have been provided to assist you in this process. Applicable forms should be attached to this checklist for preliminary review.

**1. Design and Technology Charrette (section 5.4.A)**

Please indicate that each topic below was discussed during the charrette.

- Natural shade to reduce heat island effect from parking lots and landscaping areas
- Shielded or reduced parking and façade lighting to reduce nigh sky pollution
- Reuse of existing building to conserve our resources
- Avoiding sewer and waterway contamination
- Use local building materials and products to support local economy and reduce the environmental impacts from transportation
- Encourage the use of public transportation
- Protect wet-lands and green spaces
- Provide recycling center
- Other topics

required
required
required

Please attach a brief narrative summarizing charrette concepts which are to be incorporated into the design. Submit a copy of the narrative to the design team.

**HPBRS Checklist Item**

**Contract Document Source**

**2. Commissioning Agent (section 5.5.A)**

- The specifications for commissioning agent responsibilities for fundamental building components are located in the following sections:

	required
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**3. Life-Cycle Cost Analysis (section 5.5.B)**

- Complete the Life-cycle Cost Analysis Worksheet and attach with this checklist. Items to be costed shall include a minimum of major mechanical system components and energy efficiency measures to assist in selection.

required
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**4. CFC Reduction in HVAC and Refrigeration Equipment (section 5.5.B)**

- HVAC and refrigeration equipment have been specified to use no chlorofluorocarbons (CFC) base refrigerants.

required
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The information and details describing non-CFC HVAC and refrigeration equipment are located in the following specification sections and/or are indicated on the following drawing sheet/notes:

See Specifications submitted as part of the DD submittal

**5. Ventilation Systems (section 5.5.D)**

The mechanical system complies with Standard 62

required

**6. Drainage Systems (section 5.5.E)**

The drainage system has been designed to avoid accumulation of standing water around or in the building.

Site Grading Plan indicates finished grades around building slope away from building. A storm drainage collection system of inlets and pipes convey water away from building into detention/retention ponds on-site.

required

**7. Landscape and Irrigation Systems (section 5.5.F)**

The landscape and irrigation system has been designed according to DFCM Guidelines for Landscape & Irrigation  
 Attach completed Form C

required

**8. Fundamental Lighting Design (section 5.5.G)**

The lighting system has been designed according to IESNA Lighting Handbook

required

**9. Mold Prevention During Construction (section 5.5.H)**

Mold prevention instructions for construction are located in the following specification sections and/or are indicated on the following drawing sheets/notes according to the HPBRS.

See Specifications submitted as part of the DD submittal

required

**10. Filtration Media Replacement (section 5.5.I)**

Filtration media replacement instructions are located in the following specification sections and/or are indicated on the following drawing sheets/notes.

See Specifications submitted as part of the DD submittal

required

**11. Thermal Comfort (section 5.5.J)**

Thermal comfort requirements have been designed according to Standard 55 (with the allowed exceptions listed in the HPBRS).

required

**12. Energy Performance (section 5.6.A) Size is >75000 SF**

Complete form D by listing and describing each energy efficiency measure that has been incorporated in to the building design. Measures are those obtained from the energy modeler. If available, a current energy modelers list may also be submitted in lieu of form D.

required

<input checked="" type="checkbox"/> The commissioning agent's role to verify the energy efficiency measures is described in the following specification sections and/or is indicated on the following drawing sheets/notes.	See Specifications submitted as part of the DD submittal	required
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**13. Energy Performance (section 5.6.B.1) Small Building Option < 75000 SF**

<input type="checkbox"/> Complete the Small Building Prescriptive Energy Form E and attach with this checklist		required
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**14. Daylighting (section 5.7.A.1)**

		Potential Pts
<input checked="" type="checkbox"/> Daylighting was designed as the primary lighting system for 75-95% of the spaces as described in the HPBRS.		3
<input type="checkbox"/> Attach the completed copy of daylighting hand calculations (Form F) or the daylighting computer simulation analysis.  <input type="checkbox"/> The commissioning agent's role to verify the daylighting measures is described in the following specification sections and/or is indicated on the following drawing sheets/notes.		

**15. Evaporative Cooling (section 5.7.B.1)**

<input checked="" type="checkbox"/> Evaporative cooling system was designed as described in the HPBRS section 5.7.B.1.		2
<input type="checkbox"/> The commissioning agent's role to verify the evaporative cooling systems is described in the following specification sections and/or is indicated on the following drawing sheets/notes.	See Specifications submitted as part of the DD submittal	

**16. Demand-Controlled Ventilation (section 5.7.B.2)**

<input checked="" type="checkbox"/> The ventilation system was designed as described in the HPBRS section 5.7.B.1.		1
<input type="checkbox"/> The commissioning agent's role to verify the demand-controlled ventilation systems is described in the following specification sections.	See Specifications submitted as part of the DD submittal	

**17. Under-floor Air Distribution (section 5.7.B.3)**

<input type="checkbox"/> The design incorporates an under-floor air distribution system as described in the HPBRS.		0
<input type="checkbox"/> The commissioning agent's role to verify the demand-controlled ventilation systems is described in the following specification sections.		

**18. Renewable Energy (section 5.7.C.1)**

<input type="checkbox"/> The design uses renewable energy to reduce ____% of the source energy use		0
<input type="checkbox"/> The renewable energy systems is described in the following specification sections and/or is indicated on the following drawing sheets/notes.		

**19. Low Emitting Materials (section 5.7.D.1)**

<input checked="" type="checkbox"/> Adhesives and sealants have been specified to meet the current version of USGBC LEED NC Credit 4.1 Requirements	1
<input type="checkbox"/> Paints and coatings have been specified to meet the current versions of USGBC LEED NC Credit 4.2 Requirements	0
<input checked="" type="checkbox"/> Carpets have been specified to meet USGBC LEED NC Credit 4.3 Requirements	1
<input checked="" type="checkbox"/> Composite woods have been specified to meet the current version of USGBC LEED NC Credit 4.4 Requirements	1

**20. Pollutant Source Control (section 5.7.D.2)**

<input checked="" type="checkbox"/> Source ventilation systems and separation walls have been designed to vent pollution sources and prevent cross contamination.	Refer to Wind Study	1
<input checked="" type="checkbox"/> HVAC has been designed to avoid the possibility of mold and dust accumulation according to the HPBRS.	Refer to Wind Study	1
<input checked="" type="checkbox"/> Particle arresting filtration is specified to meet requirements as described in the HPBRS.	Refer to Wind Study	1

**21. Construction Indoor Air Quality (section 5.7.D.3)**

<input checked="" type="checkbox"/> List where specifications require the contractor to implement an indoor air quality management plan.		1
<input checked="" type="checkbox"/> List where specifications include instructions for VOC emitting materials and products to be off-gassed in a well-ventilated staging area		
<input checked="" type="checkbox"/> List where specifications include instructions to use fans during installation of VOC emitting materials and products. Details incorporate polyethylene vapor retarders on porous materials.		
<input checked="" type="checkbox"/> List where specifications include instructions to protect HVAC fans and ductwork from accumulating dust during construction.		
<input checked="" type="checkbox"/> List where specifications include instructions to vacuum dust that has accumulated in the HVAC fans and ductwork with a HEPA vacuum and remove and oil films from metal surfaces.		
<input checked="" type="checkbox"/> List where specifications include instructions to vacuum carpet and other soft surfaces with a HEPA vacuum.		
<input checked="" type="checkbox"/> List where specifications include instructions to flush the building for 15 days with 100% outside air prior to occupancy and after substantial completion		1

**22. Additional Commissioning (section 5.7.E.1)**

<input checked="" type="checkbox"/> Commissioning agent reviewed design and made recommendations for the design prior to completion of construction documents
<input checked="" type="checkbox"/> Specifications include instructions for commissioning agent to review contractor submittals relative to the systems being commissioned.

<input checked="" type="checkbox"/> Specifications include instructions to develop a recommissioning plan to schedule commissioning activities to assure the building is continuously tuned to optimize performance.		2
--	--	---

**23. Acoustics (section 5.7.F.1)**

<input type="checkbox"/> Acoustical levels are limited to a maximum of _____ dBA background, and 0.6 second reverberating times.		0
<input type="checkbox"/> Provide calculations or list where the information and details illustrating compliance with acoustical criteria are located in the following specification sections and/or are indicated on the following drawing sheets/notes.		

**24. Sustainable Materials (section 5.7.G.1)**

<input checked="" type="checkbox"/> Major materials have been specified to contain required recycled content according to the requirements in the HPBRS.		2
--	--	---

**25. Waste Reduction (section 5.7.H.1)**

<input checked="" type="checkbox"/> List where specifications require the contractor to reduce overall waste according to the requirements of the HPBRS. ____% of overall waste shall be recycled, composted, and salvaged.		1
---	--	---

**26. Water Reduction Credits (section 5.7.I.1)**

<input checked="" type="checkbox"/> Water efficient fixtures and appliances have been specified and meet the criteria in the HPBRS.		2
<input checked="" type="checkbox"/> The information and details illustrating compliance of the water efficient fixtures are located in the following specification sections and/or are indicated on the following drawing sheets/notes.	See Specifications	

**27. Building Performance Monitoring Multi-Building (section 5.7.J.1)**

<input type="checkbox"/> The building performance monitoring system has been designed as described in the HPBRS.		0
<input type="checkbox"/> The building performance monitoring systems is described in the following specification sections and/or is indicated on the following drawing sheets/notes:		

**28. System Performance Monitoring (section 5.7.J.2)**

<input checked="" type="checkbox"/> Equipment to provide continuous metering for the items listed in the HPBRS has been selected according to the HPBRS.		1
<input checked="" type="checkbox"/> Lighting systems (list where noted in construction documents)	Metering equipment will be installed	
<input checked="" type="checkbox"/> Motor Loads > 20 hp (kWh and kW) (list where noted in construction documents)	Metering equipment will be installed	
<input checked="" type="checkbox"/> Variable speed drive operation (list where noted in construction documents)		
<input checked="" type="checkbox"/> Chillier efficiency or chiller plan efficiency (list where noted in construction documents)		

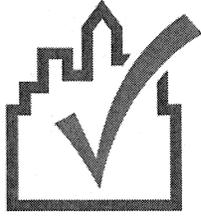
<input checked="" type="checkbox"/>	Air and water economizer operation (list where noted in construction documents)	
<input checked="" type="checkbox"/>	On variable volume system, supply air static pressure and volume. (list where noted in construction documents)	
<input checked="" type="checkbox"/>	Boiler efficiency or boiler plant efficiency (list where noted in construction documents)	
<input checked="" type="checkbox"/>	Process loads (kWh and kW) (list where noted in construction documents)	Metering equipment will be installed

**29. Exceptional energy or environmental measures (section 5.7.K.1)**

<input type="checkbox"/>	Provide a detailed explanation of each exceptional energy or environmental measure not specifically addressed in the HPBRS. Include charts, graphs or other appropriate materials to convey the concept and attach to this form.	2
<input type="checkbox"/>	The innovation measure is described in the following specification sections and/or is indicated on the following drawing sheets/notes: Heat Recovery system	

Total Points

24



COMcheck Software Version 3.6.0

# Interior Lighting and Power Compliance Certificate

## 90.1 (2004) Standard

### Section 1: Project Information

Project Type: **New Construction**

Project Title : **USU USTAR**

Construction Site:

Owner/Agent:

Designer/Contractor:

### Section 2: General Information

Building Use Description by: **Activity Type**

<u>Activity Type(s)</u>	<u>Floor Area</u>
Common Space Types:Office - Enclosed	10803
Common Space Types:Laboratory	32478
Common Space Types:Lobby	3962
Common Space Types:Conference/Meeting/Multipurpose	1350
Common Space Types:Corridor/Transition	17711
Common Space Types:Stairs-Active	4000
Common Space Types:Electrical/Mechanical	31631
Common Space Types:Restrooms	2918
Common Space Types:Active Storage	5516
Common Space Types:Dining Area - General	597
Common Space Types:Food Preparation	1785
Common Space Types:Inactive Storage	3811

### Section 3: Requirements Checklist

#### Interior Lighting:

1. Total proposed watts must be less than or equal to total allowed watts.

Allowed Watts	Proposed Watts	Complies
133822	83160	YES

2. Exit signs 5 Watts or less per side.

#### Controls, Switching, and Wiring:

3. Independent manual or occupancy sensing controls for each space (remote switch with indicator allowed for safety or security).
4. Occupant sensing control in class rooms, conference/meeting rooms, and employee lunch and break rooms.

*Exceptions:*

Spaces with multi-scene control; shop classrooms, laboratory classrooms, and preschool through 12th grade classrooms.

5. Automatic shutoff control for lighting in >5000 sq.ft buildings by time-of-day device, occupant sensor, or other automatic control.

*Exceptions:*

24 hour operation lighting; patient care areas; where auto shutoff would endanger safety or security.

6. Master switch at entry to hotel/motel guest room.
7. Separate control device for display/accent lighting, case lighting, task lighting, nonvisual lighting, lighting for sale, and demonstration lighting.
8. Tandem wired one-lamp and three-lamp ballasted luminaires (No single-lamp ballasts).

*Exceptions:*

Electronic high-frequency ballasts;

Luminaires not on same switch;  
Recessed luminaires 10 ft. apart or surface/pendant not continuous;  
Luminaires on emergency circuits.

**Voltage Drop:**

- 9. Feeder conductors have been designed for a maximum voltage drop of 2 percent.
- 10. Branch circuit conductors have been designed for a maximum voltage drop of 3 percent.

**Section 4: Compliance Statement**

*Compliance Statement:* The proposed lighting design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed lighting system has been designed to meet the 90.1 (2004) Standard requirements in COMcheck Version 3.6.0 and to comply with the mandatory requirements in the Requirements Checklist.

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Name - Title	Signature	Date
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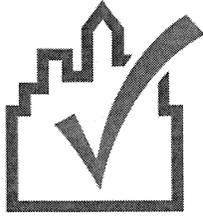
**Section 5: Post Construction Compliance Statement**

**Record Drawings and Operating and Maintenance Manuals:**

- 1. Construction documents with record drawings and operating and maintenance manuals provided to the owner.

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Lighting Designer or Contractor Name	Signature	Date
--------------------------------------	-----------	------



COMcheck Software Version 3.6.0

# Interior Lighting Application Worksheet

## 90.1 (2004) Standard

### Section 1: Allowed Lighting Power Calculation

A Area Category	B Floor Area (ft2)	C Allowed Watts / ft2	D Allowed Watts (B x C)
Common Space Types:Office - Enclosed	10803	1.1	11883
Common Space Types:Laboratory	32478	1.4	45469
Common Space Types:Lobby	3962	1.3	5151
Common Space Types:Conference/Meeting/Multipurpose	1350	1.3	1755
Common Space Types:Corridor/Transition	17711	0.5	8856
Common Space Types:Stairs-Active	4000	0.6	2400
Common Space Types:Electrical/Mechanical	31631	1.5	47447
Common Space Types:Restrooms	2918	0.9	2626
Common Space Types:Active Storage	5516	0.8	4413
Common Space Types:Dining Area - General	597	0.9	537
Common Space Types:Food Preparation	1785	1.2	2142
Common Space Types:Inactive Storage	3811	0.3	1143
Total Allowed Watts =			133822

### Section 2: Proposed Lighting Power Calculation

A Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	B Lamps/ Fixture	C # of Fixtures	D Fixture Watt.	E (C X D)
<b>Common Space Types:Office - Enclosed (10803 sq.ft.)</b>				
Linear Fluorescent: PF82D: PENDANT INDIRECT- DIMMABLE / 48" T8 32W (Super T8) / Electronic	2	8	62	496
Linear Fluorescent: PF83: PENDANT INDIRECT / 48" T8 32W (Super T8) / Electronic	3	2	68	136
Linear Fluorescent: PF82DS: PENDANT INDIRECT- DAYLIGHTING / 48" T8 32W (Super T8) / Electronic	2	4	62	248
Linear Fluorescent: PF83DS: PENDANT INDIRECT- DAYLIGHTING / 48" T8 32W (Super T8) / Electronic	3	24	184	4416
Compact Fluorescent: GB222: GRID BASKET INDIRECT / BIAx 40W / Electronic	2	48	85	4080
Compact Fluorescent: DF61W: SQUARE DOWNLIGHT - WALL WASH / Triple 4-pin 26W / Electronic	1	6	26	156
Linear Fluorescent: PF123: PENDANT INDIRECT / 48" T8 32W (Super T8) / Electronic	3	4	68	272
Linear Fluorescent: GN8W: RECESSED ASYMMETRIC WALL WASH / 48" T8 32W (Super T8) / Electronic	2	2	60	120
Linear Fluorescent: GA242: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	2	2	47	94
Linear Fluorescent: UC41: UNDERCABINET LIGHT / 48" T8 32W (Super T8) / Electronic	1	7	30	210
Linear Fluorescent: GA243: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	3	3	68	204
<b>Common Space Types:Laboratory (32478 sq.ft.)</b>				
Linear Fluorescent: P123DS: PENDANT INDIRECT- DAYLIGHTING / 48" T8 32W (Super T8) / Electronic	3	16	276	4416
Linear Fluorescent: PF243: PENDANT INDIRECT / 48" T8 32W (Super T8) / Electronic	3	10	408	4080
Linear Fluorescent: PF243E: PENDANT INDIRECT / 48" T8 32W (Super T8) / Electronic	3	6	408	2448
Linear Fluorescent: GA244: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	4	46	88	4048
Linear Fluorescent: PF83DS: PENDANT INDIRECT- DAYLIGHTING / 48" T8 32W (Super T8) / Electronic	3	4	184	736
Linear Fluorescent: GA142W: PRISMATIC TROFFER - WASHDOWN / 48" T8 32W (Super T8) / Electronic	2	21	47	987

Linear Fluorescent: GA243W: PRISMATIC TROFFER - WASHDOWN / 48" T8 32W (Super T8) / Electronic	3	48	68	3264
Linear Fluorescent: FA143W: PRISMATIC TROFFER - WASHDOWN / 48" T8 32W (Super T8) / Electronic	3	88	68	5984
Linear Fluorescent: GA142: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	2	6	47	282
Linear Fluorescent: GA244W: PRISMATIC TROFFER - WASHDOWN / 48" T8 32W (Super T8) / Electronic	4	5	88	440
Linear Fluorescent: FA244W: PRISMATIC TROFFER - WASHDOWN / 48" T8 32W (Super T8) / Electronic	4	15	88	1320
Linear Fluorescent: VF142: VAPOR TIGHT COOLER LIGHT / 48" T8 32W (Super T8) / Electronic	2	2	47	94
Linear Fluorescent: GA243: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	3	28	68	1904
Linear Fluorescent: FA243: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	3	4	68	272
Incandescent: GD22: DARK ROOM LIGHT / Other	3	4	300	1200
Linear Fluorescent: WF142W: WALL BRACKET - WASHDOWN / 48" T8 32W (Super T8) / Electronic	2	2	47	94
Linear Fluorescent: FA243W: PRISMATIC TROFFER - WASHDOWN / 48" T8 32W (Super T8) / Electronic	3	6	68	408
Linear Fluorescent: GA242: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	2	5	47	235
Linear Fluorescent: C142G: INDUSTRIAL STRIP W/ WIRE GUARD / 48" T8 32W (Super T8) / Electronic	2	1	47	47
Linear Fluorescent: FA142W: PRISMATIC TROFFER - WASHDOWN / 48" T8 32W (Super T8) / Electronic	2	1	47	47
<b>Common Space Types:Lobby (3962 sq.ft.)</b>				
Linear Fluorescent: GN8: NARROW RECESSED / 48" T8 32W (Super T8) / Electronic	1	1	60	60
Linear Fluorescent: GN16: RECESSED SATIN LENS NARROW / 48" T8 32W (Super T8) / Electronic	1	2	120	240
Linear Fluorescent: GN20: NARROW RECESSED / 48" T8 32W (Super T8) / Electronic	1	4	150	600
Linear Fluorescent: GA242W: PRISMATIC TROFFER- WASHDOWN / 48" T8 32W (Super T8) / Electronic	2	6	47	282
Linear Fluorescent: WN4: RECESSED VERTICAL NARROW / 48" T8 32W (Super T8) / Electronic	1	2	30	60
Compact Fluorescent: DF61: RECESSED DOWNLIGHT / Triple 4-pin 26W / Electronic	1	11	26	286
Compact Fluorescent: DF61W: RECESSED DOWNLIGHT / Triple 4-pin 26W / Electronic	1	4	26	104
Linear Fluorescent: GN12: RECESSED SATIN LENS NARROW / 48" T8 32W (Super T8) / Electronic	1	12	90	1080
Compact Fluorescent: GB222: GRID BASKET INDIRECT / BIAx 40W / Electronic	2	6	85	510
<b>Common Space Types:Conference/Meeting/Multipurpose (1350 sq.ft.)</b>				
Linear Fluorescent: PF83D: PENDANT INDIRECT- DIMMABLE / 48" T8 32W (Super T8) / Electronic	3	6	184	1104
Linear Fluorescent: GN8W: RECESSED ASYMMETRIC WALL WASH / 48" T8 32W (Super T8) / Electronic	2	6	60	360
Linear Fluorescent: PF163D: PENDANT INDIRECT- DIMMABLE / 48" T8 32W (Super T8) / Electronic	3	4	368	1472
Linear Fluorescent: GN16W: RECESSED ASYMMETRIC WALL WASH / 48" T8 32W (Super T8) / Electronic	2	2	188	376
<b>Common Space Types:Corridor/Transition (17711 sq.ft.)</b>				
Linear Fluorescent: GA242: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	2	30	47	1410
Linear Fluorescent: GN4: RECESSED SATIN LENS NARROW / 48" T8 32W (Super T8) / Electronic	1	80	30	2400
Linear Fluorescent: GN20: RECESSED SATIN LENS NARROW / 48" T8 32W (Super T8) / Electronic	1	2	150	300
Linear Fluorescent: GN76: RECESSED SATIN LENS NARROW / 48" T8 32W (Super T8) / Electronic	1	1	570	570
Linear Fluorescent: GN24: RECESSED SATIN LENS NARROW / 48" T8 32W (Super T8) / Electronic	1	1	180	180
Linear Fluorescent: WN2: RECESSED VERTICAL NARROW / 48" T8 32W (Super T8) / Electronic	1	2	40	80
Linear Fluorescent: WN4: RECESSED VERTICAL NARROW / 48" T8 32W (Super T8) / Electronic	1	3	30	90
Linear Fluorescent: GN12: RECESSED SATIN LENS NARROW / 48" T8 32W (Super T8) / Electronic	1	4	90	360
Linear Fluorescent: FN12: RECESSED SATIN LENS NARROW / 48" T8 32W (Super T8) / Electronic	1	1	90	90

Linear Fluorescent: GA142W: PRISMATIC TROFFER - WASHDOWN / 48" T8 32W (Super T8) / Electronic	2	68	47	3196
Compact Fluorescent: GB222: GRID BASKET INDIRECT / BIAX 40W / Electronic	2	4	85	340
Linear Fluorescent: GN44: RECESSED SATIN LENS NARROW / 48" T8 32W (Super T8) / Electronic	1	2	330	660
Linear Fluorescent: GN40: RECESSED SATIN LENS NARROW / 48" T8 32W (Super T8) / Electronic	1	2	300	600
Linear Fluorescent: FN2: RECESSED VERTICAL NARROW / 48" T8 32W (Super T8) / Electronic	1	4	40	160
Linear Fluorescent: GN8: RECESSED SATIN LENS NARROW / 48" T8 32W (Super T8) / Electronic	1	12	60	720
Linear Fluorescent: GA243: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	3	1	68	68
Linear Fluorescent: FA142W: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	2	15	47	705
Linear Fluorescent: SA142B: PRISMATIC TROFFER - BIOSEAL / 48" T8 32W (Super T8) / Electronic	2	19	47	893
Linear Fluorescent copy 1: SA143B: PRISMATIC TROFFER - BIOSEAL / 48" T8 32W (Super T8) / Electronic	3	41	68	2788
<b>Common Space Types:Stairs-Active (4000 sq.ft.)</b>				
Linear Fluorescent: WF143: WALL BRACKET / 48" T8 32W (Super T8) / Electronic	3	32	68	2176
Linear Fluorescent: WN4: RECESSED VERTICAL NARROW / 48" T8 32W (Super T8) / Electronic	1	2	30	60
<b>Common Space Types:Electrical/Mechanical (31631 sq.ft.)</b>				
Linear Fluorescent: C142G: INDUSTRIAL STRIP W/ WIRE GUARD / 48" T8 32W (Super T8) / Electronic	2	136	47	6392
Incandescent: VN1: ELEVATOR WELL EM LIGHT / Incandescent 100W	1	3	100	300
Linear Fluorescent: CR142G: INDUSTRIAL STRIP W/ WIRE GUARD / 48" T8 32W (Super T8) / Electronic	2	8	47	376
Linear Fluorescent: GA242: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	2	4	47	188
<b>Common Space Types:Restrooms (2918 sq.ft.)</b>				
Linear Fluorescent: FN16S: NARROW FLANGED SEMI RECESSED / 48" T8 32W (Super T8) / Electronic	4	2	120	240
Compact Fluorescent: DF81S: LENSED SHOWER DOWNLIGHT / Triple 4-pin 32W / Electronic	1	6	36	216
Linear Fluorescent: FA142: FLANGED PRISMATIC / 48" T8 32W (Super T8) / Electronic	2	6	47	282
Linear Fluorescent: FN20S: NARROW FLANGED SEMI RECESSED / 48" T8 32W (Super T8) / Electronic	5	6	150	900
Compact Fluorescent: FB222: GRID BASKET INDIRECT / BIAX 40W / Electronic	1	1	85	85
Linear Fluorescent: WF142: WALL BRACKET / 48" T8 32W (Super T8) / Electronic	2	10	47	470
Linear Fluorescent: FN24S: NARROW FLANGED SEMI RECESSED / 48" T8 32W (Super T8) / Electronic	6	4	180	720
Linear Fluorescent: FA142W: FLANGED PRISMATIC -WASHDOWN / 48" T8 32W (Super T8) / Electronic	2	8	47	376
<b>Common Space Types:Active Storage (5516 sq.ft.)</b>				
Linear Fluorescent: GA142: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	2	3	47	141
Linear Fluorescent: CR142G: INDUSTRIAL STRIP W/ WIRE GUARD / 48" T8 32W (Super T8) / Electronic	2	3	47	141
Linear Fluorescent: GA142W: PRISMATIC TROFFER - WASHDOWN / 48" T8 32W (Super T8) / Electronic	2	5	47	235
Linear Fluorescent: WF142W: WALL BRACKET - WASHDOWN / 48" T8 32W (Super T8) / Electronic	2	2	47	94
Linear Fluorescent: C142G: INDUSTRIAL STRIP W/ WIRE GUARD / 48" T8 32W (Super T8) / Electronic	2	31	47	1457
Linear Fluorescent: FA142W: FLANGED SEALED PRISMATIC / 48" T8 32W (Super T8) / Electronic	2	6	47	282
Linear Fluorescent: FA142X: FLANGED XPLOSION PROOF PRISMATIC / 48" T8 32W (Super T8) / Electronic	2	8	47	376
Linear Fluorescent: GA242: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	2	5	47	235
<b>Common Space Types:Dining Area - General (597 sq.ft.)</b>				
Linear Fluorescent: GN16H: NARROW GRID RECESSED W/ HEAD / 48" T8 32W (Super T8) / Electronic	1	4	220	880
Linear Fluorescent 35: WN4: RECESSED VERTICAL NARROW / 48" T8 32W (Super T8) / Electronic	1	1	30	30
<b>Common Space Types:Food Preparation (1785 sq.ft.)</b>				
Linear Fluorescent: GA242: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	2	5	47	235

Linear Fluorescent: GA244: PRISMATIC TROFFER / 48" T8 32W (Super T8) / Electronic	4	11	88	968
Linear Fluorescent: WF142: WALL BRACKET / 48" T8 32W (Super T8) / Electronic	2	1	47	47
Common Space Types: Inactive Storage (3811 sq.ft.)				
Linear Fluorescent: C142G: INDUSTRIAL STRIP W/ WIRE GUARD / 48" T8 32W (Super T8) / Electronic	2	8	47	376
				Total Proposed Watts = 83160

### Section 3: Compliance Calculation

If the Total Allowed Watts minus the Total Proposed Watts is greater than or equal to zero, the building complies.

Total Allowed Watts = 133822  
Total Proposed Watts = 83160  
Project Compliance = 50662

Interior Lighting **PASSES**: Design 38% better than code.

USU USTAR BUILDING  
DOE-2 ENERGY MODEL  
DRAFT REPORT  
DESIGN DEVELOPMENT PHASE  
November 25, 2008



EXECUTIVE SUMMARY:

An energy simulation of the USU USTAR building was performed using the industry standard DOE-2 engine. The front end used to run the model was eQUEST version 3.6. A simulation was performed using: 1) ASHRAE 90.1 Energy Standard (Baseline), 2) VAV-Reheat as submitted for design development review.

This report provides a general overview of the parameters used to perform each simulation along with the energy usage and utility costs of each simulation. The energy simulation calculated the total energy usage as follows:

Baseline Model = 48,573.5 MBTU

Proposed Design= 33,257.6 MBTU

Using Rocky Mountain Power and Questar Gas utility rate schedules, the energy simulation calculated the total yearly utility costs as follows:

Baseline Model = \$467,476

Proposed Design = \$315,988

Using the equation to calculate percentage improvement listed in the LEED Handbook and shown in a later section of this document, a 32.4% utility cost savings is realized which qualifies for 7 points for EA credit 1.



## ANALYSIS:

The systems were modeled as follows:

1. Baseline: In accordance with LEED NC 2.2 requirements, the baseline model meets the guidelines established by ASHRAE Standard 90.1. The building envelope and fenestration were set using thermal property requirements as specified in appendix G of ASHRAE 90.1 for baseline models. The HVAC system consists of three packaged VAV AHUs complete with a hot water preheat coil, DX cooling coil and associated air cooled condensing unit, a 100% air economizer, and zone HW reheat coils. The hydronic heating system consists of two 80% efficient gas-fired boilers. The domestic hot water system consists of a single 78% efficient gas-fired boiler. Two 80% efficient gas-fired steam boilers were modeled which provide steam for humidification and sterilizing uses. All spaces were modeled with 100% outdoor air and exhaust. The equipment loads were modeled in laboratory and animal room areas at 10 W/sq. ft and matched ASHRAE guidelines for office equipment in office areas and other non-lab spaces.
2. Proposed Design: The proposed design matches the aforementioned baseline model in size, orientation, shape, and thermal loads. The building envelope and fenestration were modeled with the thermal properties for the materials shown on the architects design development drawings. The HVAC system consists of three separate VAV Air Handling systems complete with a hot water preheat coil, chilled water cooling coil, indirect/direct evaporative cooling, 100% economizer, and energy recovery unit, and zone hot water reheat coils. The chilled water system consists of two high efficiency water cooled chillers with variable speed control and two cooling towers with variable speed fans. The hydronic heating system consists of six 94% efficient gas-fired boilers. High temperature differentials were used on the hydronic systems to save pump energy. The chilled water system was modeled with a 14° differential and the hot water system used a 30° differential. The domestic hot water system consists of a single 94% efficient gas-fired boiler. Two 82% efficient gas-fired steam boilers with stack economizers were modeled to handle the steam loads in the building.

**CONCLUSION:**

Energy usage and utility cost savings were calculated and are depicted in the below table. The cost savings data was calculated using Rocky Mountain Power schedule 6 and Questar Gas schedule F-1. The equation used to calculate percentage improvement comes from the LEED NC version 2.2 Reference Guide under EA credit 1. The equation has the form:

$$\text{Percentage improvement} = 100 \times (1 - \text{Proposed Building Performance} / \text{Baseline Building Performance})$$

Simulation	Site Energy, MBTU			Utility Cost, \$			Percentage Improvement	
	Electric	Natural Gas	Total	Electric	Natural Gas	Total	Energy	Cost
Baseline	12,152.20	36,421.20	48,573.40	251,644	215,832	467,476	---	---
Proposed design	8,689.20	24,568.40	33,257.60	170,245	145,743	315,988	31.5	32.4

Table 1. Results of DOE-2 energy analysis for the USU USTAR schematic design.

**APPENDIX A**  
**BASELINE DATA**



REPORT- BEPS Building Energy Performance

WEATHER FILE- Salt Lake CityUtmy2

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY MBTU	1602.0	0.0	5558.1	0.0	3012.2	0.0	322.1	1657.8	0.0	0.0	0.0	0.0	12152.2
FM1 NATURAL-GAS MBTU	0.0	0.0	24787.5	11539.9	0.0	0.0	0.0	0.0	0.0	0.0	93.8	0.0	36421.2
MBTU	1602.0	0.0	30345.7	11539.9	3012.2	0.0	322.1	1657.8	0.0	0.0	93.8	0.0	48573.5

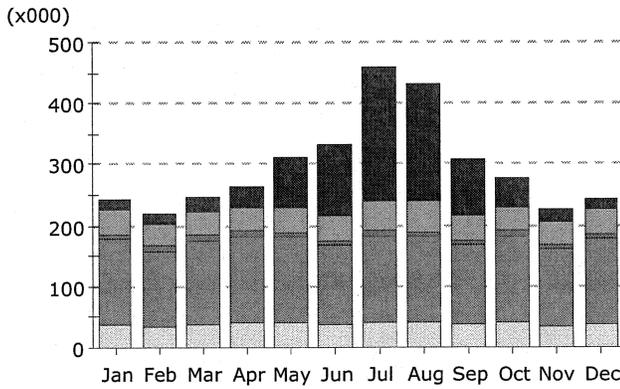
TOTAL SITE ENERGY 48573.48 MBTU 438.2 KBTU/SQFT-YR GROSS-AREA 438.2 KBTU/SQFT-YR NET-AREA  
 TOTAL SOURCE ENERGY 72878.00 MBTU 657.5 KBTU/SQFT-YR GROSS-AREA 657.5 KBTU/SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 72.8  
 PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.0

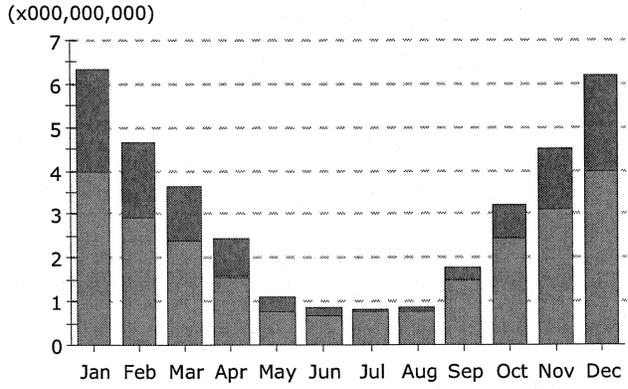
NOTE: ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.



**Electric Consumption (kWh)**



**Gas Consumption (Btu)**



- Area Lighting
- Exterior Usage
- Water Heating
- Refrigeration
- Task Lighting
- Pumps & Aux.
- Ht Pump Supp.
- Heat Rejection
- Misc. Equipment
- Ventilation Fans
- Space Heating
- Space Cooling

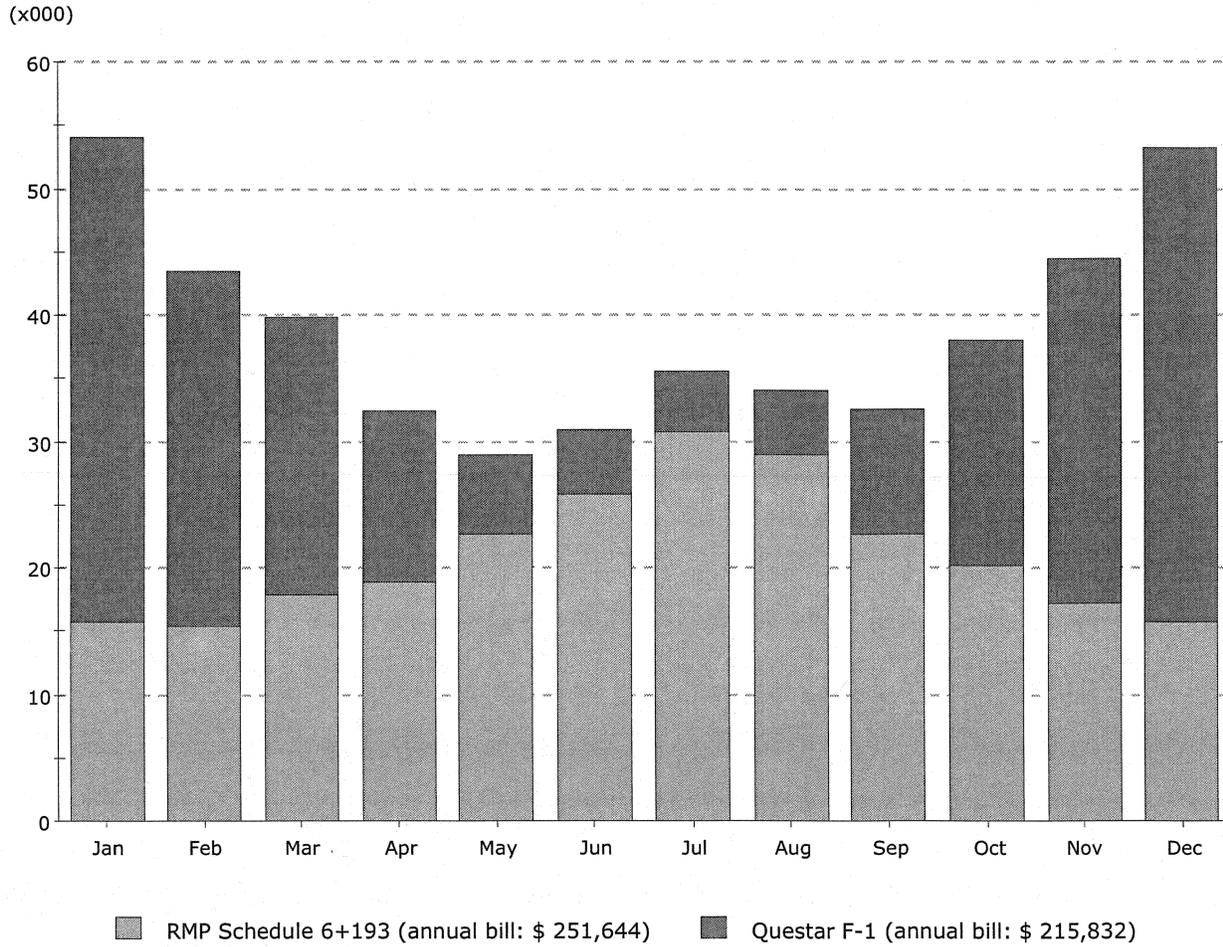
**Electric Consumption (kWh x000)**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	17.5	16.4	23.5	34.7	80.9	117.6	218.1	192.4	95.6	48.7	19.8	17.5	882.6
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	39.1	35.8	38.1	38.0	39.9	40.5	50.8	49.0	39.0	38.6	37.8	39.1	485.7
Pumps & Aux.	8.7	7.9	8.3	7.8	7.4	6.9	7.7	7.5	7.0	8.0	8.4	8.7	94.4
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	137.3	123.6	136.4	141.6	141.5	130.1	141.6	141.5	130.8	141.7	125.1	137.3	1,628.5
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	39.3	35.6	39.3	41.0	41.1	37.5	41.1	41.1	37.5	41.1	35.7	39.3	469.4
<b>Total</b>	<b>242.0</b>	<b>219.1</b>	<b>245.7</b>	<b>263.2</b>	<b>310.9</b>	<b>332.5</b>	<b>459.2</b>	<b>431.5</b>	<b>309.8</b>	<b>278.1</b>	<b>226.7</b>	<b>241.8</b>	<b>3,560.6</b>

**Gas Consumption (Btu x000,000,000)**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	2.37	1.69	1.23	0.86	0.36	0.19	0.07	0.11	0.27	0.76	1.41	2.22	11.54
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.09
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	3.97	2.94	2.39	1.55	0.76	0.69	0.76	0.76	1.48	2.43	3.10	3.97	24.79
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Total</b>	<b>6.35</b>	<b>4.64</b>	<b>3.63</b>	<b>2.42</b>	<b>1.12</b>	<b>0.88</b>	<b>0.84</b>	<b>0.88</b>	<b>1.76</b>	<b>3.20</b>	<b>4.51</b>	<b>6.19</b>	<b>36.42</b>

**Monthly Utility Bills (\$)**



**Total Annual Bill Across All Rates: \$ 467,476**

**APPENDIX B**  
**VAV BOILER DATA**



REPORT- BEPS Building Energy Performance

WEATHER FILE- Salt Lake CityUtmy2

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY MBTU	1209.2	0.0	5572.9	17.7	155.5	0.3	371.5	1362.3	0.0	0.0	0.0	0.0	8689.2
FM1 NATURAL-GAS MBTU	0.0	0.0	22253.9	2236.5	0.0	0.0	0.0	0.0	0.0	0.0	78.0	0.0	24568.4
MBTU	1209.2	0.0	27826.8	2254.1	155.5	0.3	371.5	1362.3	0.0	0.0	78.0	0.0	33257.6

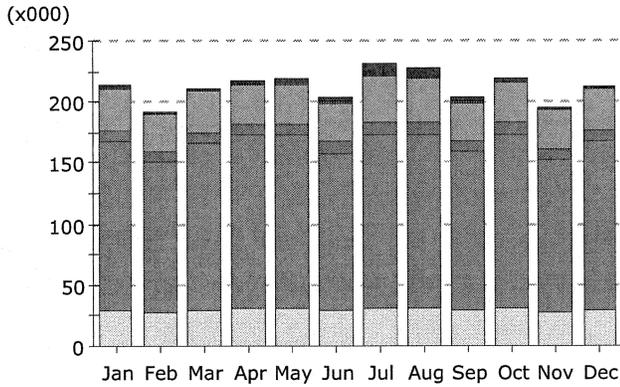
TOTAL SITE ENERGY 33257.57 MBTU 300.1 KBTU/SQFT-YR GROSS-AREA 300.1 KBTU/SQFT-YR NET-AREA  
 TOTAL SOURCE ENERGY 50636.01 MBTU 456.8 KBTU/SQFT-YR GROSS-AREA 456.8 KBTU/SQFT-YR NET-AREA

PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 76.3  
 PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.0

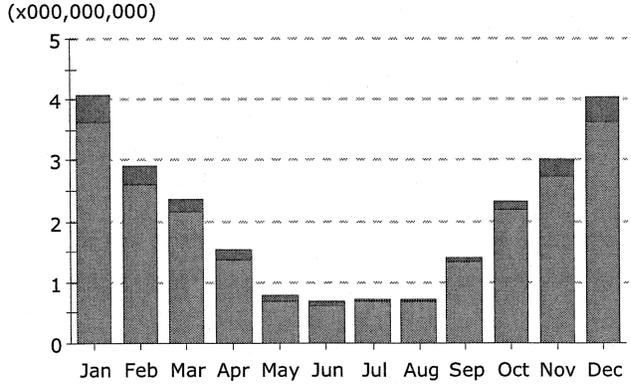
NOTE: ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.



**Electric Consumption (kWh)**



**Gas Consumption (Btu)**



- Area Lighting
- Exterior Usage
- Water Heating
- Refrigeration
- Task Lighting
- Pumps & Aux.
- Ht Pump Supp.
- Heat Rejection
- Misc. Equipment
- Ventilation Fans
- Space Heating
- Space Cooling

**Electric Consumption (kWh x000)**

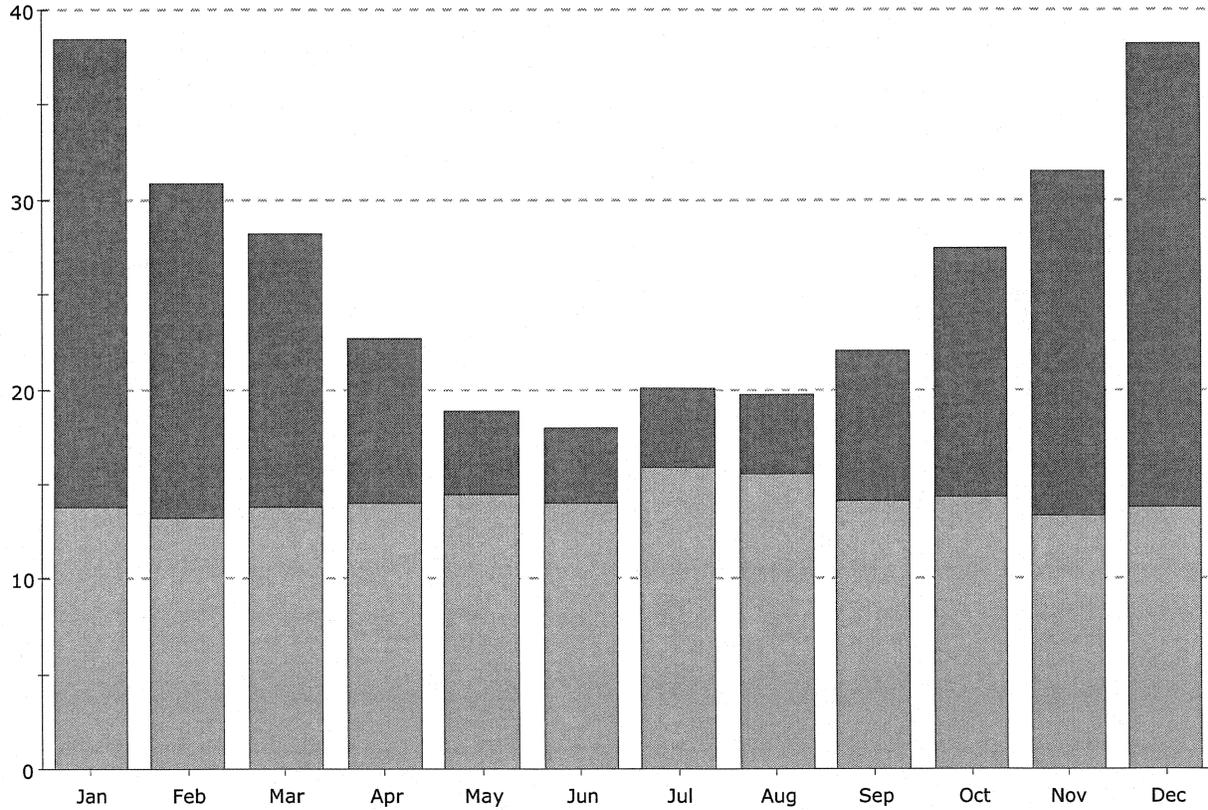
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	1.9	1.7	2.2	2.6	3.8	4.6	9.9	7.9	4.0	3.2	1.9	1.8	45.6
Heat Reject.	-	-	-	-	0.0	0.0	0.1	0.0	0.0	-	-	-	0.1
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.8	0.7	0.5	0.4	0.3	0.2	0.1	0.2	0.2	0.4	0.6	0.8	5.2
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	33.7	30.8	32.9	32.5	33.3	32.1	37.7	36.8	31.4	32.5	31.8	33.7	399.1
Pumps & Aux.	9.4	7.9	8.8	8.7	9.0	8.9	10.6	10.3	8.9	9.2	8.1	9.0	108.8
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	138.2	124.3	137.0	141.6	141.5	130.1	141.6	141.5	130.8	142.3	125.8	138.2	1,632.9
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	29.7	26.8	29.7	31.0	31.0	28.3	31.0	31.0	28.3	31.0	26.9	29.7	354.3
<b>Total</b>	<b>213.7</b>	<b>192.2</b>	<b>211.0</b>	<b>216.8</b>	<b>218.9</b>	<b>204.2</b>	<b>231.0</b>	<b>227.7</b>	<b>203.6</b>	<b>218.5</b>	<b>195.2</b>	<b>213.0</b>	<b>2,545.9</b>

**Gas Consumption (Btu x000,000,000)**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.45	0.29	0.21	0.16	0.09	0.07	0.05	0.05	0.07	0.14	0.25	0.40	2.24
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.08
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	3.63	2.60	2.15	1.38	0.67	0.61	0.67	0.67	1.32	2.18	2.74	3.63	22.25
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Total</b>	<b>4.09</b>	<b>2.90</b>	<b>2.37</b>	<b>1.55</b>	<b>0.77</b>	<b>0.68</b>	<b>0.72</b>	<b>0.73</b>	<b>1.40</b>	<b>2.33</b>	<b>3.00</b>	<b>4.04</b>	<b>24.57</b>

**Monthly Utility Bills (\$)**

(x000)



■ RMP Schedule 6+193 (annual bill: \$ 170,245)    ■ Questar F-1 (annual bill: \$ 145,743)

**Total Annual Bill Across All Rates: \$ 315,988**



# LEED-NC

LEED-NC Version 2.2 Registered Project Checklist

Design Development Submittal 12-09-08

## Utah State University USTAR Building

Yes ? No

10		4		Sustainable Sites	14 Points	Responsible Party
Y		Prereq 1		<b>Construction Activity Pollution Prev, Erosion &amp; Sediment Control plan</b> The civil engineer will provide an erosion and sediment control plan as part of the construction documents	Req.	civil
1		Credit 1		<b>Site Selection</b> , do not devel building, hardscape, road, or parking on farmlands, undeveloped, habitat, wetlands, near water, or public park land. Project is located in an established research park for Utah State University Innovation Campus EP Credit: none	1	client
			1	Credit 2 <b>Development Density &amp; Community Connectivity</b> , construct or renovate on prev. developed site w/ 60k sf/acre density OR community connectivity reqs. EP Credit: none	1	
			1	Credit 3 <b>Brownfield Redevelopment</b> , develop a site documented as contaminated or defined as brownfield. EP Credit: none	1	
1		Credit 4.1		<b>Alternative Transportation</b> , Public Transportation Access, 1/2 mile of comm rail, light rail, or subway. Or 1/4 mile of 2 bus stops (city or campus) Design Team to evaluate and locate existing public transportation bus stops and Campus Bus/Shuttle stops EP Credit: transportation management plan.	1	architect
1		Credit 4.2		<b>Alternative Transportation</b> , Bicycle Storage & Changing Rooms. Meet requirements for commercial/institutional or residential situations. Building to provide exterior bicycle storage and showers.changing rooms EP Credit: transportation management plan.	1	architect
1		Credit 4.3		<b>Alternative Transportation</b> , Low-Emitting and Fuel-Efficient Vehicles. provide cars for 3% occup, OR preferred parking for 5% of parking capacity, OR alternative fueling stations for 3% parking capacity. Parking to be designated for low emitting and fuel efficient vehicles EP Credit: transportation management plan.	1	architect
1		Credit 4.4		<b>Alternative Transportation</b> , Parking Capacity. carpool parking for 5% of parking spaces OR provide for shared vehicle programs OR no new spaces. Project will exceed the parking requirements of local zoning and will carpool/ Vanpool parking for 5% of total provided stalls. EP Credit: transportation management plan.	1	architect/civil
			1	Credit 5.1 <b>Site Development</b> , Protect of Restore Habitat. Limit site disturbances OR restore or protect 50% of native veg where previous developed or graded. Project to restore 50% or more of the site with native vegetation--may need to utilize the master plan detention pond EP Credit: restoring or protecting 75% of site area on previous devel or graded.	1	architect/civil
1		Credit 5.2		<b>Site Development</b> , Maximize Open Space. exceed local reqs by 25% OR if no reqs then open are to match footprint OR 20% open area for project site. Building footprint is 38,530 SF. DD Phase vegetated open space in 60,166 SF. Complies with Option 2 of LEED SS 5.2 EP Credit: double the open space required.	1	architect/landscape
1		Credit 6.1		<b>Stormwater Design, Quantity Control</b> : IF exist. imperviousness LESS than 50% then, no increase in peak discharge rate OR stream channel protection. IF exist. imperviousness MORE than 50% then 25% decrease in stormwater runoff. Achieved by reducing the rate and quantity of runoff by means of the detention/ retention ponds on the site. Existing imperviousness is less than 50%. EP Credit: none	1	civil/landscape
1		Credit 6.2		<b>Stormwater Design, Quality Control</b> : plan that would reduce impervious covers, promote infiltration, capture and treat runoff of 90% of annual rainfall. EP Credit: none Will be achieved by use of the detention/retention ponds, bio-swales placed at inlets and "snout" oil/water separators.	1	civil/landscape

			1	Credit 7.1	<b>Heat Island Effect, Non-Roof:</b> shade, 29 SRI, or open grid for 50% of site hardscape. OR 50% of parking under cover with roof meeting 29 SRI. We currently have shade trees in the design but they will not add up to 50%-- not in budget. EP Credit: if 100% rather than 50% OR 100% parking rather than 50%.	1	civil/landscape
			1	Credit 7.2	<b>Heat Island Effect, Roof:</b> meet SRI requirements for 75% of roof, OR 50% vegetated roof, OR combination of vegetated and meet SRI to meet formula. EP Credit: if 100% of roof is a green roof system. The Building's roof to have a solar reflectance index within LEED requirements which essentially means a white membrane .	1	architect
			1	Credit 8	<b>Light Pollution Reduction,</b> exiting light amount OR automatic shutoff after hours AND exterior lighting output. The interior lighting will be positioned so that the direct beam illumination will fall within the building. In addition, all non-emergency light fixtures will be automatically be turned off after normal business hours. Exterior lighting will be design to achieve an overall power density which is 20% below the referenced standard. This project will be classified as a LZ3 zone and the exterior lighting designed to meet the requirements of that zone. EP Credit: none	1	Electrical

Yes ? No

3	2	<b>Water Efficiency</b>	5 Points
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			1	Credit 1.1	<b>Water Efficient Landscaping,</b> Reduce potable water for irrig by 50% through species, irrig, harvest, recycle wastewater, public non-potable H <sub>2</sub> O Project to utilize drought tolerant landscape and drip irrigation USU does not want to use drip irrigation. EP Credit: none	1	Landscape Architect
			1	Credit 1.2	<b>Water Efficient Landscaping,</b> No Potable Use or No Irrigation. use only harvest, recycled H <sub>2</sub> O, graywater, nonpotable OR no perm. irrig. landscaping Project to utilize drought tolerant landscape but USU does not want a temporary irrigation system. This point may not be achievable. EP Credit: none	1	Landscape Architect
			1	Credit 2	<b>Innovative Wastewater Technologies,</b> reduce potable water for sewage 50% by fixtures or nonpotable water OR treat 50% on-site (infiltrate or use) EP Credit: reduction potable to 100% OR treat 100% on-site. Utilize water-conserving fixtures, Bio-Swales and Detention Basins	1	Civil/Mechanical
			1	Credit 3.1	<b>Water Use Reduction,</b> 20% Reduction in potable water usage than baseline calculated for toilets, urinals, lavs, showers, kitchen sinks, inside the building. Project will utilize low water use fixtures and occupancy sensors This applies to water closets, urinals, lavs, showers and sinks (non-lab) EP Credit: see 3.2.	1	Mechanical
			1	Credit 3.2	<b>Water Use Reduction,</b> 30% Reduction in potable water usage than baseline calculated for toilets, urinals, lavs, showers, kitchen sinks, inside the building. Project will utilize low water use fixtures and occupancy sensors This applies to water closets, urinals, lavs, showers and sinks (non-lab) EP Credit: meet 40% OR demonstrate a different system.	1	Mechanical

Yes ? No

9	3	5	<b>Energy &amp; Atmosphere</b>	17 Points
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Y	Prereq 1	<b>Fundamental Commissioning of the Building Energy Systems</b> DFCM to hire a commissioning agent ASAP!	Req.	client
Y	Prereq 2	<b>Minimum Energy Performance,</b> meet listed provisions. Building to be designed to exceed minimum energy performance	Req.	mechanical
Y	Prereq 3	<b>Fundamental Refrigerant Management,</b> no use of CFC refrigerants. Project will not utilize CFC's	Req.	mechanical



1	Credit 5	<b>Measurement &amp; Verification</b> , implement a M&V to evaluate building/energy system performance for no less than one year of post-construction occupancy. EP Credit: none Client to determine if they want to include metering equipment and perform M&V 1 year post construction	1	mechanical/electrical
1	Credit 6	<b>Green Power</b> , provide 35% of power through a 2yr. renewable contract with an agency. EP Credit: none Client to determine if they want to purchase green power	1	client

Yes ? No

4	4	5	<b>Materials &amp; Resources</b>	13 Points
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Y	Prereq 1	<b>Storage &amp; Collection of Recyclables</b> , recycling collection area for paper, cardboard, glass, plastic, metal (minimum). Provide for recycling collection areas (interior and exterior)	Req.	architect/client
1	Credit 1.1	<b>Building Reuse</b> , Maintain 75% of Existing Walls, Floors & Roof. hazardous materials are excluded. EP Credit: none	1	
1	Credit 1.2	<b>Building Reuse</b> , Maintain 95% of Existing Walls, Floors & Roof hazardous materials are excluded. EP Credit: none	1	
1	Credit 1.3	<b>Building Reuse</b> , Maintain 50% of Interior Non-Structural Elements EP Credit: none	1	
1	Credit 2.1	<b>Construction Waste Management</b> , recycle or salvage 50% from disposal, develop plan to identify. soil and land debris do not count. CMGC to utilize waste recycling firm EP Credit: see below.	1	cmgc
1	Credit 2.2	<b>Construction Waste Management</b> , recycle or salvage 75% from disposal, develop plan to identify. soil and land debris do not count. CMGC to utilize waste recycling firm EP Credit: recycle or salvage 95%	1	cmgc
1	Credit 3.1	<b>Materials Reuse 5%</b> , use salvaged, refurbished, or reused material for 5% of the total value of materials on the project. equipment does not count. Architect to study options for utilizing salvaged materials EP Credit: see below.	1	architect
1	Credit 3.2	<b>Materials Reuse 10%</b> , use salvaged, refurbished, or reused material for 10% of the total value of materials on the project. equipment excluded. Architect to study options for utilizing salvaged materials EP Credit: use salvaged, refurbished, or reused material for 15%.	1	architect
1	Credit 4.1	<b>Recycled Content</b> , 10% (post-consumer + ½ pre-consumer), use materials equal to 10% value of materials. equipment excluded. Select and specify products that utilize recycled content. EP Credit: see below.	1	architect/cmgc
1	Credit 4.2	<b>Recycled Content</b> , 20% (post-consumer + ½ pre-consumer), use materials equal to 20% value of materials. equipment excluded. Select and specify products that utilize recycled content. EP Credit: value must equal 30%.	1	architect/cmgc
1	Credit 5.1	<b>Regional Materials</b> , 10% Extracted, Processed & Manufactured Regionally 10% material cost. portion breakdowns are possible. equipment excluded. Select and specify products produced and manufactured regionally. EP Credit: see below.	1	architect/cmgc
1	Credit 5.2	<b>Regional Materials</b> , 20% Extracted, Processed & Manufactured Regionally 20% material cost. portion breakdowns are possible. equipment excluded. Select and specify products produced and manufactured regionally. EP Credit: value must equal 40%.	1	architect/cmgc
1	Credit 6	<b>Rapidly Renewable Materials</b> , 10 yr harvest cycle. Constitute 2.5% of total building material value based on cost. Select and specify materials that are rapidly renewable such as bamboo, agrifiber linoleum, wheatboard, cork. EP Credit: value must equal 10%.	1	architect/cmgc
1	Credit 7	<b>Certified Wood</b> , use 50% wood material cost for FSC certified material. structural, dimensional, flooring, sheathing, doors, finishes, furniture possible. Select and specify certified wood products. EP Credit: wood material cost must equal 95%.	1	architect/cmgc

Yes ? No

13 2 Indoor Environmental Quality 15 Points

Y	Prereq 1	<b>Minimum IAQ Performance</b> , meet requirements System design to meet requirements	Req.	mechanical
Y	Prereq 2	<b>Environmental Tobacco Smoke (ETS) Control</b> , prohibit smoking and include exterior smoking area OR interior smoking with mechanical req. Utah Clean Air Act--Smoke Free Building	Req.	client
1	Credit 1	<b>Outdoor Air Delivery Monitoring</b> , monitor Co2, provide airflow to meet formula requirement. 1. Airflow measurement stations with feedback will be used for outdoor air intakes and will be controlled and monitored by the building DDC control system to provide required outside air ventilation. If the system fails to provide the required level of fresh air, a visible and audible alarm will be generated by the DDC system. 2. Conference rooms and other high density occupancy spaces (higher than 25 people per 100 sf) will have individual room CO2 sensors with feedback that are continually monitored by the DDC system, higher than desired CO2 levels will trigger increased ventilation by the variable air volume system. If system does not respond to maintain desired CO2 levels, an alarm will be generated by the DDC system. EP Credit: none	1	mechanical
1	Credit 2	<b>Increased Ventilation</b> , meet ventilation rates AND diagram and calculations OR multizone analytic model to predict airflow. Ventilation (per person) will be increased 30%. EP Credit: none	1	mechanical
1	Credit 3.1	<b>Construction IAQ Management Plan, During Construction</b> . meet SMACNA guidelines, protect material from moisture, filter air handlers. Filters will be provided on return air grille to keep ductwork clean while system is operated during construction. EP Credit: none	1	mechanical
1	Credit 3.2	<b>Construction IAQ Management Plan, Before Occupancy</b> , perform building air flush-out, OR IAQ testing, and meet contaminant maximum. Client to allow 16-20 day flush-out prior to occupancy. EP Credit: none	1	cmgc/mechanical
1	Credit 4.1	<b>Low-Emitting Materials</b> , Adhesives, Sealants and Aerosols. meet requirements listed in chart. Specify, select and utilize low voc adhesives, sealants and aerosols. EP Credit: none	1	architect/cmgc
1	Credit 4.2	<b>Low-Emitting Materials</b> , Paints & Coatings & Primers. meet VOC content limits for finishes, coating, stains, sealers, shellacs, etc. Specify, select and utilize low voc paints and coatings and primers. May be difficult to get this credit with the special coatings required in Vivarium and BSL3 EP Credit: none	1	architect/cmgc
1	Credit 4.3	<b>Low-Emitting Materials</b> , Carpet and pad Systems must meet CRI's Green Label Plus program. adhesive must meet COV limits. Specify, select and utilize carpet and pad systems that meet CRI's Green Label EP Credit: none	1	architect/cmgc
1	Credit 4.4	<b>Low-Emitting Materials</b> , Composite Wood & Agrifiber Products. no formaldehyde (manufactured or field applied). FF&E not included. Specify, select and install composite wood and agrifiber products that are formaldehyde free. EP Credit: none	1	architect/cmgc
1	Credit 5	<b>Indoor Chemical &amp; Pollutant Source Control</b> . provide entryway system with mats, AND exhaust hazardous areas, AND meet MERV of 13. 1. Design to provide for permanent entry way systems in the primary direction of travel to capture dirt and particulates. 2. Exhaust will be provided from the building general exhaust system to keep areas of pollutants sufficiently negative with respect to adjacent spaces. 3. Air handlers will have MERV 13 high efficiency filters which filter outside air and return air. EP Credit: none	1	architect/mechanical
1	Credit 6.1	<b>Controllability of Systems</b> , Lighting. individual controls for 90% of occupants AND lighting system controllability for shared multi-occupant spaces. Provide individual lighting controls for 90% (minimum) of the building occupants. Individual lighting controls will be provided for a minimum of 90% of the building occupants. In addition, lighting system controllability will be provided for shared occupant spaces to meet group needs and preferences. EP Credit: none	1	electrical

1			Credit 6.2	<b>Controllability of Systems, Thermal Comfort.</b> individual control for 50% of occupants (operable window possible). AND multi-occupant spaces. The building mechanical system will provide individual VAV boxes to almost all rooms. Each VAV box will have its own thermostat allowing individual control or adjustment. Small offices and other non-lab spaces will have operable windows. Individual labs will each have an adjustable VAV box and thermostat. EP Credit: none	1	mechanical
1			Credit 7.1	<b>Thermal Comfort, Design HVAC and envelope to meet standard.</b> demonstrate compliance. Each space will be designed to provide comfort levels as established by ASHRAE 55-2004 Thermal Comfort for human occupancy. EP Credit: none	1	mechanical/architect
1			Credit 7.2	<b>Thermal Comfort, Verification.</b> Occupant survey within 6-18 months after occupancy. Corrective plan is 20% of occupants are unsatisfied. An assessment of the building thermal comfort satisfaction will be performed within 6 to 18 months after occupancy. If it is determined that more than 20% of occupants are dissatisfied with thermal comfort, a plan for corrective action will be established and implemented. EP Credit: none	1	mechanical
1			Credit 8.1	<b>Daylight &amp; Views, Daylight 75% of Spaces.</b> meet glazing factor calcs OR simulation model OR measurements of reg occupied spaces. contain glare. Provide windows/views at occupied spaces. EP Credit: achieve day lighting of 95% of regularly occupied spaces.	1	architect
1			Credit 8.2	<b>Daylight &amp; Views, Views for 90% of Spaces.</b> direct line of sight for 90% of regularly occupied spaces. offices and open areas possible. Provide windows/views at occupied spaces. EP Credit: point possible, but no prescribed requirements. petition for point.	1	architect

Yes ? No

1	4	<b>Innovation &amp; Design Process</b>			5 Points
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1			Credit 1.1	<b>Innovation in Design:</b> Fume Hood Commissioning	1	Cx or owner
1			Credit 1.2	<b>Innovation in Design:</b> Provide Specific Title Reduction in processed water usage	1	mechanical
1			Credit 1.3	<b>Innovation in Design:</b> IEQ Credit 8.1: Daylight and Views for 95% of occupied spaces MR Credit 7: Use 95% FSC Wood	1	architect
1			Credit 1.4	<b>Innovation in Design:</b> sophisticated lighting control system A sophisticated lighting control system will be used to control the interior and exterior lighting. This system will employ occupancy sensors, light level sensors, and other methods to reduce the energy used by light fixtures during normal hours of operation.	1	electrical
1			Credit 2	<b>LEED® Accredited Professional.</b> at least 1 accredited principal involved. ajc to provide LEED AP (Jill)	1	architect

Yes ? No

40	15	14	<b>Project Totals (pre-certification estimates)</b>	69 Points
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Certified 26-32 points Silver 33-38 points Gold 39-51 points Platinum 52-69 points



**GEOTECHNICAL ENGINEERING REPORT  
USU USTAR RESEARCH INSTITUTE  
1600 NORTH 600 EAST  
LOGAN, UTAH**

Submitted To:

**Ms. Jill Jones  
AJC Architects  
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Salt Lake City, UT 84105**

Submitted By:

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**February 1, 2008  
Project No. 7-817-005223**





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February 1, 2008

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Re: **Geotechnical Study Report**  
**USU USTAR Research Institute**  
**1600 North 600 East**  
**Logan, Utah**  
**AMEC Job No. 7-817-005223**

## **1. INTRODUCTION**

### **1.1 Objectives and Scope**

This report presents the results of our geotechnical study for the proposed Utah State University USTAR Research Institute building. The location of the planned project is approximately 1600 North 600 East Street in Logan, Utah. The approximate location of the site is shown on Figure 1, Vicinity Map. The objectives of this investigation were to explore and evaluate subsurface materials and conditions and develop recommendations for the design and construction of the new building. The studies were conducted in accordance with the scope of work outlined in AMEC's proposal PL07-086 dated October 17, 2007 and a scope change letter, dated December 4, 2007. AMEC's scope of work included a site reconnaissance, field explorations, laboratory testing, engineering analyses, and report preparation.

## **2. PROJECT DESCRIPTION**

We understand the proposed construction will consist of a three story above grade steel and concrete building. The building will be "L" shaped and will have a footprint of approximately 33,000 sf. We anticipate maximum column loads to be on the order of 750 to 1,000 kips. Areas surrounding the building will be landscaped and parking areas will be included. We anticipate that traffic in the parking areas will consist of a light volume of automobiles and light trucks, and occasional medium-weight trucks.

## **3. SITE DESCRIPTION**

### **3.1 Site Conditions**

The majority of the project site is situated on land that has been primarily used for agriculture. There are several existing structures such as stables and hay covers on the east of the site, which will be removed for the project, and an above grade storm water detention basin is located in the northwest corner of the site. The site is located within the Utah State University Research Park and is bordered on the north by 1600 North, on the south by buildings and pastures, on the east by an adjacent Utah State research building, and on the east by stables

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and hay covers. The site is relatively flat with a slope down to the west. The approximate elevation of the site is 4,580 feet above sea level.

### **3.2 Geology**

The project site is located in Cache Valley Utah near the eastern edge of the Basin and Range physiographic province, which extends from the Sierra Nevada Mountains to the Wasatch Mountains. The Basin and Range province is characterized by north-trending mountain ranges and intervening sediment-filled valleys. The mountain ranges are bounded by high-angle normal faults formed in response to regional extension of the earth's crust. A geologic map prepared by Dover, 1995<sup>1</sup> indicates that the site is underlain by alluvial and lacustrine deposits placed during the Provo Stage of Lake Bonneville. Soils consists of silt, clay, sand, and gravel to depths of approximately 50 to 75 feet.

## **4. FIELD EXPLORATIONS & LABORATORY TESTING**

### **4.1 Field Explorations**

Subsurface materials and conditions at the project site were investigated on October 25, 2007 with 8 borings designated B-1 through B-8 and on January 18, 2008 with 2 cone penetration tests designated CPT-1 and CPT-2. The approximate locations of the borings and cones are shown on Figure 2, Site Plan. All field operations were observed by a technician provided by our firm, who maintained a detailed log of the materials and conditions encountered in each bore hole and directed the sampling and testing operations. Additional information on the field exploration is presented in Appendix A, Field Explorations-Borings and Appendix C, Cone Penetration Testing.

### **4.2 Laboratory Testing**

Laboratory testing consisted of natural moisture content, gradations, fines washes, Atterberg limits, consolidation, and corrosion testing. Details concerning the tests and the laboratory results can be found in Appendix B, Laboratory Testing.

## **5. SUBSURFACE CONDITIONS**

### **5.1 Fill and Disturbed Soil Conditions**

Subsurface investigations encountered agriculturally disturbed surface soils over the majority of the site extending down approximately 1 foot below grade. In addition to these disturbed soils, 3 feet of fill was present over the eastern part of the site. The top of fill is 3 feet above adjacent agricultural land and appears to have been placed during the construction of adjacent structures. This fill contains debris such as concrete blocks. At the northeast corner, there is a 6-foot high berm, which encloses a storm water detention area.

---

<sup>1</sup> Dover, J.H.; 1995; Geologic Map of the Logan 30' x 60' Quadrangle, Cache and Rich Counties, and Lincoln and Uinta Counties, Wyoming; U.S. Geological Survey Miscellaneous Publication MAP I-2210, Scale 1:100,000

## 5.2 Geotechnical Profile

Logs of the borings B-1 through B-8 are presented on Figures 3A through 3H, Log of Borings. The terms used to describe the soils disclosed by the borings are defined on Figure 4, Soil Classification Chart & Legend. Cone Penetration Results can be found in Appendix C.

The native soil profile is comprised of surficial lean clay underlain by silty sand with gravel and layered silts and clays. Cone penetration tests indicate upper clay is underlain by a 5-foot layer of sand and gravel followed by 20 to 30 feet of inter-layered silt, silty clay, and silty sand. Underlying this layer of silt and sand is 7 to 10 feet layer of clay, followed by at least a 12-foot layer of dense sand and gravel. This layer of sand and gravel was encountered at 40 feet in CPT-1 and 48 feet in CPT-2. Underlying this dense layer of sand and gravel is silt and clay followed by inter-layered sand and silt.

Liquid limits on tested samples typically ranged from 23 to 35, and plasticity indices ranged from 3 to 14. One sample from boring B-3 at a depth of 14 feet was non-plastic. Dry densities ranged from 106.6 to 109.5 pcf with moisture contents ranging from 20.3 to 22.8 percent.

## 5.3 Groundwater

At the time of the boring investigation, groundwater was encountered at depths ranging from 6.0 to 8.5 feet below grade in borings B-2 and B-8. Subsequent measurements more than a week later indicate groundwater at depths ranging from 7.7 to 9.5 feet. Additionally, equilibrium pore pressures measured in sand layers at 40 feet in CPT-1 and 52 feet in CPT-2 indicate pressures equivalent to a water table at approximately 20 feet. Fluctuations in groundwater and perched groundwater do occur due to variations in precipitation, runoff, water levels in nearby ditches, drainages and other factors. Longer-term groundwater fluctuations should be anticipated with the highest seasonal levels generally occurring during the late spring and summer months.

## 6. CONCLUSIONS AND RECOMMENDATIONS

### 6.1 General

The site is generally unfavorable to the support of the proposed building on shallow foundations due to heavy building loads. It is anticipated that these heavy loads will require the use of alternative foundation systems such as a mat foundation, rammed aggregate piers, driven piles, or auger cast piles.

For structures associated with the project where shallow spread footings can be used, it is recommended that the footings be established upon structural fill extending down to suitable undisturbed native soils. Flatwork (inside and outside) may be established upon properly prepared native soils, and/or upon structural fill extending down to suitable undisturbed native soils.

Undocumented fills are often poorly compacted and contain deleterious material within their matrix. It is our experience that undocumented fills have an increased risk of total and differential settlements, which can lead to poor performance of foundations and pavements. Existing undocumented fill in the east of the site should be completely removed from beneath the building footprint and pavement areas. If existing site fill meets structural fill requirements, it

may be reused on site as structural fill. Excavated native soils may be placed in landscaped areas, but should not be used as structural fill.

Agriculturally disturbed soil must be improved through scarification and re-compaction or removed entirely from below structures and parking areas. Compaction of these soils should meet the same standards as the compaction standards for structural fill.

Fine grained soils encountered on site are prone to moisture sensitivity and are easily disturbed and softened by construction equipment.

Considering the depth of shallow footings with respect to the water table, the water table could be an issue during the construction of the project. Soils at the bottom of footing excavations may be soft and wet and easily disturbed. Although we do not anticipate shallow footings or mat foundations to be below the water table, dewatering and soil stabilization may be necessary, if these conditions occur.

Liquefaction settlement is a concern with the site. Measures can be taken to improve structural connections, improve site soils, or use deep foundations as dictated by the risk the client is willing to accept. Mat foundations can cope with additional uniform settlements, but may have some problems if significant differential settlement occurs. Rammed aggregate piers can reduce the overall liquefaction settlement, while driven piers and auger cast piles can bypass liquefiable layers to bear on deep stable soils. All alternative foundation systems offer improvements over the basic shallow spread footing foundation with respect to liquefaction settlement, but the selection of a foundation system is related to acceptable cost and the risk that the client is willing to accept.

If grades are to be raised more than approximately 3 feet above existing grade, our office should be contacted for further engineering analyses. Thick areal fill can often induce significant settlement over time as underlying layers of soft saturated clays and silts consolidate under the weight of the fill. Further analysis will be needed to determine settlement and its affects on any structure if fills exceed 3 feet.

Subgrade pavement characteristics indicate fair support characteristics. Pavement sections include 4 inches of base course over 8 inches of granular borrow materials as subbase improvement. Asphalt thickness options range from 3 to 4 inches of asphaltic concrete, depending on expected traffic loads.

An alternative to shallow foundations is to establish the foundation upon a rammed aggregate pier. Rammed aggregate piers are a proprietary foundation system developed by the Geopier Foundation Company (Geopier<sup>®</sup>). They are constructed by drilling a 24 or 30 inch diameter hole, removing a volume of soil, and then building a bottom bulb of clean, open-graded stone using beveled, high-energy tamper. The Geopier shaft is constructed on top of the bottom bulb using well-graded highway base course stone placed in lifts (12-inches compacted thickness). Geopier shaft lengths typically range between 8 and 25-feet as measured from the footing subgrade. The result of construction is a reinforced zone of soil directly under footings that allows for the construction of shallow spread footings proportioned for a relatively high bearing pressure.



Geopier-reinforced soils improve the subgrade below conventional spread footings, reduce the compressibility of underlying soil, allow for a higher bearing pressure to be used for design, and can often reduce liquefaction settlement potential. If serious consideration is given to a rammed aggregate pier foundation, then our office should be contacted for additional information after which Geopiers will need to be contacted to offer preliminary design recommendations.

Our analysis indicates driven piles or auger cast piles can bear upon a layer of sand and gravel at approximately 40 to 50 feet below grade.

Considering above factors, several foundation alternatives are considered feasible for the research building, depending on the cost and risk the client is willing to accept. A summary of foundation alternatives along with the potential advantages and disadvantages is presented in the following table.

Foundation Type	Advantages	Disadvantages
Mat Foundations	<ul style="list-style-type: none"> <li>• Conventional construction</li> <li>• No significant equipment mobilization other than for earthwork</li> <li>• The prepared pad can readily accommodate variations in equipment layouts and future foundations</li> </ul>	<ul style="list-style-type: none"> <li>• High concrete requirement for thick mats.</li> <li>• Structural fill must be imported to the site – should be granular soils</li> <li>• Excavations within two feet of the groundwater table may encounter soft, saturated subgrade conditions – careful excavation and placement will be required.</li> <li>• May be prone to additional settlement and differential settlement from liquefaction</li> </ul>
Rammed Aggregate Pier	<ul style="list-style-type: none"> <li>• Will provide higher bearing capacities for conventional foundation designs</li> <li>• Helps densify surrounding soils as rock lifts are rammed into place.</li> <li>• Can help reduce the potential for liquefaction seismic settlements.</li> </ul>	<ul style="list-style-type: none"> <li>• Moderately expensive</li> <li>• Must mobilize specialty contractor</li> <li>• Expensive for lightly loaded structures</li> </ul>
Auger-cast piles	<ul style="list-style-type: none"> <li>• Relatively high compressive capacities</li> <li>• Less vibrations than driven piles</li> <li>• Can install to significant depths to reduce effects from seismic settlements.</li> </ul>	<ul style="list-style-type: none"> <li>• Moderately expensive</li> <li>• Must mobilize specialty contractor</li> <li>• Expensive for lightly loaded structures</li> <li>• It is difficult to verify proper installation.</li> <li>• Requires large amounts of concrete grout</li> </ul>
Steel Pipe Piles	<ul style="list-style-type: none"> <li>• Relatively high compressive and uplift capacities</li> <li>• Can install to significant depths to reduce effects of seismic settlements</li> <li>• Helps densify soils as they are being driven, which can help with preventing liquefaction events.</li> </ul>	<ul style="list-style-type: none"> <li>• Moderately expensive</li> <li>• Must mobilize specialty contractor</li> <li>• Expensive for lightly loaded structures</li> <li>• It produces significant vibrations that can affect nearby structures.</li> <li>• Susceptible to corrosion from soluble chlorides.</li> </ul>

## **6.2 Earthwork**

### **6.2.1 Site Preparation**

Preparation of the site should consist of stripping all fill, debris, vegetation, frozen soils, loose soils, and disturbed soils from the area. Any foundation elements from prior structures should be removed entirely and replaced with structural fill.

For prior agricultural areas, stripping should extend down at least 6 inches below buildings and parking areas. After stripping is complete, the site soils should be scarified down at least 8 inches, moisture conditioned, and re-compacted to the same compaction standard as structural fill. As an alternative to scarification and re-compaction, stripping should extend down to 14 inches below existing grade, after which grades can be raised back up with structural fill. Upon completion of site preparation, the exposed subgrade should be observed by a qualified representative of the geotechnical engineer to assess the result of the stripping and scarification processes.

For areas with several feet of fill, the fill should be entirely removed along with the upper 12 inches of underlying soils. Berm soils associated with the detention area will also need to be removed down to native undisturbed soils.

If pavement areas are not paved closely after preparation of the subgrade, they should be proof-rolled with a heavy pneumatic-tire roller or equivalent rubber-tire construction equipment to verify the subgrade has not been weakened by ponding and infiltration of precipitation. Any soft areas identified by the proof rolling should be removed down to firm native soil or a maximum of two feet below grade and replaced with structural fill.

The site soils are predominately fine-grained. If the fine-grained soil is exposed to significant precipitation, snow melt or other sources of water, it may become slippery and soft, and disturbed by construction traffic. Disturbed and softened soils are unsuitable for support of foundations and pavement and should be removed and replaced with granular structural fill in building and pavement areas. On site soil that may need to be used for backfill or grading fill may become too wet to achieve proper compaction without drying.

The contractor should be aware of these potential difficulties. The risk of problems can be reduced by performing earthwork activities during warmer months. Other precautions may be desirable such as placing gravel working pads, temporary grading to channel run off away from roads, stockpiles and excavations, and covering the stockpile soils.

### **6.2.2 Excavations**

Temporary construction excavations in soils not exceeding 4 feet in depth may be constructed with near-vertical side slopes. Temporary excavation slopes up to 10 feet in height and above the water table may be constructed no steeper than one horizontal to one vertical (1H:1V). If excessive sloughing occurs, the excavation slope should be flattened. Excavations encountering the groundwater table or perched groundwater will require much flatter slopes, shoring and bracing, and/or dewatering. Excavation safety and dewatering is the responsibility of the contractor. All excavations should be constructed in conformance with Federal, State and local regulations. All excavations must be inspected periodically by qualified personnel. If any signs of instability are noted, immediate remedial action must be initiated.



### 6.2.3 Fill Requirements

Fill material should be free from debris, vegetation, roots, other unsuitable material, frozen material, and excess moisture. Structural fill should also conform to the gradation and plasticity requirements shown in the following table, Fill Material Requirements.

#### FILL MATERIAL REQUIREMENTS

Fill Name	Type	Application	Max Size in.	Max Percent Passing			Max Liquid Limit	Max Plasticity Index
				No. 4	No. 10	No. 200		
Structural	S1	Below structural elements	4	-	60	30	35	15
Upper Slab	UF	Immediately below slabs, upper 4 inches	2		25	5	-	-
Free Draining	FD	Drainage layers of drainage backfill	4		5	2	-	-

Existing site fill may be reused as structural site grading fill if it meets the requirements of structural fill.

### 6.2.4 Fill Placement and Compaction Requirements

Structural fill and floor slab fill should be compacted to at least 95 percent of the maximum dry density at a moisture content within about 3 percent of optimum as determined by ASTM D-1557 (modified Proctor). Structural fill should extend out from the edge of footings a distance equal to half the depth of the fills. For example, if the structural fill depth is 4 feet, the fill should extend out at least 2 feet past the outside edge of the footing.

Fill should be placed and compacted in lifts. The lift thickness should be appropriate for the type of equipment being used so that the entire lift thickness is compacted to the required level. With heavy compaction equipment, we recommend that loose lift thickness be limited to a maximum of 12 inches unless specific arrangements are made with the testing entity to verify compaction in thicker lifts. Fill compaction should be tested frequently. The contractor should have sufficient testing early to verify that compaction methods are adequate to meet compaction requirements and regular additional testing to demonstrate consistent compaction.

Where free draining fill is used to collect or drain water, a filter fabric capable of preventing the migration of fines into the free draining fill should be placed between the fill and native soil on all sides.

Fill in landscaped areas should be compacted to a minimum of 85 percent of the maximum dry density as determined by ASTM D-1557.

If pumping of the subgrade occurs when compacting fill, compaction should immediately stop and the geotechnical engineer consulted for appropriate action.

Excess compaction of backfill behind walls can cause significant stresses against walls and should be avoided. The use of moderate to heavy equipment, especially compactors, near walls can also cause significant stresses against walls and should be avoided. Such equipment should not operate within a distance equal to the height of the wall to minimize the potential for excessive lateral pressure. Compaction close to the walls should be accomplished using hand-operated vibratory plate compactors or small trench compactors.

#### **6.2.5 Fill Placement Considerations**

In general, we recommend that the contractor be left to determine the most cost effective and practical means to place and compact fill. However, the following information may be helpful.

When performing compaction testing, the measured degree of compaction is only meaningful if gradation of the soil tested in the field corresponds to the gradation of the samples tested in the lab from which the maximum dry density and optimum moisture was determined. The fill material should be sampled and tested in the laboratory at a frequency appropriate for the variability of the fill. For highly variable soils this can be extremely difficult to ensure and there is a significant risk that field testing may not be representative. Additional measures such as limiting lift thickness may be advised.

The maximum particle size should generally be limited to  $\frac{1}{2}$  of the compacted lift thickness. Oversize pieces at the lift surface can carry the weight of the compaction equipment resulting in a poorly compacted zone around the oversized particle. Over a relatively firm subgrade, large pieces extending above the surface of the fill can result in a concentrated foundation load and/or thin section of footing.

All compaction equipment has a limited depth of influence. For hand operated equipment such as vibratory plate or "jumping jack" compactors, we recommend that the compacted lift thickness be limited to 4 inches. For small "trench" rollers, moderate sized roller compactors and larger roller compactors we recommend that compacted lift thickness be limited to 6, 8 and 12 inches unless it can be demonstrated that the recommended compaction can be achieved throughout the lift with thicker lifts.

#### **6.2.6 Utility Trenches**

It should be noted that utility trench excavations have the potential to degrade the engineering properties of the adjacent fill materials. Utility trench walls that are allowed to move laterally can lead to reduced bearing capacity and increased settlement of adjacent structural elements and overlying slabs. Backfill for utility trenches is as important as the original preparation or structural fill placed to support either a foundation or slab. Therefore, it is imperative that the backfill for utility trenches be placed to meet the project specifications for the structural fill of this project.

Most utility companies and municipalities are now requiring that AASHTO Type A-1 or A-1-a soil (granular soil with less than less than 25 or 15 percent fines, respectively) be used as backfill over utilities. These organizations are also requiring that in public roadways the backfill over major utilities be compacted over the full depth of fill to at least 96 percent of the maximum dry density as determined by the AASHTO T-180 (ASTM D-1557) method of compaction. We



recommend that as the major utilities continue onto the site that these compaction specifications are followed.

### 6.2.7 Finished Grading

Finish grading should be established to convey water away from foundation walls and backfill and to prevent ponding. Down spouts should discharge away from foundation backfill. Irrigation above or near any wall backfill should be minimized. We recommend that landscaped surfaces adjacent to buildings be sloped down away from the buildings at a minimum slope of 6 inches down in the first 10 feet (5 percent) away from buildings. Concrete flatwork or pavement adjacent to buildings should slope down away from the buildings at a slope of 1 percent or more.

## 6.3 Foundations

### 6.3.1 Design Criteria

Foundation support for the proposed project can be provided by conventional wall and column-type spread footings provided resulting capacities are sufficient for the required loads. If loads exceed the provided soil capacities, other foundation may be necessary. The following table presents general options for footing design:

#### DESIGN CRITERIA

Footing Location	Foundation Type	Bearing Soils	Foundation Depth (feet)	Allowable Bearing Capacity (psf)	Max Width (feet)	
					Square Column	Wall
At Grade Level	Spread Foundations	Min. 2' Structural Fill <sup>2</sup>	1.0 <sup>1</sup>	2,500	12	5
		Min 4' Structural Fill <sup>2</sup>	2.5 <sup>1</sup>	3,000	12	5

**Notes:**

1. Bottom of footing elevation below finished floor. For exterior footings, footings should be at the depth listed in this table, or 2.5' below exterior grade, whichever is deeper.
2. Footings should be founded upon properly compacted structural fill, which has been placed on undisturbed native soil.

In addition to the above table, a footing bearing graph is provided in Figure 5 for square footings underlain by 4 feet of granular structural fill. Selected footings should have widths and bearing pressures below both the allowable bearing pressure line and the 1-inch settlement line. This graph allows for flexibility and optimization of the design. Footing depths are assumed to be at least 2.5 feet below grade for this graph (Figure 5).

Strip (wall) footings should have a minimum footing width of 1½ feet, and square footings should have a minimum footing width of 2 feet in order to maintain bearing capacity. The allowable bearing pressure applies to the total of real loads, i.e., dead load plus frequently and/or permanently applied live loads. The allowable bearing pressure can be increased by one-third for the total of all loads: dead, live, and wind or seismic.

Soft, loose, or otherwise unsuitable soils, if encountered at footing depth, should be removed down to firm subgrade material and replaced with granular structural fill or a lean concrete flowable fill.

### **6.3.2 Settlements**

Settlement of foundations designed and installed in accordance with the above recommendations should not exceed 1 inch.

### **6.3.3 Installation**

Under no circumstances should the footings be installed upon loose or disturbed soil, sod, rubbish, construction debris, topsoil, frozen soil, non-engineered fill, highly expansive clays, other deleterious materials, or within ponded water. If there are unsuitable conditions encountered, the soils must be completely removed and replaced with compacted granular structural fill. If granular soils become loose or disturbed, they must be properly re-compacted before the footings are poured. The width of replacement fill below footings should be equal to the width of the footing plus ½ foot for each foot of fill thickness on either side of the footing. For example, if the width of the footing is 2 feet and the thickness of the structural fill beneath the footing is 2 feet, the width of the structural fill at the base of the footing excavation would be a total of 4 feet.

### **6.3.4 Lateral Resistance**

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, ultimate coefficient of friction values of 0.35 and 0.45 may be utilized for footings established on silt or on granular structural fill, respectively.

Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 300 pounds per cubic foot

(pcf). Below the water table, this granular soil should be considered equivalent to a fluid with a density of 150 pcf.

A combination of passive earth resistance and friction may be utilized provided that the friction component of the total is divided by 1.5.

## **6.4 Mat Foundations**

### **6.4.1 Mat Design**

The site is generally favorable to supporting the proposed building on mat foundations. A  $k_1$  modulus of subgrade reaction of 100 pci can be used for design. This value represents an

estimate of the modulus of subgrade reaction for a 1 x 1 plate at the site. The value should be adjusted for the larger areas associated with mats using the following expression for cohesive and cohesionless soil:

Modulus of Subgrade Reaction,  $k_s = \left(\frac{k_1}{B}\right)$  for Cohesive Soil

$$k_s = k_1 \left(\frac{B+1}{2B}\right)^2 \text{ for Cohesionless Soil}$$

Where:  $k_s$  = Coefficient of Vertical Subgrade Reaction for Loaded Area  
 $k_1$  = Coefficient of Vertical Subgrade Reaction for 1x1 square foot area  
 $B$  = Width of Area Loaded, in feet

#### 6.4.2 Mat Settlements

Settlements of mat foundations should be approximately less than 1.5 inches, using a maximum net allowable bearing pressure of 650 psf for the mat. Settlement will occur throughout the construction process as soils are gradually loaded. Typically more than 50 percent of the settlement occurs during the construction phase of the project. Differential settlements should be approximately ½ inch, or less, between the corner of the mat and the center of the mat.

#### 6.4.3 Mat Recommendations

Mats should be established on native soils or structural fill extending to suitable native soils. It is recommended that mat foundations are underlain by a minimum thickness of 6-inches of "free-draining" granular material, such as 1-inch to ¾-inch crushed rock. Base course should be installed in a single lift and compacted until well keyed.

Under no circumstance should mats be established upon loose or disturbed soils, sod, rubbish, construction debris, non-engineered fill, other deleterious materials, expansive soils, frozen soils, or within ponded water.

### 6.5 Pipe Pile Foundation

#### 6.5.1 Design Criteria

We have evaluated the static compressive capacities for 12.75- and 16.0-inch diameter, closed end steel pipe piles, using data collected primarily from cone penetration tests. Boring logs and laboratory testing were also referenced in pile capacity calculations. Piles will rely primarily on a dense layer of sand and gravel for end bearing at approximately 40 to 50 feet below grade; the majority of the pile capacity will result from tip resistance within these soils. A factor of safety of 2.25 was applied against ultimate soil failure under real load conditions, a factor of safety of 1.2 was applied for a post-liquefaction condition. The calculated ultimate vertical capacities are based on an installed center-to-center spacing equal to or greater than three times the pile diameter. Piles must be spaced no closer than three pile diameters, center to center. Piles driven at a closer spacing will require reduction in their axial lateral capacity due to pile group effects.

Soils that experience liquefaction during a major earthquake are capable of generating approximately 2 to 3 inches of additional settlement at the site. This settlement will produce additional loading upon piles in the form of negative skin friction as the soils around the pile settle. We estimate that the depth of down-drag to be approximately 25 feet. Piles should bear upon the layer of dense sand and gravel encountered at a depth of 40 to 50 feet below grade. Therefore pile should be driven until they encounter this dense layer at a minimum of 40 feet below grade. Piles supported by this dense sand layer can be designed with an allowable pile capacity of 65 and 100 kips for 12.75 and 16-inch piles, respectively.

### **6.5.2 Installation**

Driving through the lacustrine soils should be relatively straightforward. Diesel and hydraulic hammers are presently utilized in the northern Utah area. Based on Wave Equation Analysis Program (WEAP) analysis, we anticipate that hammers used at the site should have a striking energy in the range of 39,000 to 52,000 foot-pounds per blow for 12.75-inch pipe piles and between 42,000 to 76,000 foot-pounds per blow for 16-inch pipe piles. Piles should have a yield strength of 45 ksi. Diesel Hammers should use a pile cushion with steel piles to reduce induced stress.

The process of pile installation can cause significant vibrations in nearby facilities, sometimes causing damage. Monitoring of nearby buildings is advised.

### **6.5.3 Pile Settlements**

Ultimate settlement of pile groups designed and installed in accordance with the above recommendations and supporting the maximum anticipated real loads previously described are expected to be less than approximately one-half of an inch with differential settlements between adjacent pile caps on the order of one-half the total settlement. Settlements should occur rapidly as the foundation is being loaded. We estimate approximately 60 percent of the ultimate settlements to occur during construction.

### **6.5.4 Pile Lateral Capacities**

The response of piles to potential applied lateral loads was analyzed using LPILE Plus for Windows, Version 5.0. Piles with diameters of 12.75 and 16 inches were each analyzed for top of pile deflections of approximately  $\frac{1}{4}$ ,  $\frac{1}{2}$ , and 1 inch. A fixed head condition was assumed for the analysis. The lateral capacities of concrete filled pipe piles do not differ significantly from empty piles; therefore, piles were assumed to be 50-foot, empty, close-ended, pipe piles.

The native soil profile representative of the site was used in the analyses. The soil design parameters used in the LPILE analysis, are summarized in the following table.



### Soil Profile for Pile Lateral Resistance

Soil/Bedrock Type	Depth Interval (ft)	Unit Weight (pcf)	Cohesion / Compressive Strength (psi)	Friction Angle (degrees)	$\epsilon_{50}$ / Soil Modulus (lbs/inch)	k-Value (lb/inch <sup>3</sup> )
Stiff Clay	0 to 7	110	10.42	--	.005	--
Sand and Gravel	7 to 11	75 <sup>1</sup>	--	33	--	90
Silt and Sandy Silt	11 to 35	71 <sup>1</sup>	3.47	29	.010	50
Soft Lean Clay	35 to 45	60 <sup>1</sup>	11.11	--	.020	--
Sand and Gravel	45 to 55	75 <sup>1</sup>	--	35	--	125

<sup>1</sup> Effective unit weight below groundwater level

The following deflections at the top of the piles, 12 inches above grade, and the indicated lateral resistances are tabulated below:

### Estimated Pile Lateral Resistance

Top Deflection (inches)	Shear Force (kips)	
	12.75-in dia.	16.0-in dia.
0.25	12	17.5
0.5	17	24
1.0	24	36

#### 6.5.5 Pile Uplift Capacities

The uplift pile capacities for the 12.75 and 16 inch pile are 45 and 60 kips, respectively. The uplift capacity includes a factor of safety of 2.25 against ultimate soil failure under real load conditions. The uplift capacities do not include the weight of the piles. The design uplift capacity of the pile group should be the capacity of a single pile times the number of piles.

All pile capacities presented in this report relate to geotechnical capacities only. Structural capacities are determined by others.

#### 6.5.6 Driving Observation

Driving of the piles should be supervised on a continuous basis. The project geotechnical engineer should review all driving data on a day-to-day basis. Pile installation must be monitored dynamically using a Pile Driving Analyzer (PDA) on 5 percent of all the piles. This will provide verification of the pile capacities during and after driving. For each pile tested, if the capacity can not be verified based on the initial drive test, a re-strike test must be performed. Case Pile Wave Analysis Program (CAPWAP) should be performed in order to give pile capacity and an estimate of the distribution of resistance along the pile and at the toe.

## **6.6 Auger Cast Pile Foundation**

### **6.6.1 Design Criteria**

We have evaluated the static compressive capacities for 1.5-foot diameter auger cast piles. Capacities have been developed using measured cone skin and tip resistance. A factor of safety of 2.5 was applied against ultimate soil failure under real load conditions, a factor of safety of 1.2 was applied for a post-liquefaction condition. The calculated ultimate vertical capacities are based on an installed center-to-center spacing equal to or greater than three times the auger-cast pile diameter. Auger cast piles must be spaced no closer than three pile diameters, center to center. Piles drilled at a closer spacing will require reduction in their axial lateral capacity due to pile group effects.

Auger-cast piles will also experience 25 feet of soil down-drag after a liquefaction event. Analyses have taken into account the resulting negative skin friction. There should be a minimum tip elevation of 40 feet for the auger cast piles. The allowable capacity for an 18-inch auger cast pile embedded into the dense sand or gravel layer at 40 to 50 feet below grade is 100 kips.

### **6.6.2 Auger Cast Pile Installation**

Drilling through the upper layer of the lacustrine and alluvial soils should be relatively straightforward. However, drilling should become more difficult as the dense layer of sand and gravel is encountered. During installation, it is imperative that the auger end within dense sand or gravel at a minimum depth of 40 feet below grade. Maintaining a constant head of grout within the auger stems is important to the proper installation of auger cast piles. It will help to keep the hole open and will help to keep debris and soil from being incorporated into the column.

### **6.6.3 Auger Cast Pile Settlements**

Ultimate settlement of pile groups designed and installed in accordance with the above recommendations and supporting the maximum anticipated real loads previously described are expected to be less than approximately one-half of an inch with differential settlements between adjacent pile caps on the order of one-half the total settlement. Settlements should occur rapidly as the foundation is being loaded. We estimate approximately 60 percent of the ultimate settlements to occur during construction.

### **6.6.4 Auger Cast Pile Lateral Capacities**

The response of piles to potential applied lateral loads was analyzed using LPILE Plus for Windows, Version 5.0. A pile with a diameter of 1.5 feet was analyzed for top of pile deflections of approximately  $\frac{1}{4}$ ,  $\frac{1}{2}$ , and 1 inch. A fixed head condition was assumed for the lateral analysis, and the piles were assumed to be 40-foot, (4000 psi) concrete shafts.

The native soil profile representative of the site was used in the analyses. The soil/bedrock design parameters used in the LPILE analysis, are the same as used in section 6.5.4 Pile Lateral Capacities.

The following deflections at the top of the piles, 12 inches above grade, and the indicated lateral resistances are tabulated below:

#### Estimated Auger Cast Pile Lateral Resistance

Top Deflection (inches)	Shear Force (kips)
	1.5 ft dia.
0.25	17.5
0.5	25
1.0	36

#### 6.6.5 Auger Cast Pile Uplift Capacities

The design value for the allowable uplift capacity of auger cast piles installed to a minimum of 40 feet below grade is 30 kips. The uplift capacity includes a factor of safety of 2.5 against ultimate soil failure under real load conditions. The uplift capacities do include the weight of the piles. The design uplift capacity of pile groups should be the capacity of a single pile times the number of piles.

All pile capacities presented in this report relate to geotechnical capacities only. Structural capacities are determined by others.

#### 6.6.6 Auger Cast Pile Observation

The drilling of piles should be supervised on a continuous basis. The volume of grout pumped into the holes per depth should be tracked in order to help verify proper installation of the pile. During grouting, the bottom of the auger should remain below the grout surface until the pile grout has reached the surface. The project geotechnical engineer should be allowed to review all data on a day-to-day basis. We recommend that pile installation be tested by means of a full scale load test.

#### 6.7 Lateral Earth Pressures

Design lateral earth pressures for embedded walls depend on the type of construction, i.e., the ability of the wall to yield. The two possible conditions regarding the ability of the wall to yield include the at-rest and the active earth pressure cases. The at-rest earth pressure case applies to walls that are relatively rigid and laterally supported at top and bottom and therefore is unable to yield. The

active earth pressure case applies to walls that are capable of yielding slightly away from the backfill by either sliding or rotating about the base. A conventional cantilevered retaining wall is an example of a wall that develops the active earth pressure case by yielding.

Yielding and non-yielding walls can be designed using a lateral earth pressure based on an equivalent fluid having a unit weight of 35 and 55 pcf, respectively. The ground surface should be sloped down at a minimum of 5 percent away from the wall.

### **6.7.1 Seismic Lateral Earth Pressures**

Lateral earth pressure resulting from seismic loading can be calculated based on an equivalent fluid weight of 15 and 30 pounds per cubic foot for active and at-rest cases, respectively. This is assuming an even grade or negative slope at the top of the backfilled wall. For seismic loading the pressure should be inverted increasing from 0 at the base of the wall to a maximum at the top of the wall.

### **6.8 Floor Support**

Floor slabs may be established upon suitable native soils and/or upon structural fill extending to suitable native soils. Slabs may be established upon properly prepared existing near-surface soil, suitable undisturbed natural soils, and/or upon structural fills extending down to suitable natural soils or properly prepared existing near-surface soils. It is recommended that floor slabs are underlain by a minimum thickness of 4-inches of "free-draining" granular material, such as 1-inch to ¾-inch crushed rock. Base course should be installed in a single lift and compacted until well keyed. Settlements of lightly loaded floor slabs are anticipated to be minor.

Under no circumstance should floor slabs be established upon loose or disturbed soils, sod, rubbish, construction debris, non-engineered fill, other deleterious materials, expansive soils, frozen soils, or within ponded water.

### **6.9 Seismic Hazards**

#### **6.9.1 General**

Northern Utah is an area of high seismic activity associated with the East Cache fault zone, which defines the eastern boundary of the Basin and Range province. The East Cache fault zone is considered capable of generating earthquakes as large as magnitude 7.3<sup>2</sup>.

Utah municipalities have adopted the International Building Code (IBC) 2006. The IBC 2006 code determines the seismic hazard for a site based upon regional acceleration mapping prepared by the United States Geologic Survey (USGS) and the soil site class. The structure must be designed in accordance with the procedures presented in the IBC 2006 edition. The risk from geologic hazards other than those discussed below is low.

#### **6.9.2 IBC Site Class**

For dynamic structural analysis, Site Class "D," as defined in Table 1615.1.1, Site Class Definitions of the 2006 IBC, can be utilized.

#### **6.9.3 Earthquake Ground Motions**

The IBC 2006 code provides values of ground and structural acceleration for structural design. These design accelerations are based on data collected and interpreted by the US Geological Survey (USGS, 1997) for the maximum considered earthquake (MCE), a level of ground

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<sup>2</sup> Arabasz, W.J., Pechmann, J.C., and Brown, E.D., 1992, Observational seismology and the evaluation of earthquake hazards and risk in the Wasatch Front area, Utah, in Gori, P.L., and Hays, W.W., eds., Assessment of regional earthquake hazards and risk along the Wasatch Front, Utah: U.S. Geological Survey Professional Paper 1500-D, 36 p.



acceleration associated with a 2 percent probability of being exceeded in 50 years (which we abbreviate as 2%PE50yrs). The IBC allows the use of 2/3 of these values. This represents a standard design and risk level, adjusted for local seismicity. Structures could be designed for higher accelerations if the additional costs are out weighed by reduced risk.

Using 41.7667 degrees north latitude and 111.8167 degrees west longitude as the project coordinates; the following table summarizes spectral accelerations for the maximum considered earthquake.

**DESIGN EARTHQUAKE ACCELERATIONS**

Spectral Acceleration Value	MCE* Ground Motion Values for Site Class B % g
0.2-Sec Spectral Acceleration ( $S_s$ )	89.9
1.0-Sec Spectral Acceleration ( $S_1$ )	31.7

\*MCE – Maximum considered earthquake

For Site Class D and the above-referenced short and long term spectral acceleration values, the amplification factors  $F_a = 1.14$  and  $F_v = 1.767$  values can be used for design.

**6.9.4 Surface Fault Rupture**

Known active faults are not mapped in the immediate vicinity of the site. The risk of surface fault rupture affecting the site is very low.

**6.9.5 Liquefaction & Lateral Spread**

Liquefaction is a condition where earthquake ground motion causes a build up of water pressure in the spaces between saturated soil particles causing the soil to behave like a fluid. Liquefaction will generally occur only in relatively loose granular or low-plasticity fine-grained soil subjected to earthquake ground motion with sufficient intensity and sufficient duration. Damaging settlement may result from liquefaction. Damaging lateral movement known as lateral spread may occur if liquefaction occurs beneath a slope or near a free-face, such as the bank of a river.

The site is located in an area that has been mapped as having a “moderate to high liquefaction potential” on planning maps. This generally means that high groundwater is present below the

site. Our investigation confirmed a high water table of approximately seven feet below ground surface at the site. Additionally, field and laboratory analyses confirm that highly susceptible liquefiable soils like low consistency saturated silts are present below the site.

From analysis of cone data, we estimate that settlement due to liquefaction could be as high as two to three inches during a major seismic event. Current methods do not allow precise estimates of settlement due to liquefaction. If liquefaction were to occur, the settlement could be greater or less than estimated.

There are several potential options for addressing potential settlement due to liquefaction including:

- Accept the risk without any additional measures.
- Design the structure to minimize the potential for collapse. This might include designing grade beams to tie foundation together, extra reinforcing in foundations, strengthening key connections, or other measures.
- Mitigate the liquefaction by grouting or densification of the liquefiable layers. This would partly be accomplished through a rammed aggregate foundation system.
- Support the structure on deep foundations extending through the liquefiable layers such as driven piles.

Mitigation is generally very expensive and usually not considered except for critical structures. Deep foundations can also be costly, but are used more widely to help prevent liquefaction settlement.

Although disturbed layering was not encountered during our soil investigation, the results of a lateral spread analysis indicate a potential for lateral spread at the site. Although slopes are mild, they are still within the limits of observed lateral spread; grain-size and soil density is also consistent with potentially liquefiable materials. Available analysis methods are weighted toward sites where lateral spread has occurred; therefore, the lateral spread displacement model may be skewed to predict lateral spread when in fact no lateral spread may occur. Lateral spreading is also dependent on the presence of continuous liquefiable layers below the site. With these considerations, our model indicates total lateral displacements could be approximately a foot, if lateral spread were to occur.

Complete mitigation of lateral spread potential can be difficult to realize. Lateral spread can be a regional problem with movement occurring over large land areas. Prevention often requires mitigation at a regional scale because spreading can overwhelm localized mitigation efforts. Typical mitigation of lateral spread consists of subsurface barriers, which include slurry walls, sheet-pile walls, and columnar walls consisting of packed gravel or a soil cement mix. Barrier walls can also consist of liquefaction ground improvement procedures. Deep foundation such as driven piles or drilled pile can also provide some lateral resistance to soil movement, but such resistance can be overwhelmed if the area and displacement of the lateral spread slide is too great.

The risk of lateral spread occurring during the life of the structure is low, but not negligible. In order for lateral spread to occur there has to be a sizeable earthquake near the site, which may or may not induce liquefaction in site soils. If liquefaction does occur, it does not necessarily mean lateral spread will occur. Soil conditions and empirical models suggest it may occur, but it is not a certainty with a large scale earthquake. Therefore the risk of lateral spread is generally considered low. Similar to liquefaction settlement, mitigation measures for lateral spread are generally very expensive and usually not considered except for critical structures.

#### **6.10 Soil Corrosivity and Sulfate Attack on Concrete**

Soil corrosivity and sulfate attack was performed on site soils and was found to be negligibly corrosive. It is our judgment that site soils can use cement type I or II for concrete placed in contact with the on-site soil.



## 6.11 Pavements

Existing site surface soils exhibit good support characteristics for pavements. From available laboratory data, we estimate the subgrade to have a CBR value of 4. This value was used to calculate pavement sections consistent with Utah Department of Transportation design procedures and recommendations.

Good drainage is vital to the long-term performance of a roadway surface. Parking areas should allow for complete drainage of surface water without the formation of puddles.

Prior to placement of any structural fill or the pavement design section, the exposed subgrade should be prepared as discussed in Section 6.2.1, Site Preparation. If subgrade soils become loose, saturated, or disturbed they should be recompacted to the requirements for structural fill or be removed and replaced with structural fill. A suitable pavement section resulting in adequate pavement performance is highly dependent on actual traffic loading [18 kip equivalent single axle loads (ESALs) especially for heavy truck traffic]. The designer/owner should choose the appropriate sections to meet the anticipated traffic volume and life expectancy. The section capacity is reported as daily ESALs, Equivalent 18 kip Single Axle Loads. Typical Light Trucks impart 0.25 to 0.50 ESALs per truck; medium sized trucks and school buses impart 1.0 to 1.5 ESALs per truck; heavy trucks impart 2.0 to 2.5 trucks per day. It takes approximately 1,200 passenger cars to impart 1 ESAL.

If the design team considers that any assumptions are not accurate, AMEC should be informed in order that we may review the pavement designs as necessary. Similarly, AMEC should be contacted if alternate designs are needed. The pavement materials and placement should be in accordance with the Utah Department of Transportation or American Public Works Association specifications.

### Pavement Design Parameters

Design Life	20 years
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability	90%
Std Deviation - Flexible	0.45
Asphaltic-Concrete Structural Coefficient	0.4
Untreated Road Base	0.10
Granular Subbase	0.08
Design CBR	4



### Flexible Pavement Sections

Alternate	Area of Placement	Daily 18-kip ESALs	Flexible		
			AC	UTBC	GB
Alternate 1	Auto Parking/Drives	4	3.0"	4.0"	8.0"
Alternate 2		8	3.5"	4.0"	8.0"
Alternate 3		16	4.0"	4.0"	8.0"

**Notes:**

1. Full depth asphalt or increased asphalt thickness can be increased by adding 1.0-inch asphalt for each 4 inches of base course or granular borrow replaced.
2. Based on our experience, limited data, and analysis, we anticipate Alternate 1 as the best cost effective option for the project. However, we recommend that the designer/owner perform their own assessment to determine whether this suggested pavement section really does meet project traffic needs, or whether one of the other alternates would have a capacity better suited to the expected traffic.

### Rigid Pavement Sections

Pavement Use	Daily 18-kip ESALs	Layer Thickness (inches)	
		Portland Cement Concrete	Untreated Base Course
Auto Drives	12	5	4
Truck Drives	32	6	4

Sidewalks not subject to vehicle traffic can consist of 4 inches of concrete over 4 inches of granular base. Trash dumpster pads should consist of at least 6 inches of concrete over 4 inches of granular base. Areas in front of dumpsters can be subject to repeated heavy loading from dump trucks, which can cause early failure in asphalt. Great consideration should be given to using a concrete apron in front of the dumpster to help prevent pavement failure.

## 7. LIMITATIONS

This report has been prepared to aid the architect and engineer in the design of this project. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of the earthwork, foundations, and floor slabs. In the event that any changes in the design and location of the building as outlined in this report are planned, we should be given the opportunity to review the changes and to modify or reaffirm the conclusions and recommendations of this report in writing.

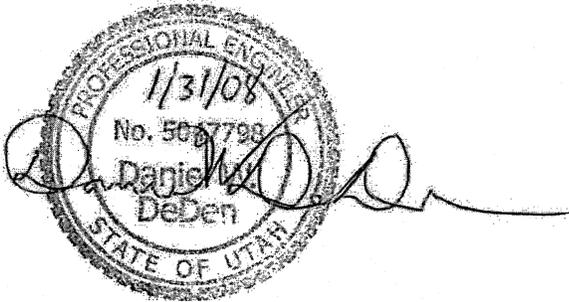
The conclusions and recommendations submitted in this report are based on the data obtained from the borings made at the locations indicated on Figure 2, Site Plan, and from other sources of information discussed in this report. In the performance of subsurface investigations, specific information is obtained at specific locations at specific times. However, it is acknowledged that variations in soil conditions may exist between explorations. This report does not reflect any variations that may occur between these explorations. The nature and extent of variation may not become evident until construction. If, during construction, subsurface conditions are different from those encountered in the explorations, we should be advised at once so that we can observe and review these conditions and reconsider our recommendations where necessary.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices at this time along the Wasatch Front.

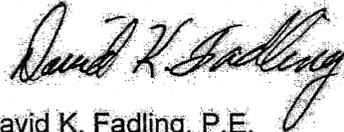
We appreciate the opportunity to provide this service for you. If you have any questions or require additional information, please do not hesitate to contact us.

Respectfully submitted,  
AMEC Earth & Environmental, Inc.

Reviewed by:



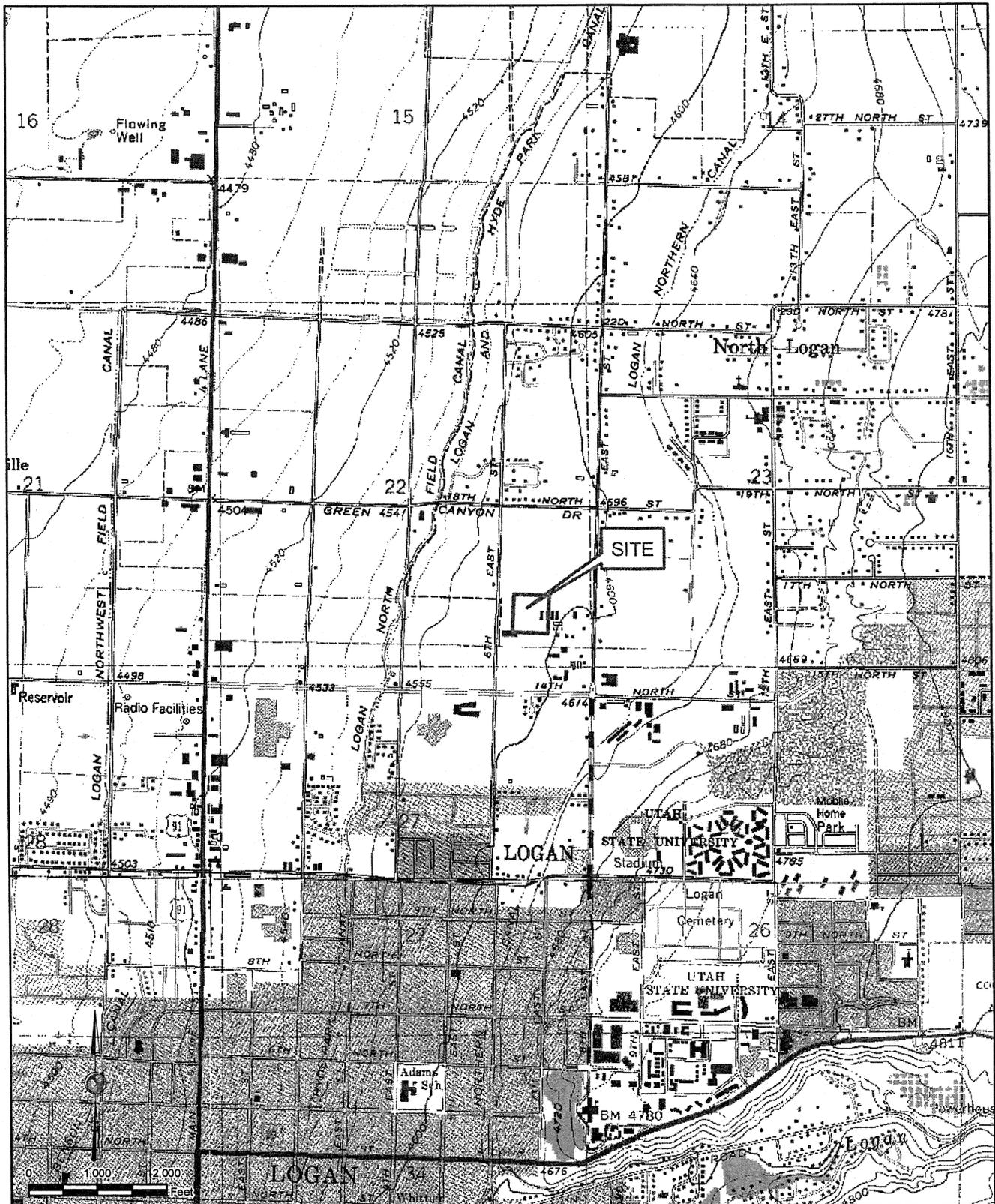
Daniel W. DeDen, P.E.  
Professional Engineer



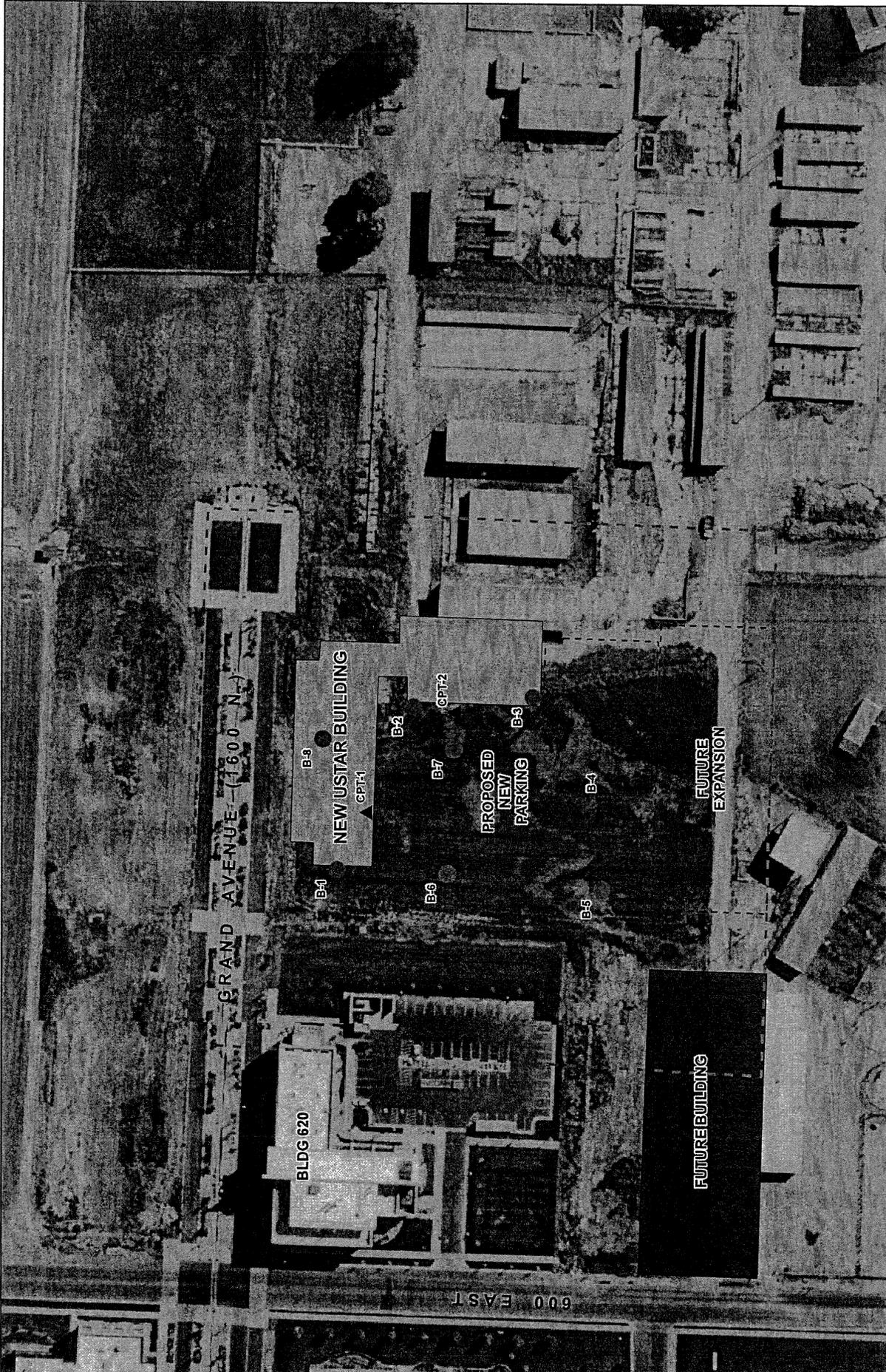
David K. Fadling, P.E.  
Senior Engineer

Addressee (4)





<b>AMEC Earth &amp; Environmental</b> 9865 South 500 West Sandy, Utah 84070 Tel: (801) 999-2002 Fax: (801) 999-2098				CLIENT <b>AJC Architects</b> 703 East 1700 South Salt Lake City, Utah 84105	
<b>PROJECT</b> UTAH STATE UNIVERSITY USTAR RESEARCH INSTITUTE 1600 North 600 East Logan, Utah		Smithfield Quadrangle USGS 7.5 Minute Series (Topographic)		DWN BY: MKW      DATUM: NAD 83      DATE: 11/07/07 CHKD BY: BMP      P:\Geo\2007\7-817-005223\GIS\Figure1 Vicinity Map      PROJECT NO: 7-817-005223 PROJECTION: UTM 12 North      SCALE: 1 inch equals 2,000 feet      FIGURE NO: 1	
<b>TITLE</b> VICINITY MAP					



<b>Legend</b> Approximate Bore Location In Proposed Building Footprint Approximate Bore Location At Proposed Parking Area Cone Penetration Test Location	<b>CLIENT</b> AJC Architects 703 East 1700 South Salt Lake City, Utah 84105  AMEC Earth & Environmental 8865 South 500 West Sandy, Utah 84070 Tel: (801) 999-2002 Fax: (801) 999-2089	<b>ameco</b>	<b>PROJECT</b> UTAH STATE UNIVERSITY USTAR RESEARCH INSTITUTE 1600 North 600 East Logan, Utah	P:\060007\417-005223 03/12/08 DATE:
			<b>DOWN BY:</b> MKW CHK'D BY: BMP DXTUM: N/A PROJECTION: N/A SCALE: NOT TO SCALE	PROJECT NO: 7-417-005223 FIGURE NO: 2

# LOG OF BORING NO. B-1

Project Name: USU USTAR  
 Location: 1600 North 600 East  
 Logan, UT  
 Project No: 7-817-005223

Date Drilled: 10/25/07  
 Rig Type: SIMCO 2800  
 Drilled By: A Cache  
 Logged By: R. Buxton



Sheet 1 of 1

Elevation, feet	Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
			Surface El.:									
			Lean CLAY [CL] very stiff, dark brown, dry to moist, low to medium plastic, pinholes, major roots to 2", plow disturbance to 12"	D-1	71	16						
5			Layered SILTS and CLAYS with fine sand [CL-ML] stiff to very stiff, light brown to grey, damp to wet, low to medium plasticity, occasional silty sand layers 1" to 12".	D-2	52	18	107	21	86	28	7	
			Some Gravels at 8.5' - 12'									
10				D-3	16	16			47			
15				D-4	20	16	108	22				
20				D-5	24	0						
21.5			Bottom of Boring at 21.5' 1 1/4" Slotted PVC pipe installed to 19'									
25												

Remarks:

Water Level Observations

▽		
▽	9.5 ft	11/6/07

*The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.*

Figure 3A

## LOG OF BORING NO. B-2

Project Name: USU USTAR  
 Location: 1600 North 600 East  
 Logan, UT  
 Project No: 7-817-005223

Date Drilled: 10/25/07  
 Rig Type: SIMCO 2800  
 Drilled By: A Cache  
 Logged By: R. Buxton



Sheet 1 of 1

Elevation, feet	Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
			Surface El.:									
		[Diagonal Hatching]	Lean CLAY [CL] very stiff, dark brown, dry to moist, low to medium plastic, pinholes, major roots to 2", plow disturbance to 12"	D-1	36	13						
	3.5											
	5	[Diagonal Hatching]	Layered SILTS and CLAYS with fine sand [CL-ML] stiff to very stiff, light brown to grey, damp to wet, low to medium plasticity, occasional silty sand layers 1" to 12"	D-2	27	13						
	7.0											
	10	[Dotted]	Silty GRAVEL with Sand [GM] medium dense to dense, wet, subangular to angular clasts	D-3	16	16	110	20	61	23	3	
	10.0											
	15	[Diagonal Hatching]	Layered SILTS and CLAYS with fine sand [CL-ML] stiff to very stiff, light brown to grey, damp to wet, low to medium plasticity, occasional silty sand layers 1" to 12" some gravel at 11.5' to 12.5'	D-4	16	13						
	15.0		Bottom of Boring at 15'									

AMEC.SLC.BORING.1.BASE 7-817-005223 USU USTAR RESEARCH INSTITUTE.GPJ\_LAGNN10.GDT 11/29/07

Remarks:	Water Level Observations		The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.	Figure 3B
	▽ 6.0 ft	10/25/07		
	▽			

# LOG OF BORING NO. B-3

Project Name: USU USTAR  
 Location: 1600 North 600 East  
 Logan, UT  
 Project No: 7-817-005223

Date Drilled: 10/25/07  
 Rig Type: SIMCO 2800  
 Drilled By: A Cache  
 Logged By: R. Buxton



Sheet 1 of 1

Elevation, feet	Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
			Surface El.:									
		1.0	Lean CLAY [CL] very stiff, dark brown, dry to moist, low to medium plastic, pinholes, major roots to 2", plow disturbance to 12"									
		2.0	Silty GRAVEL with Sand [GM] medium dense to dense, dry, angular to subangular clasts									
		5	Layered SILTS and CLAYS with fine sand [CL-ML] stiff to very stiff, light brown to grey, damp to wet, low to medium plasticity, occasional silty sand layers 1" to 12"	D-1	22	16	103	23	60			
		10		D-2	15	0						
		15		D-3	12	12	107	23	77	NP	NP	
		20		D-4	12	12	106	23		28	8	
		20.5	Bottom of Boring at 20.5' 1 1/4" Slotted PVC pipe Installed to 19'									
		25										

Remarks:

Water Level Observations

▽	
▽ 7.7 ft	11/6/07

*The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.*

Figure 3C

AMEC.S.L.C.BORING.1.BASE 7-817-005223 USU USTAR RESEARCH INSTITUTE.GPJ LAGNN10.GDT 11/29/07

# LOG OF BORING NO. B-4

Project Name: **USU USTAR**  
 Location: **1600 North 600 East**  
**Logan, UT**  
 Project No: **7-817-005223**

Date Drilled: **10/25/07**  
 Rig Type: **SIMCO 2800**  
 Drilled By: **A Cache**  
 Logged By: **R. Buxton**



Sheet 1 of 1

Elevation, feet	Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
			Surface El.:									
		0.8	Lean CLAY [CL] very stiff, dark brown, dry to moist, low to medium plastic, pinholes, major roots to 2", plow disturbance to 12"									
		3.0	Silty GRAVEL with Sand [GM] medium dense to dense, dry, angular to subangular clasts	D-1	22	16						
		3.5	Layered SILTS and CLAYS with fine sand and gravel [CL-ML] stiff to very stiff, light brown to grey, dry, low to medium plasticity									
	5		Bottom of Boring at 3.5'									
	10											
	15											
	20											
	25											

Remarks:

Water Level Observations

▽	
▽	

*The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.*

Figure 3D

AMEC.S.L.C.BORING.1.BASE 7-817-005223 USU USTAR RESEARCH INSTITUTE.GPJ LAGNN10.GDT 11/29/07

# LOG OF BORING NO. B-5

Project Name: USU USTAR  
 Location: 1600 North 600 East  
 Logan, UT  
 Project No: 7-817-005223

Date Drilled: 10/25/07  
 Rig Type: SIMCO 2800  
 Drilled By: A Cache  
 Logged By: R. Buxton



Sheet 1 of 1

Elevation, feet	Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
			Surface El.:									
		0.8 1.3	Lean CLAY [CL] very stiff, dark brown, dry to moist, low to medium plastic, pinholes, major roots to 2", plow disturbance to 12"									
		5.0	Silty GRAVEL with Sand [GM] medium dense to dense, brown, dry, angular to subangular clasts									
		5.0	Layered SILTS and CLAYS with fine sand [CL-ML] stiff to very stiff, light brown to grey, damp, low to medium plasticity, occasional silty sand layers	D-1	18	18						
			Bottom of Boring at 5'									
	5											
	10											
	15											
	20											
	25											

Remarks:	Water Level Observations		The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.	Figure 3E
	▽			
	▽			

AMEC.S.L.C.BORING.1.BASE.7-817-005223.USU.USTAR.RESEARCH.INSTITUTE.CPJ.LAGNIN10.GDT.11/29/07

# LOG OF BORING NO. B-6

Project Name: USU USTAR  
 Location: 1600 North 600 East  
 Logan, UT  
 Project No: 7-817-005223

Date Drilled: 10/25/07  
 Rig Type: SIMCO 2800  
 Drilled By: A Cache  
 Logged By: R. Buxton



Sheet 1 of 1

Elevation, feet	Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
			Surface El.:									
		1.0	Lean CLAY [CL] very stiff, dark brown, dry to moist, low to medium plastic, pinholes, major roots to 2" plow disturbance to 12"									
		3.0	SILT [ML] very stiff, brown, dry to moist	D-1	16	16						
		5.0	Layered SILTS and CLAYS with fine sand [CL-ML] stiff to very stiff, light brown to grey, dry, low to medium plasticity, occasional silty sand layers	GS-2								
	5		Bottom of Boring at 5'									
	10											
	15											
	20											
	25											

Remarks:

Water Level Observations

▽	
▽	

*The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.*

Figure 3F

AMEC.SLC.BORING.1.BASE 7-817-005223 USU USTAR RESEARCH INSTITUTE.GPJ LAGNN10.GDT 11/25/07

# LOG OF BORING NO. B-7

Project Name: USU USTAR  
 Location: 1600 North 600 East  
 Logan, UT  
 Project No: 7-817-005223

Date Drilled: 10/25/07  
 Rig Type: SIMCO 2800  
 Drilled By: A Cache  
 Logged By: R. Buxton



Sheet 1 of 1

Elevation, feet	Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
			Surface El.:									
			Lean CLAY [CL] very stiff, dark brown, dry to moist, low to medium plastic, pinholes, major roots to 2", plow disturbance to 12"									
			Layered SILTS and CLAYS with fine sand [CL-ML] stiff to very stiff, light brown to grey, damp, low to medium plasticity, occasional silty sand layers	D-1	9	11			92			
	5		Bottom of Boring at 5'									
	10											
	15											
	20											
	25											

Remarks:	Water Level Observations		<i>The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.</i>	Figure 3G
	▽			
	▽			

AMEC.SLC.BORING.1.BASE 7-817-005223 USU USTAR RESEARCH INSTITUTE.GPJ\_LAGNN10.GDT 11/29/07

## LOG OF BORING NO. B-8

Project Name: USU USTAR  
 Location: 1600 North 600 East  
 Logan, UT  
 Project No: 7-817-005223

Date Drilled: 10/25/07  
 Rig Type: SIMCO 2800  
 Drilled By: A Cache  
 Logged By: R. Buxton



Sheet 1 of 2

Elevation, feet	Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
			Surface El.:									
			CLAY with Silt [CL] very stiff, dark brown, dry to moist, low to medium plastic, pinholes, major roots to 2", plow disturbance to 12"									
	5		Silty GRAVEL with Sand [GM] medium dense to dense, dry, subangular to angular clasts.	S-1	39	2						
	10		SILT to SILT with Clay [CL-ML] layered silts and clays with fine sand; stiff to very stiff, light brown to grey, wet, low to medium plasticity, occasional silty sand and clay layers 1" to 12"	S-2	8	18						
	15		some gravel at 13.5'	S-3	6	15						
	20		Silty GRAVEL with Sand [GM] medium dense to dense, dry, subangular to angular clasts.	S-4	10	16						
	25		SILT to SILT with Clay [CL-ML] layered silts and clays with fine sand; stiff to very stiff, light brown to grey, wet, low to medium plasticity, occasional silty sand and clay layers 1" to 12"	S-5	8	18						
Remarks:				Water Level Observations		The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.						
				▽	8.5 ft							10/25/07
				▽	8.0 ft							11/6/07
Figure 3H												

AMEC.SLC.BORING.1.BASE.7-817-005223 USU USTAR RESEARCH INSTITUTE.GPJ\_LAGNN10.GDT.11/29/07

# LOG OF BORING NO. B-8

Project Name: USU USTAR  
 Location: 1600 North 600 East  
 Logan, UT  
 Project No: 7-817-005223

Date Drilled: 10/25/07  
 Rig Type: SIMCO 2800  
 Drilled By: A Cache  
 Logged By: R. Buxton



Sheet 2 of 2

Elevation, feet	Depth, feet	Graphic Log	Surface El.:  MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
		[Hatched Area]		X								
30		[Hatched Area]		X S-6	9	14						
35		[Hatched Area]		X S-7	17	14						
		[Hatched Area]	37.0									
		[Hatched Area]	Lean CLAY [CL] medium stiff, grey to dark grey, wet, low to medium placticity									
40		[Hatched Area]		X S-8	4/6"	24			35	14		
45		[Hatched Area]		X S-9	5	18						
		[Hatched Area]	45.5									
		[Hatched Area]	Bottom of Boring at 45.5' 1 1/4" Slotted PVC pipe Installed to 19'									
50		[Hatched Area]										

Remarks:

Water Level Observations

▽	8.5 ft	10/25/07
▽	8.0 ft	11/6/07

*The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.*

Figure 3H

AMEC.SLC.BORING.1.BABE 7-817-005223 USU USTAR RESEARCH INSTITUTE.GPJ LAGNN10.GDT 11/29/07

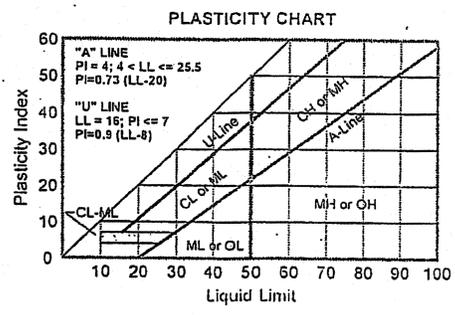
# SOIL CLASSIFICATION CHART & LEGEND



MAJOR DIVISIONS		GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS Less than 50% passes No. 200 sieve	GRAVELS (50% or more of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passing No. 200 sieve)	GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures
		GRAVELS WITH FINES (More than 12% Passing No. 200 sieve)	GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures
			GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-silt mixtures	
	SANDS (50% or more of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passing No. 200 sieve)	SW	Well graded sands, gravelly sands
		SANDS WITH FINES (More than 12% Passing No. 200 sieve)	SP	Poorly graded sands, gravelly sands
SM			Silty sands, sand-silt mixtures	
SC	Clayey sands, sand-clay mixtures			
FINE-GRAINED SOILS 50% or more passes No. 200 sieve	SILTS Limits Plot Below A Line	SILTS OF LOW PLASTICITY (Liquid Limit less than 50)	ML	Inorganic silts, clayey silts of low to medium plasticity
		SILTS OF HIGH PLASTICITY (Liquid Limit 50 or more)	MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
	CLAYS Limits Plot Above A Line	CLAYS OF LOW PLASTICITY (Liquid Limit less than 50)	CL	Inorganic clays of low to medium plasticity, gravelly, sandy, and silty clays
		CLAYS OF HIGH PLASTICITY (Liquid Limit 50 or more)	CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity
	ORGANICS SILTS AND CLAYS	ORGANIC SILTS AND CLAYS OF LOW PLASTICITY (Liquid Limit less than 50)	OL	Organic silts and clays of low to medium plasticity, sandy organic silts and clays
		ORGANIC SILTS OF HIGH PLASTICITY (Liquid Limit 50 or more)	OH	Organic silts and clays of high to medium plasticity, sandy organic silts and clays
ORGANIC SOILS	PRIMARILY ORGANIC MATTER (dark in color and organic odor)	PT	Peat	

NOTE: Coarse-grained soils with between 5% and 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the gray zone on the plasticity chart have dual classifications.

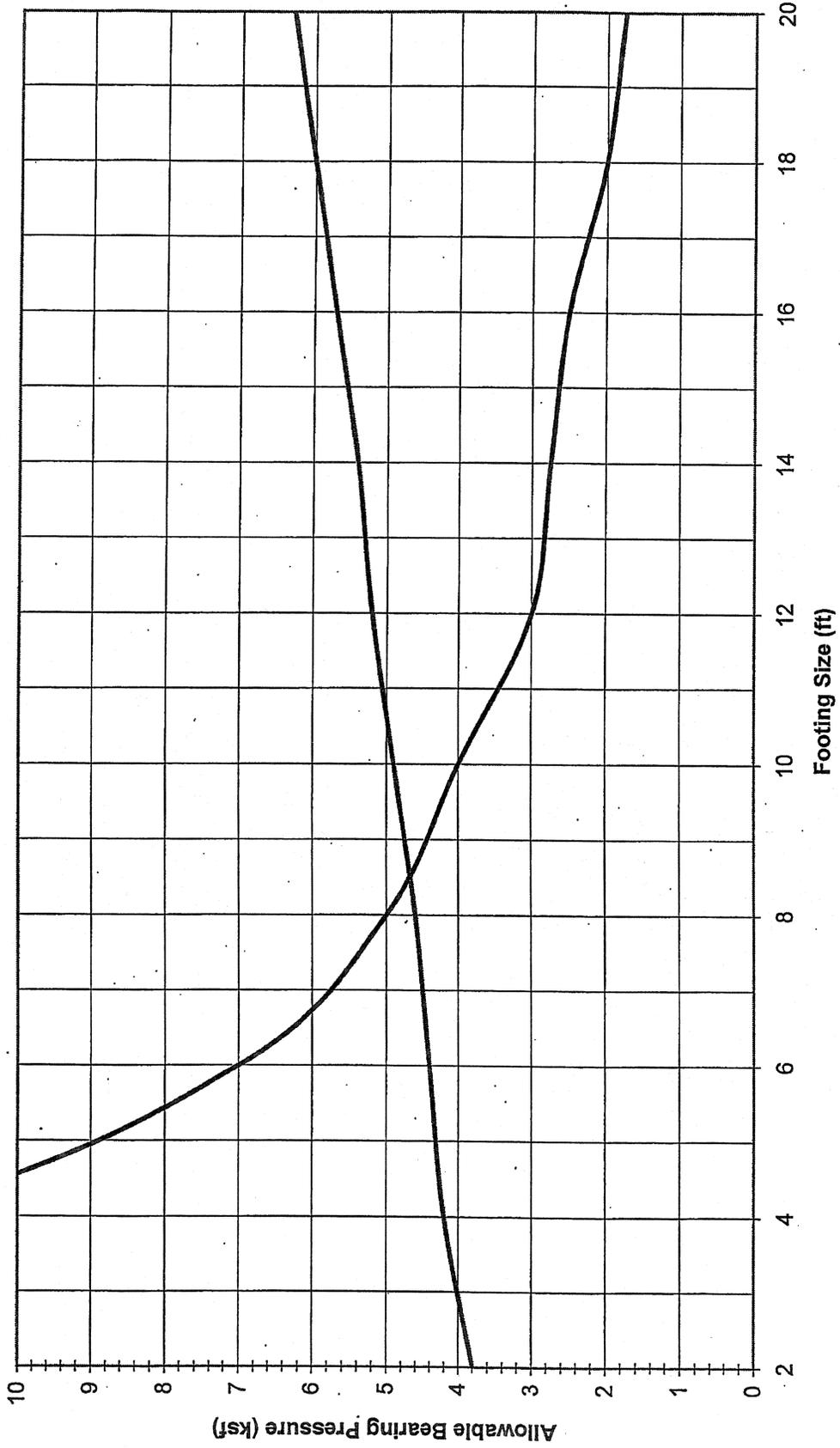
- D - Dames and Moore Sampler
- S - Split Spoon Sampler (SPT)
- T - Pushed Thin Walled Tube
- GS - Grab Sample
- BS - Bulk Sample
- DT - Driven Thin Wall
- C - Rock Core Sample
- CS - Continuous Soil Sample
- R - California Ring Sampler
- Water Level at Time of Drilling
- Stabilized Water Level
- CBR California Bearing Ratio
- PP Pocket Penetrometer, tsf
- ST Swell Test
- TOR Torvane Shear, psf
- UC Unconfined Compression, psf
- NR No Recovery



Material	Particle Size	
	mm	Sieve sizes
Boulders	304.8 to 914.4	12 in to 36 in
Cobble	76.2 to 304.8	3 in to 12 in
Gravel	4.76 to 19.1	3/4 in to 3 in
	19.1 to 76.2	#4 to 3/4 in
Sand	2.00 to 4.76	#10 to #4
	0.42 to 2.00	#40 to #10
	0.074 to 0.42	#200 to #40
Silt & Clay	<0.074	<#200

Figure 4

# Footing Bearing Pressure Chart



— 1 in. Settlement Line    — Allowable Pressure at 2.5' Depth

\* For square footing underlain with 4 feet of granular fill

Figure 5



**APPENDIX A**  
**FIELD EXPLORATIONS**





## APPENDIX A

### FIELD EXPLORATIONS - BORINGS

#### General

Subsurface materials and conditions at the project site were investigated on October 25, 2007 with 8 borings designated B-1 through B-8. The approximate locations of the borings are shown on Figure 2, Site Plan. All field operations were observed by a senior technician provided by our firm, who maintained a detailed log of the materials and conditions encountered in each boring and directed the sampling operations.

#### Borings

The borings were drilled with a truck-mounted SIMCO 2800 drill rig provided and operated by A Cache of Mendon, Utah. The borings were advanced to depths ranging from 5 to 45.5 feet below grade using hollow-stem auger drilling and sampling techniques. Disturbed samples were obtained from the borings at three to five-foot intervals of depth. Disturbed samples were obtained using a three inch O.D. Dames & Moore sampler and a two inch standard split spoon sampler. At the time of sampling, the Standard Penetration Test was conducted. This test consists of driving the split-barrel sampler into the soil a distance of 18 inches using a 140-lb hammer falling from a height of 30 inches. The number of blows required to drive the sampler the last 12 inches is recorded as the penetration resistance for the Dames & Moore Split barrel sampler and the standard split spoon sampler. The penetration resistance provides a measure of the relative density of granular soils, such as sand, and the relative consistency, or stiffness, of cohesive soils, such as silt. It should be recognized that penetration resistance values tend to overestimate the relative density of coarse granular soils, such as those containing significant amounts of gravel and cobble-sized particles. The soil samples obtained in the split-spoon sampler were carefully examined in the field, and representative portions were saved in containers for further examination and physical testing in our laboratory.

Logs of the borings are shown on Figures 3A through 3H, Log of Borings. Each log presents a descriptive summary of the various types of material encountered and notes the depth where the materials and/or characteristics of the materials change. To the right of the descriptive summary, the numbers and types of samples taken during the drilling operation are indicated. The terms used to describe the soils are defined on Figure 4, Soil Classification Chart & Legend.



**APPENDIX B**  
**LABORATORY TESTING**





## APPENDIX B

### LABORATORY TESTING

#### General

All samples obtained from the field were transported to our laboratory for examination and testing. The physical characteristics were noted, and the field classifications were modified where necessary. The laboratory testing program was conducted to provide data for our engineering analyses. The laboratory program included determinations of natural moisture content, washed sieve analyses, gradation, Atterberg Limits, consolidation, and chemical tests. The following sections describe the testing program in more detail.

#### Natural Moisture Content

Natural moisture content determinations were made in general conformance with ASTM D 2216. The results are presented on Figures 3A through 3H, Log of Borings.

#### Unit Weight

The dry unit weight, or density, of undisturbed soil samples was determined in the laboratory in general conformance with ASTM D 2937.

#### Percent Passing the No. 200 Sieve (Washed Sieve Analysis)

The silt and clay content (percent passing the No. 200 sieve) were evaluated for selected soil samples in general conformance with ASTM D 1140. Oven-dried samples were weighed and placed on the No. 200 sieve. The silt and clay were washed through the sieve, and the sample remaining on the sieve was oven-dried and weighed. The change in sample weight is used to calculate the percent of material passing the No. 200 sieve.

#### Gradation Tests

Gradation tests were performed on selected samples in general accordance with ASTM C 136 to aid in classifying soils. The oven-dried samples were weighed and vibrated through a series of different size sieves. The individual sieves were then weighed in order to calculate the percentage of gravel, sand and fine grained material.

#### Atterberg Limits

Atterberg Limit tests were performed in general accordance with ASTM D 4318 on representative samples of the native soils encountered at the site to verify field classifications.

#### One-Dimensional Consolidation Tests

Consolidation tests were performed in general accordance with ASTM D 2435 to obtain data on the compressibility characteristics of samples of relatively undisturbed soil.

#### Chemical Tests

Chemical tests were conducted on selected samples collected from the site. Water Soluble Sulfate tests were performed by TEI Testing Services, Inc. of Salt Lake City, Utah.



**APPENDIX C**  
**CONE PENETRATION TESTING**  
**By Contec, Inc.**





AMEC

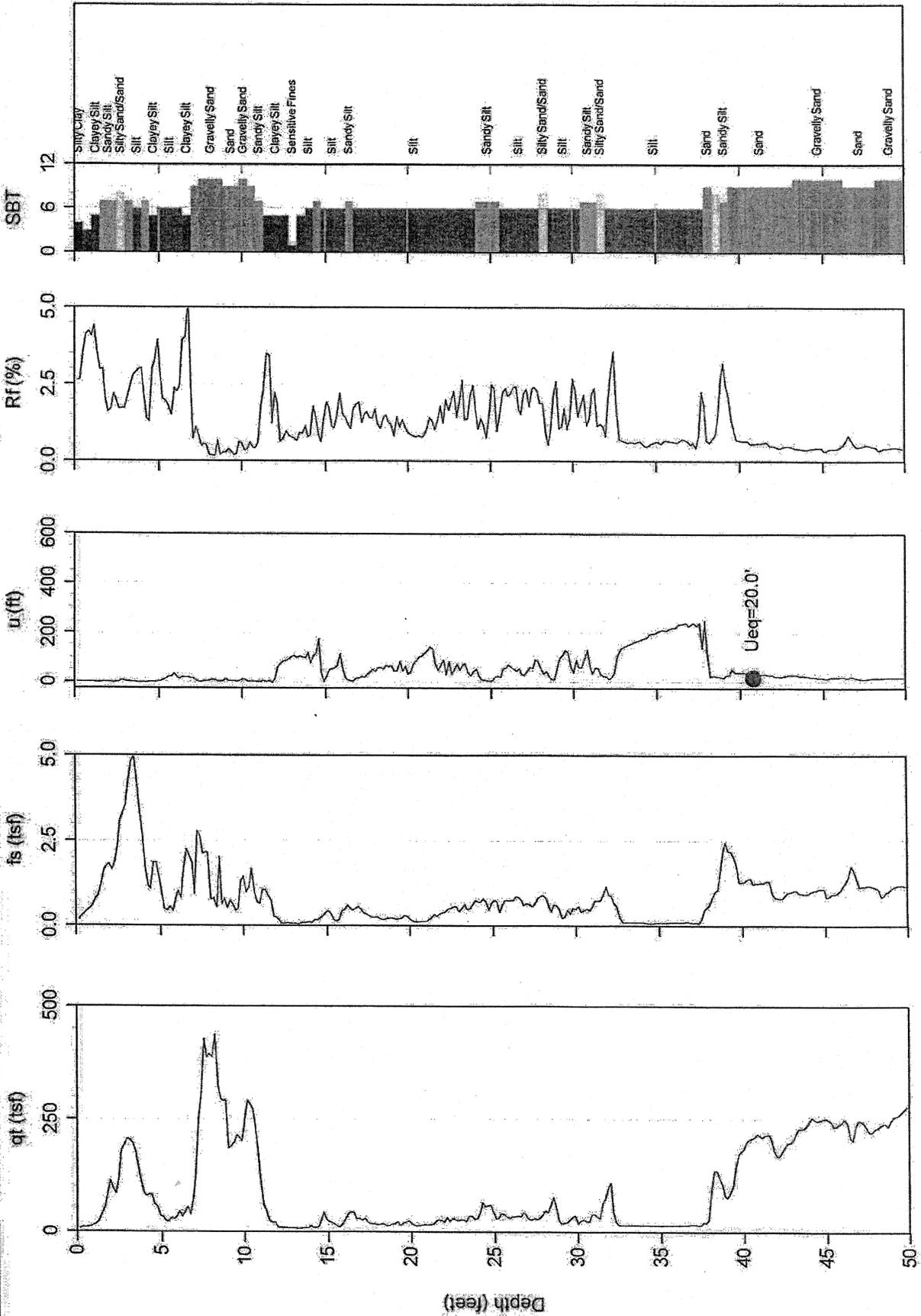
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Date: 01:18:08 13:04

Site: USU STAR BUILDING

Sounding: CPT-01

Cone: STD 20T AD183



Max Depth: 16.050 m / 52.66 ft  
 Depth Inc: 0.050 m / 0.164 ft  
 Avg Int: 0.150 m

SBT: Lunne, Robertson and Powell, 1997  
 ● Equilibrium Pore Pressure from Dissipation



AMEC

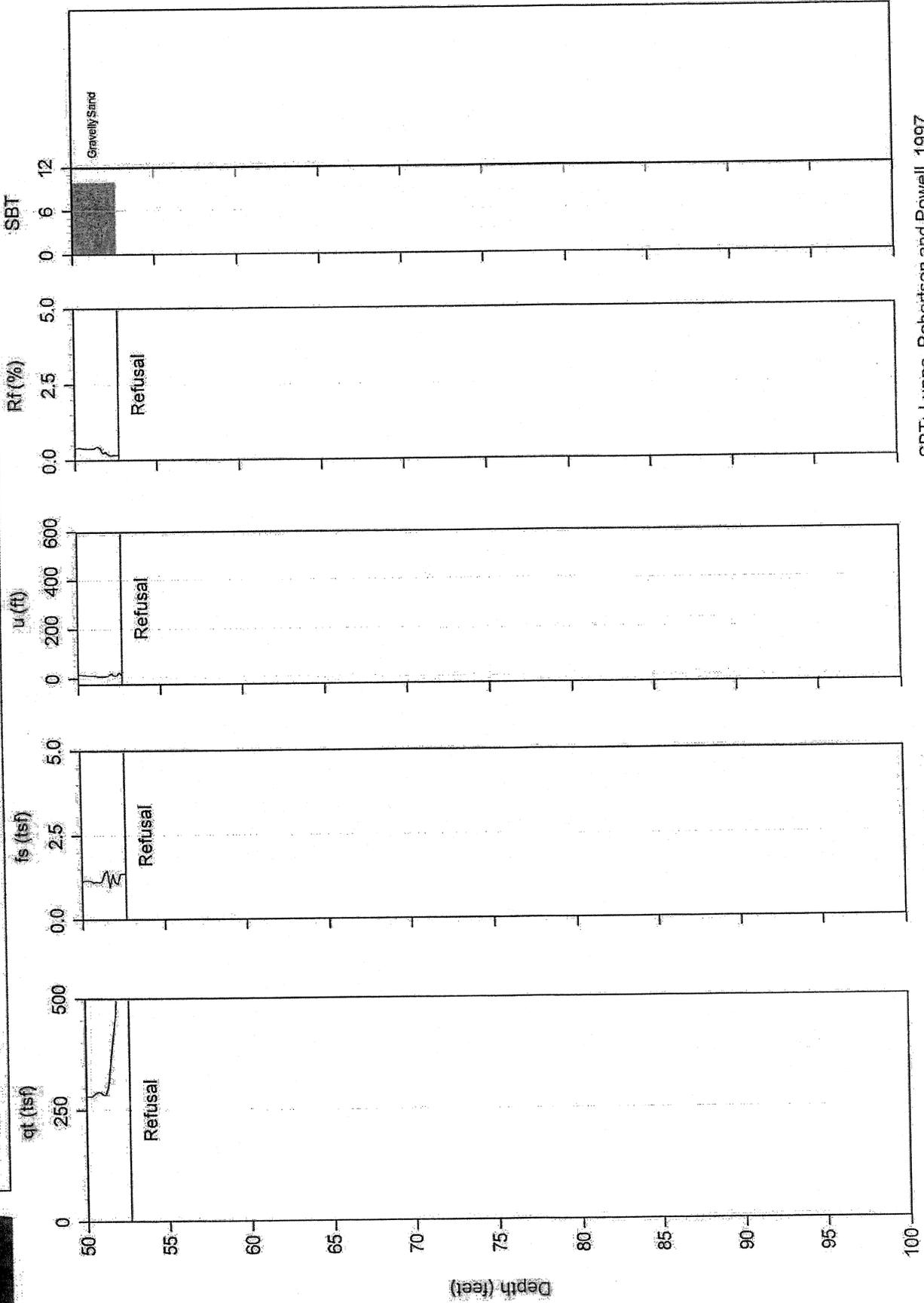
Job No: 08-310

Date: 01:18:08 13:04

Site: USUUSTAR BUILDING

Sounding: CPT-01

Cone: STD 20T AD183



Max Depth: 16.050 m / 52.66 ft  
Depth Inc: 0.050 m / 0.164 ft  
Avg Int: 0.150 m

SBT: Lunne, Robertson and Powell, 1997

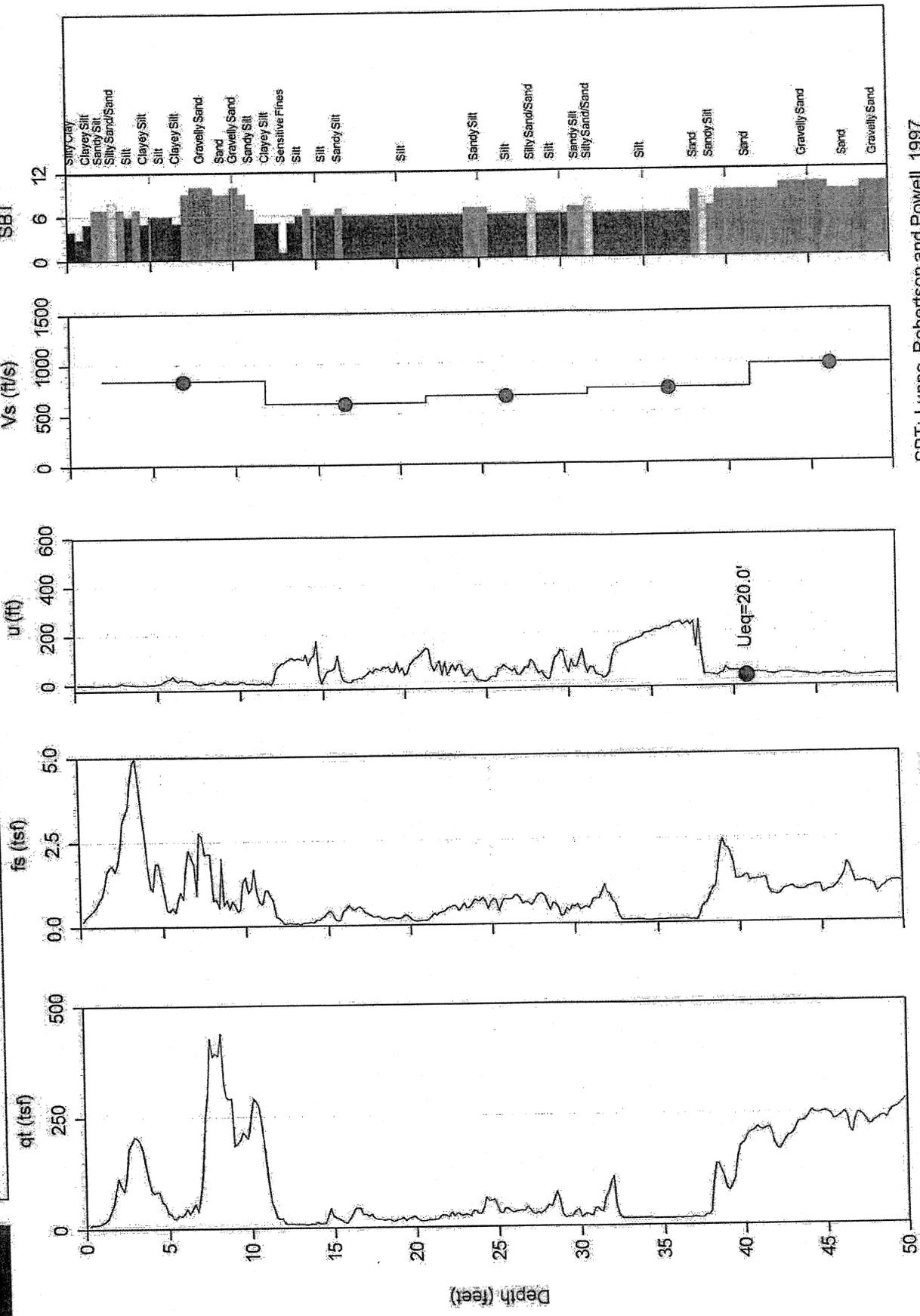
● Equilibrium Pore Pressure from Dissipation



AMEC

Job No: 08-310  
Date: 01:18:08 13:04  
Site: USU STARBUILDING

Sounding: CPT-01  
Cone: STD 20T AD183



SBT: Lunne, Robertson and Powell, 1997  
● Equilibrium Pore Pressure from Dissipation

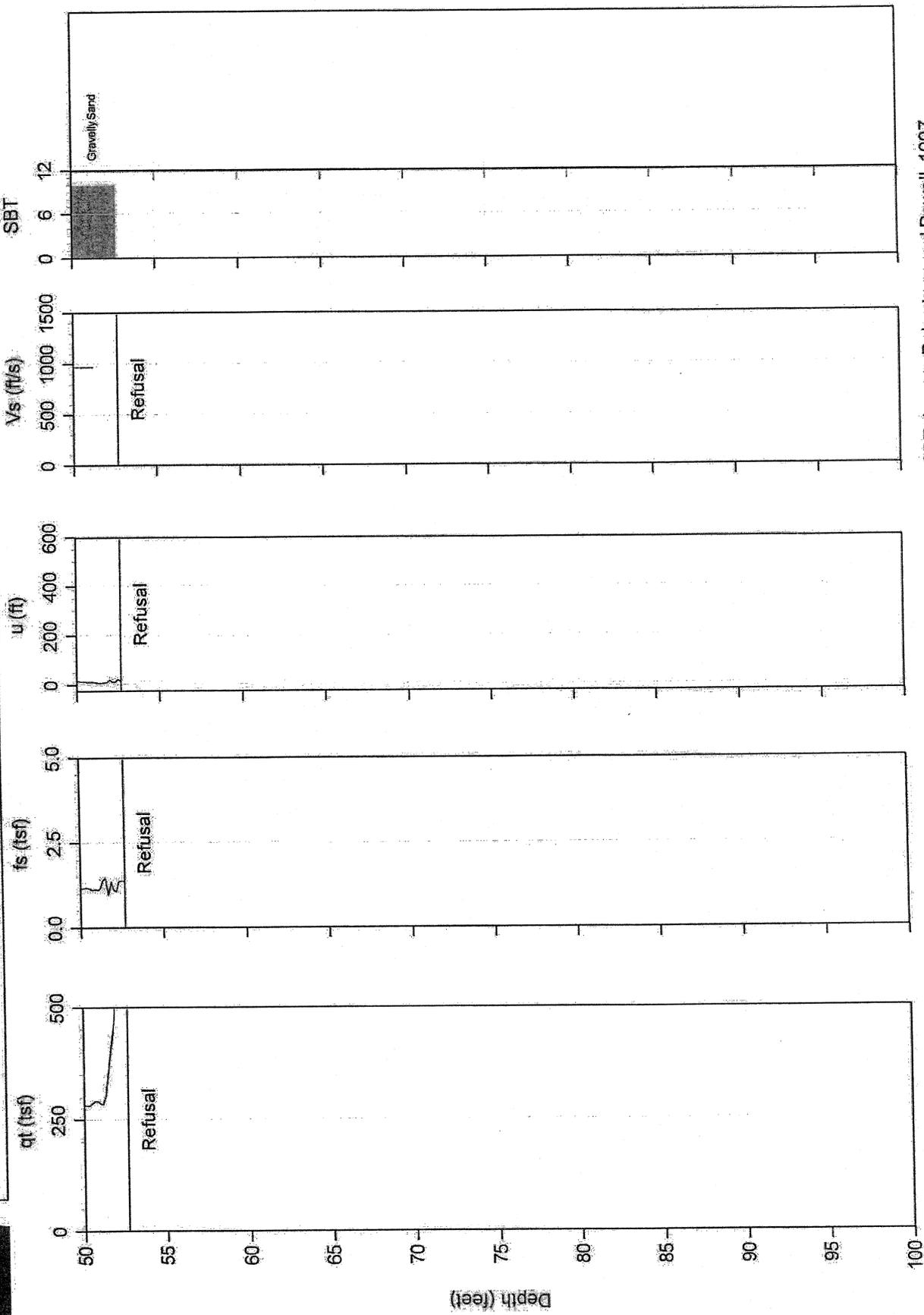
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Max Depth: 16.050 m / 52.66 ft  
Depth Inc: 0.050 m / 0.164 ft  
Avg Int: 0.150 m



AMEC

Sounding: CPT-01  
Cone: STD 20T AD183

Job No: 08-310  
Date: 01/18/08 13:04  
Site: USUUSTARBUILDING



Max Depth: 16.050 m / 52.66 ft  
Depth Inc: 0.050 m / 0.164 ft  
Avg Int: 0.150 m

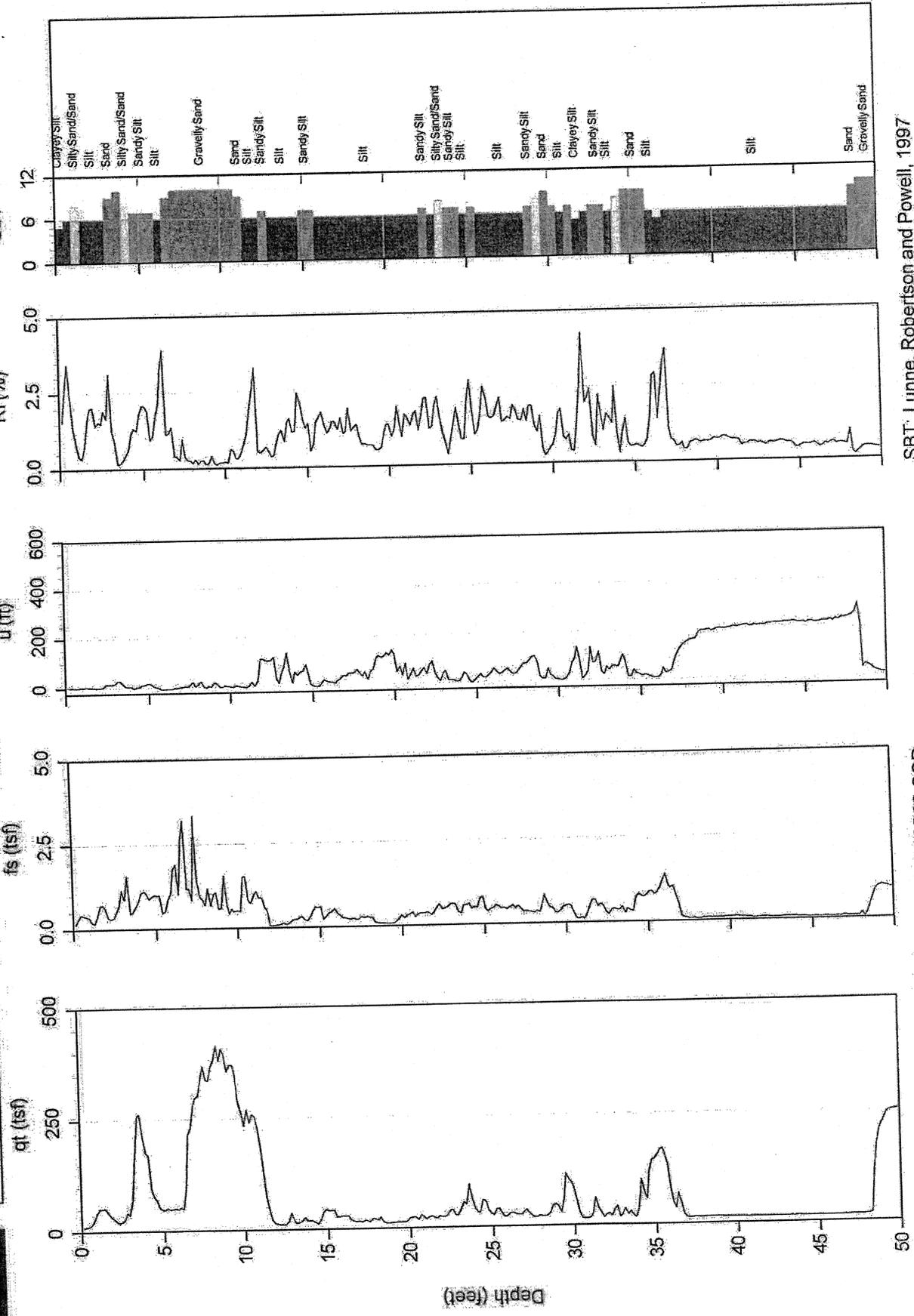
SBT: Lunne, Robertson and Powell, 1997  
● Equilibrium Pore Pressure from Dissipation



AMEC

Sounding: CPT-02  
Cone: STD 20T AD183

Job No: 08-310  
Date: 01:18:08 14:08  
Site: USU USTAR BUILDING



SBT: Lunne, Robertson and Powell, 1997

File: 310CP02.COR

Max Depth: 28.800 m / 94.49 ft  
Depth Inc: 0.050 m / 0.164 ft  
Avg Int: 0.150 m

● Equilibrium Pore Pressure from Dissipation



USTAR Building #2  
Utah State University  
Life Sciences Research Center  
Logan, Utah

## SECTION 011000 - SUMMARY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work by Owner.
5. Work under separate contracts.
6. Future work.
7. Purchase contracts.
8. Owner-furnished products.
9. Contractor-furnished, Owner-installed products.
10. Access to site.
11. Coordination with occupants.
12. Work restrictions.
13. Specification and drawing conventions.

- B. Related Section:

1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

#### 1.3 PROJECT INFORMATION

- A. Project Identification: USTAR Building #2, Life Sciences Research Center. DFCM Project No. 06292770.

1. Project Location: Utah State University, Logan Utah.

- B. Owner: State of Utah, Division of Facilities and Construction Management, State Office Building Room 4110, P.O. Box 141160, Salt Lake City, Utah 84114-1163.

1. Owner's Representative: Dave McKay, (801) 538-3287.

- C. Architect: ajc architects, 703 East 1700 South, Salt Lake City, Utah 84105.

USTAR Building # 2  
Utah State University  
Life Sciences Research Center  
Logan, Utah

D. Construction Manager/General Contractor: Gramoll Construction, 175 West 1100 North, North Salt Lake, Utah 84054.

1. Construction Manager for this Project is Project's constructor. In Divisions 01 through 49 Sections, the terms "Construction Manager" and "Contractor" are synonymous.

#### 1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of the Project is defined by the Contract Documents and consists of the following:

1. Site development, site utilities and building construction for a two wing, three level research facility building, separated into a Public / Lab wing and a Vivarium wing, as indicated on the Design Development Documents.

B. Type of Contract

1. Project will be constructed under a single prime contract.

#### 1.5 WORK BY OWNER

A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

1.6 PURCHASE CONTRACTS (To be referenced on Design Development Drawings).

1.7 OWNER-FURNISHED PRODUCTS (To be referenced on Design Development Drawings).

1.8 CONTRACTOR-FURNISHED, OWNER-INSTALLED PRODUCTS (To be referenced on Design Development Drawings).

#### 1.9 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

#### 1.10 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy adjacent buildings on campus during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
  - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
  - 2. Notify the Owner not less than 72 hours in advance of activities that will affect Owner's operations.
  
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
  - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
  - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
  - 3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
  - 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

#### 1.11 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
  - 1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.
  
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 6:00 p.m., Monday through Friday, except as otherwise indicated.
  - 1. Weekend Hours: Weekend hours may be required to maintain project schedule.
  - 2. Early Morning Hours: Insert restrictions or references to regulations by authorities having jurisdiction for restrictions on noisy work.
  - 3. Hours for Utility Shutdowns: Coordinate with Owner's Project Manager.
  - 4. Hours for Core Drilling and noisy activity: Coordinate with Owner's Project Manager.

- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
  - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
  - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
  - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
  - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor air intakes.

#### 1.12 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
  - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
  - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

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1.13 MISCELLANEOUS PROVISIONS

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000



## SECTION 011400 - WORK RESTRICTIONS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

#### 1.2 USE OF PREMISES

- A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
  - 1. Limits: Confine constructions operations to area of disturbance as indicated on drawings.
  - 2. Coordinate with the Owner for scheduling of events, work and hours of noise sensitive operations and procedures.
  - 3. Develop detailed Demolition and Construction Schedules outlining phased demolition and construction activities. Coordinate with the Owner for phasing of all Demolition and Construction activities, including the management of employees and public functions to provide the least amount of disruption for continuing normal business activities.
  - 4. Protect all adjacent areas from noise and construction dust, dirt and debris.
  - 5. Maintain employee and public access of the adjacent building and site as required and at all times during normal business hours.
  - 6. Protect employees and the public from potentially dangerous or harmful construction activities at all times.
  - 7. After hours and weekend work may be required during the course of the project. Contact Owner's Project Manager at least 72 hours in advance of when weekend hours will be required. Coordinate with the Owner's security personnel for access of the building and site during non-business hours. Provide security for construction personnel as required beyond the Owner's security forces and procedures.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011400

## SECTION 012500 - SUBSTITUTION PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Sections:
  - 1. Division 01 Section "Allowances" for products selected under an allowance.
  - 2. Division 01 Section "Alternates" for products selected under an alternate.
  - 3. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
  - 4. Divisions 02 through 49 Sections for specific requirements and limitations for substitutions.

#### 1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

#### 1.4 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use CM/GC's standard form acceptable to Owner..
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

- a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
  - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
  - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
  - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Substitution request is fully documented and properly submitted.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.
    - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received prior to the issuance of the last addenda during the bidding period. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

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- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
- b. Requested substitution does not require extensive revisions to the Contract Documents.
- c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- d. Substitution request is fully documented and properly submitted.
- e. Requested substitution will not adversely affect Contractor's construction schedule.
- f. Requested substitution has received necessary approvals of authorities having jurisdiction.
- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General project coordination procedures.
  - 2. Administrative and supervisory personnel.
  - 3. Coordination drawings.
  - 4. Requests for Information (RFIs).
  - 5. Project Web site.
  - 6. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Sections:
  - 1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
  - 2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.
  - 4. Division 01 Section "General Commissioning Requirements" for coordinating the Work with Owner's commissioning authority.

#### 1.3 DEFINITIONS

- A. RFI: Request from Owner, Construction Manager, or Architect, seeking information from each other during construction.

#### 1.4 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
  2. Preparation of the schedule of values.
  3. Installation and removal of temporary facilities and controls.
  4. Delivery and processing of submittals.
  5. Progress meetings.
  6. Preinstallation conferences.
  7. Project closeout activities.
  8. Startup and adjustment of systems.
  9. Project closeout activities.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

#### 1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown on Shop

Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
  - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
  - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
  - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
  - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
  - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
  - f. Indicate required installation sequences.
  - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

#### 1.6 KEY PERSONNEL

- A. Key Personnel Names: Within 15 days of starting construction operations, or as outlined in the Agreement, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
  1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

#### 1.7 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. RFI Forms: DFCM Form (Revised 2/9/06).
- C. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for coordination information already indicated in the Contract Documents.
    - d. Requests for adjustments in the Contract Time or the Contract Sum.
    - e. Requests for interpretation of Architect's actions on submittals.
    - f. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- D. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within five days if Contractor disagrees with response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log bi-weekly or monthly as required. Include the following:
1. Project name.
  2. Name and address of Architect and Construction Manager.
  3. RFI number including RFIs that were dropped and not submitted.
  4. RFI description.
  5. Date the RFI was submitted.
  6. Date Architect's response was received.
  7. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
  8. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

## 1.8 PROJECT MEETINGS

- A. General: CM/GC will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Construction Manager will schedule and conduct preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Conduct the conference to review responsibilities and personnel assignments.
  2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long-lead items.
    - d. Designation of key personnel and their duties.
    - e. Lines of communications.
    - f. Procedures for processing field decisions and Change Orders.
    - g. Procedures for RFIs.
    - h. Procedures for testing and inspecting.
    - i. Procedures for processing Applications for Payment.
    - j. Distribution of the Contract Documents.
    - k. Submittal procedures.
    - l. Sustainable design requirements.
    - m. Preparation of record documents.
    - n. Use of the premises and existing building.
    - o. Work restrictions.
    - p. Working hours.
    - q. Owner's occupancy requirements.
    - r. Responsibility for temporary facilities and controls.
    - s. Procedures for moisture and mold control.
    - t. Procedures for disruptions and shutdowns.
    - u. Construction waste management and recycling.
    - v. Parking availability.

- w. Office, work, and storage areas.
  - x. Equipment deliveries and priorities.
  - y. First aid.
  - z. Security.
  - aa. Progress cleaning.
4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Construction Manager, of scheduled meeting dates.
  - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility problems.
    - k. Time schedules.
    - l. Weather limitations.
    - m. Manufacturer's written recommendations.
    - n. Warranty requirements.
    - o. Compatibility of materials.
    - p. Acceptability of substrates.
    - q. Temporary facilities and controls.
    - r. Space and access limitations.
    - s. Regulations of authorities having jurisdiction.
    - t. Testing and inspecting requirements.
    - u. Installation procedures.
    - v. Coordination with other work.
    - w. Required performance results.
    - x. Protection of adjacent work.
    - y. Protection of construction and personnel.
  - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Construction Manager will schedule and conduct a Project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of record documents.
    - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - c. Submittal of written warranties.
    - d. Requirements for preparing sustainable design documentation.
    - e. Requirements for preparing operations and maintenance data.
    - f. Requirements for demonstration and training.
    - g. Preparation of Contractor's punch list.
    - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    - i. Submittal procedures.
    - j. Coordination of separate contracts.
    - k. Owner's partial occupancy requirements.
    - l. Installation of Owner's furniture, fixtures, and equipment.
    - m. Responsibility for removing temporary facilities and controls.
  4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: CM/GC will conduct progress meetings at weekly or biweekly intervals, as required.
1. Coordinate dates of meetings with preparation of payment requests.
  2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
  - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - 1) Review schedule for next period.
  - b. Review present and future needs of each entity present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Status of submittals.
    - 4) Deliveries.
    - 5) Off-site fabrication.
    - 6) Access.
    - 7) Site utilization.
    - 8) Temporary facilities and controls.
    - 9) Progress cleaning.
    - 10) Quality and work standards.
    - 11) Status of correction of deficient items.
    - 12) Field observations.
    - 13) Status of RFIs.
    - 14) Status of proposal requests.
    - 15) Pending changes.
    - 16) Status of Change Orders.
    - 17) Pending claims and disputes.
    - 18) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
  - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
5. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100



## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
1. Start-up construction schedule.
  2. Contractor's construction schedule.
  3. Daily construction reports.
  4. Special reports.
- B. Related Sections:
1. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
  2. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

#### 1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  2. Predecessor Activity: An activity that precedes another activity in the network.
  3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of the Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is the amount of time between the earliest start date and the latest start date or between the earliest finish date of a chain of activities on the Schedule. By a proposal request or modification delivered to the Contractor, the DFCM has the right to use the float time for non-critical path activities until the Contractor has reallocated such time on a newly submitted schedule.
- F. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. Printed copies, 11" x 17" maximum size.
- B. Start-up construction schedule.
  - 1. Approval of cost-loaded start-up construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. Reports:
- E. Field Condition Reports: Submit at time of discovery of differing conditions.
- F. Special Reports: Submit at time of unusual event.

#### 1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
  - 1. Review software limitations and content and format for reports.
  - 2. Verify availability of qualified personnel needed to develop and update schedule.
  - 3. Discuss constraints, including phasing, work stages, area separations, interim milestones, and partial Owner occupancy.
  - 4. Review delivery dates for Owner-furnished products.
  - 5. Review schedule for work of Owner's separate contracts.
  - 6. Review time required for review of submittals and resubmittals.

7. Review requirements for tests and inspections by independent testing and inspecting agencies.
8. Review time required for completion and startup procedures.
9. Review and finalize list of construction activities to be included in schedule.
10. Review submittal requirements and procedures.
11. Review procedures for updating schedule.

## 1.6 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
  1. Secure time commitments for performing critical elements of the Work from entities involved.
  2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

## PART 2 - PRODUCTS

### 2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
  1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
  1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
  4. Startup and Testing Time: Include not less than 15 days for startup and testing.
  5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction

Manager's administrative procedures necessary for certification of Substantial Completion.

6. Punch List and Final Completion: Include not more than 30 days for punch list and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
  2. Products Ordered in Advance: Include a separate activity for each product, as required by Owner or Architect. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  4. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing conditions.
    - b. Uninterruptible services.
    - c. Use of premises restrictions.
    - d. Environmental control.
  5. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
    - a. Subcontract awards.
    - b. Submittals.
    - c. Purchases.
    - d. Mockups.
    - e. Fabrication.
    - f. Sample testing.
    - g. Deliveries.
    - h. Installation.
    - i. Tests and inspections.
    - j. Adjusting.
    - k. Curing.
    - l. Startup and placement into final use and operation.
  6. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
    - a. Structural completion.
    - b. Permanent space enclosure.
    - c. Completion of mechanical installation.
    - d. Completion of electrical installation.
    - e. Substantial Completion.

- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Bid Package phases, Substantial Completion, and final completion.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
  - 1. Unresolved issues.
  - 2. Unanswered RFIs.
  - 3. Rejected or unreturned submittals.
  - 4. Notations on returned submittals.
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
  - 1. Utilize scheduling component of project Web site software specified in Division 01 Section "Project Management and Coordination", for Windows XP operating system.

## 2.2 START-UP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit start-up horizontal bar-chart-type construction schedule within seven days, unless otherwise specified, of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction.

## 2.3 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
  - 1. List of subcontractors at Project site.
  - 2. List of separate contractors at Project site.
  - 3. Approximate count of personnel at Project site.
  - 4. Equipment at Project site.
  - 5. Material deliveries.
  - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
  - 7. Accidents.

8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

## 2.4 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Scheduling: Refer to General Conditions for additional requirements.
  1. In-House: Contractor to employ skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
  2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- B. Contractor's Construction Schedule Updating: Refer to General Conditions for additional requirements.
- C. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
  1. Post copies in Project meeting rooms and temporary field offices.
  2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

USTAR Building #2  
Utah State University  
Life Sciences Research Center  
Logan, Utah

END OF SECTION 013200



## SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Preconstruction photographs.
  - 2. Periodic construction photographs.
  - 3. Final completion construction photographs.
- B. Related Sections:
  - 1. Division 01 Section "Submittal Procedures" for submitting photographic documentation.
  - 2. Division 01 Section "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.
  - 3. Division 01 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
  - 4. Division 02 Section "Structure Demolition" for photographic documentation before building demolition operations commence.
  - 5. Division 02 Section "Selective Structure Demolition" for photographic documentation before selective demolition operations commence.
  - 6. Division 31 Section "Site Clearing" for photographic documentation before site clearing operations commence.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph (and or video recording). Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files when requested by Owner or Architect.
  - 1. Digital Camera: Minimum sensor resolution of 5 megapixels.
  - 2. Identification: Provide the following information with each image description in file metadata tag:

- a. Name of Project.
- b. Name and contact information for photographer.
- c. Name of Architect and Construction Manager.
- d. Date photograph was taken.
- e. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
- f. Unique sequential identifier keyed to accompanying key plan.

## PART 2 - PRODUCTS

## PART 3 - EXECUTION

### 3.1 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Construction Manager's job site superintendent may take construction photographs, if qualified for digital media.
- B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
  1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
  1. Date and Time: Include date and time in file name for each image.
  2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.
- D. Preconstruction Photographs: Before commencement of site work and demolition, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
  1. Flag construction limits and excavation areas before taking construction photographs.
  2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
  3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
  4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- E. Periodic Construction Photographs: Take 20 photographs monthly, with timing each month adjusted to coincide with the cutoff date associated with each Application for

- Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Architect-Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- G. Time-Lapse Sequence Construction Photographs: Take 20 photographs as indicated, to show status of construction and progress since last photographs were taken.
1. Frequency: Take photographs monthly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment.
  2. Vantage Points: Following suggestions by Architect and photographer to select vantage points. During each of the following construction phases, take not less than two of the required shots from same vantage point each time to create a time-lapse sequence as follows:
    - a. Commencement of the Work, through completion of subgrade construction.
    - b. Above-grade structural framing.
    - c. Exterior building enclosure.
    - d. Interior Work, through date of Substantial Completion.
- H. Final Completion Construction Photographs: Take 20 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.
1. Do not include date stamp.
- I. Additional Photographs: Architect or Owner may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
1. Three days' notice will be given, where feasible.
  2. In emergency situations, take additional photographs within 24 hours of request.
  3. Circumstances that could require additional photographs include, but are not limited to, the following:
    - a. Special events planned at Project site.
    - b. Immediate follow-up when on-site events result in construction damage or losses.
    - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
    - d. Substantial Completion of a major phase or component of the Work.
    - e. Extra record photographs at time of final acceptance.
    - f. Owner's request for special publicity photographs.

END OF SECTION 013233



## SECTION 013300 - SUBMITTAL PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections:
  - 1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the schedule of values.
  - 2. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
  - 3. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
  - 4. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
  - 5. Division 01 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

#### 1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as action submittals.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as informational submittals.
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

#### 1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  - 2. Initial Submittal: Submit concurrently with start-up construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
  - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
  - 4. Format: Arrange the following information in a tabular format:
    - a. Scheduled date for first submittal.
    - b. Specification Section number and title.
    - c. Submittal category: Action, informational.
    - d. Name of subcontractor.
    - e. Description of the Work covered.
    - f. Scheduled date for Architect's and Construction Manager's final release or approval.
    - g. Scheduled dates for purchasing.
    - h. Scheduled dates for installation.
    - i. Activity or event number.

#### 1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings may be provided, upon request and receipt of Architect's Electronic Media Release form, by Architect for Contractor's use in preparing submittals.
  - 1. Architect may furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.

- a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
  - b. Digital Drawing Software Program: The Contract Drawings are available in AutoCad.
  - c. Contractor shall execute a data licensing agreement in the form of an agreement form acceptable to the Owner and Architect.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Construction Manager when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 days for review of each resubmittal.
  4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
  5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Construction Manager, through Architect.
- D. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.

2. Provide a space approximately 2 by 4 inches (50 by 100 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
  3. Include the following information for processing and recording action taken:
    - a. Project name.
    - b. Date.
    - c. Name of subcontractor.
    - d. Name of supplier.
    - e. Name of manufacturer.
    - f. Submittal number or other unique identifier, including revision identifier.
      - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
    - g. Number and title of appropriate Specification Section.
    - h. Drawing number and detail references, as appropriate.
    - i. Location(s) where product is to be installed, as appropriate.
    - j. Other necessary identification.
- E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
  2. Name file with submittal number or other unique identifier, including revision identifier.
    - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
  3. Provide means for insertion to permanently record review and approval markings and action taken by Architect and Construction Manager.
  4. Include the following information on an inserted cover sheet:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect.
    - d. Name of Construction Manager.
    - e. Name of firm or entity that prepared submittal.
    - f. Name of subcontractor.
    - g. Name of supplier.
    - h. Name of manufacturer.
    - i. Number and title of appropriate Specification Section.
    - j. Drawing number and detail references, as appropriate.
    - k. Location(s) where product is to be installed, as appropriate.



Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

- J. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  - 1. Note date and content of previous submittal.
  - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  - 3. Resubmit submittals until they are marked with approval notation from Architect's and Construction Manager's action stamp.
- K. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- L. Use for Construction: Use only final submittals that are marked with approval notation from Architect's and Construction Manager's action stamp.

## PART 2 - PRODUCTS

### 2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Action Submittals: Submit six (6) paper copies of each submittal, unless otherwise indicated. Architect, through Construction Manager, will return four copies.
  - 2. Informational Submittals: Submit two paper copies of each submittal, unless otherwise indicated. Architect will not return copies.
  - 3. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
  - 4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
  - 5. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
  - 3. Include the following information, as applicable:

- a. Manufacturer's catalog cuts.
  - b. Manufacturer's product specifications.
  - c. Standard color charts.
  - d. Statement of compliance with specified referenced standards.
  - e. Testing by recognized testing agency.
  - f. Application of testing agency labels and seals.
  - g. Notation of coordination requirements.
  - h. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
- a. Wiring diagrams showing factory-installed wiring.
  - b. Printed performance curves.
  - c. Operational range diagrams.
  - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:
- a. Three paper copies of Product Data, unless otherwise indicated. Architect, through Construction Manager, will return two copies.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based upon Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (750 by 1067 mm).
  3. Submit Shop Drawings in the following format:
    - a. Six opaque copies of each submittal. Architect and engineer will retain two copies; remainder will be returned.

- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
  3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal to Construction Manager with options selected.
  5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample set; remainder will be returned. Mark up and retain one returned Sample set as a Project record sample.
      - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

- 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.
  5. Submit product schedule in the following format:
    - a. Three paper copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
- F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. LEED Submittals: Comply with requirements specified in Division 01 Section "Sustainable Design Requirements."
1. Submit LEED submittals in the following format:
    - a. Three paper copies of LEED submittals.
- J. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.
- M. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

- N. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- Q. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- R. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - 1. Name of evaluation organization.
  - 2. Date of evaluation.
  - 3. Time period when report is in effect.
  - 4. Product and manufacturers' names.
  - 5. Description of product.
  - 6. Test procedures and results.
  - 7. Limitations of use.
- T. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- W. Field Test Reports: Submit reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- X. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

- Y. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

## 2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit six paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
  - 2. Delegated Design Engineer's are to be licensed in the State of Utah.

## PART 3 - EXECUTION

### 3.1 CONSTRUCTION MANAGER'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include name of reviewer, date of Contractor's approval. Stamp submittal shall indicate Contractor's review has been completed, and that the submittal has been reviewed, and checked for compliance with the Contract Documents.

### 3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Construction Manager's approval stamp and will return them without action.

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- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
  - 1. REVIEWED.
  - 2. REVISE AND RESUBMIT.
  - 3. FURNISH AS CORRECTED.
  - 4. REJECTED.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate design team party.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.
- E. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

## SECTION 014000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections:
  - 1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
  - 2. Divisions 02 through 49 Sections for specific test and inspection requirements.

#### 1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

- C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
1. Laboratory Mockups: Full-size, physical assemblies constructed at testing facility to verify performance characteristics.
  2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on the project site, consisting of multiple products, assemblies and subassemblies.
  3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- D. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

#### 1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

#### 1.5 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in

individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
  2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
    - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
  2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, through Construction Manager. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect or Construction Manager.

2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  3. Demonstrate the proposed range of aesthetic effects and workmanship.
  4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.
  5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  6. Demolish and remove mockups when directed, unless otherwise indicated.
- L. Integrated Exterior Mockups: Construct integrated exterior mockup in accordance with approved Shop Drawings or as indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual specification sections, along with supporting materials.
- M. Provide required lighting and additional lighting where required to enable Architect to evaluate quality of the Room Mockups: Construct room mockups incorporating required materials and assemblies, finished in accordance with requirements. Work.
- N. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections in Divisions 02 through 49.

#### 1.6 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. **Retesting/Reinspecting:** Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. **Testing Agency Responsibilities:** Cooperate with Architect and Construction Manager in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Construction Manager of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform any duties of Contractor.
- G. **Associated Services:** Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

#### 1.7 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency / special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 TEST AND INSPECTION LOG

- A. Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
  2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Architect.
  4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

#### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams

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that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

### 1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

### 1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
ACI	American Concrete Institute www.concrete.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216

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AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)	
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems (See APA - The Engineered Wood Association)	
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300

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ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9500
AWCI	Association of the Wall and Ceiling Industry www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (Now WCMA)	
AWI	Architectural Woodwork Institute www.awinet.org	(571) 323-3636
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association) www.awpa.com	(205) 733-4077
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200
CGA	Compressed Gas Association	(703) 788-2700

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[www.cganet.com](http://www.cganet.com)

CISCA	Ceilings & Interior Systems Construction Association <a href="http://www.cisca.org">www.cisca.org</a>	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute <a href="http://www.cispi.org">www.cispi.org</a>	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute <a href="http://www.chainlinkinfo.org">www.chainlinkinfo.org</a>	(301) 596-2583
CRRC	Cool Roof Rating Council <a href="http://www.coolroofs.org">www.coolroofs.org</a>	(866) 465-2523 (510) 485-7175
CPA	Composite Panel Association <a href="http://www.pbmdf.com">www.pbmdf.com</a>	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association <a href="http://www.cppa-info.org">www.cppa-info.org</a>	(800) 510-2772 (202) 462-9607
CRI	Carpet and Rug Institute (The) <a href="http://www.carpet-rug.com">www.carpet-rug.com</a>	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute <a href="http://www.crsi.org">www.crsi.org</a>	(847) 517-1200
CSA	CSA International (Formerly: IAS - International Approval Services) <a href="http://www.csa-international.org">www.csa-international.org</a>	(866) 797-4272 (416) 747-4000
CSI	Construction Specifications Institute (The) <a href="http://www.csinet.org">www.csinet.org</a>	(800) 689-2900 (703) 684-0300
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) <a href="http://www.cti.org">www.cti.org</a>	(281) 583-4087
DHI	Door and Hardware Institute <a href="http://www.dhi.org">www.dhi.org</a>	(703) 222-2010
EIA	Electronic Industries Alliance <a href="http://www.eia.org">www.eia.org</a>	(703) 907-7500
EJCDC	Engineers Joint Contract Documents Committee <a href="http://www.ejdc.org">www.ejdc.org</a>	(703) 295-5000
EJMA	Expansion Joint Manufacturers Association, Inc. <a href="http://www.ejma.org">www.ejma.org</a>	(914) 332-0040

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FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000
FMRC	Factory Mutual Research (Now FM Global)	
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	49 228 367 66 0
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GRI	(Part of GSI)	
GS	Green Seal www.greenseal.org	(202) 872-6400
GSI	Geosynthetic Institute www.geosynthetic-institute.org	(610) 522-8440
HI	Hydraulic Institute www.pumps.org	(973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAS	International Approval Services (Now CSA International)	
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369

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ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 255-1561
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
	Available from ANSI www.ansi.org	(202) 293-8020
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (702) 567-8150
ITS	Intertek Testing Service NA (Now ETL SEMCO)	
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
LMA	Laminating Materials Association (Now part of CPA)	
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864
MFMA	Metal Framing Manufacturers Association, Inc. www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America	(800) 345-1815

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	www.mhia.org	(704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937 (604) 298-7578
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(630) 942-6591
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6623 (281) 228-6200
NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-2300
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NelMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (269) 488-6382
NFHS	National Federation of State High School Associations	(317) 972-6900

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	www.nfhs.org	
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOMMA	National Ornamental & Miscellaneous Metals Association www.nomma.org	(888) 516-8585
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736 (540) 751-0930
OPL	Omega Point Laboratories, Inc. (Now ITS)	
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDCA	Painting & Decorating Contractors of America www.pdca.com	(800) 332-7322 (314) 514-7322
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720

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PTI	Post-Tensioning Institute <a href="http://www.post-tensioning.org">www.post-tensioning.org</a>	(602) 870-7540
RCSC	Research Council on Structural Connections <a href="http://www.boltcouncil.org">www.boltcouncil.org</a>	
RFCI	Resilient Floor Covering Institute <a href="http://www.rfci.com">www.rfci.com</a>	(301) 340-8580
SAE	SAE International <a href="http://www.sae.org">www.sae.org</a>	(877) 606-7323 (724) 776-4841
SDI	Steel Deck Institute <a href="http://www.sdi.org">www.sdi.org</a>	(847) 458-4647
SDI	Steel Door Institute <a href="http://www.steeldoor.org">www.steeldoor.org</a>	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association <a href="http://www.sefalabs.com">www.sefalabs.com</a>	(877) 294-5424 (516) 294-5424
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SGCC	Safety Glazing Certification Council <a href="http://www.sgcc.org">www.sgcc.org</a>	(315) 646-2234
SIA	Security Industry Association <a href="http://www.siaonline.org">www.siaonline.org</a>	(866) 817-8888 (703) 683-2075
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)	
SJI	Steel Joist Institute <a href="http://www.steeljoist.org">www.steeljoist.org</a>	(843) 626-1995
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association <a href="http://www.smacna.org">www.smacna.org</a>	(703) 803-2980
SMPTE	Society of Motion Picture and Television Engineers <a href="http://www.smpte.org">www.smpte.org</a>	(914) 761-1100
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division) <a href="http://www.sprayfoam.org">www.sprayfoam.org</a>	(800) 523-6154
SPRI	Single Ply Roofing Industry	(781) 647-7026

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[www.spri.org](http://www.spri.org)

SSINA	Specialty Steel Industry of North America <a href="http://www.ssina.com">www.ssina.com</a>	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings <a href="http://www.sspc.org">www.sspc.org</a>	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute <a href="http://www.steeltank.com">www.steeltank.com</a>	(847) 438-8265
SWRI	Sealant, Waterproofing, & Restoration Institute <a href="http://www.swrionline.org">www.swrionline.org</a>	(816) 472-7974
TCA	Tile Council of America, Inc. (Now TCNA)	
TCNA	Tile Council of North America, Inc. <a href="http://www.tileusa.com">www.tileusa.com</a>	(864) 646-8453
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance <a href="http://www.tiaonline.org">www.tiaonline.org</a>	(703) 907-7700
TMS	The Masonry Society <a href="http://www.masonrysociety.org">www.masonrysociety.org</a>	(303) 939-9700
TPI	Turfgrass Producers International <a href="http://www.turfgrasssod.org">www.turfgrasssod.org</a>	(800) 405-8873 (847) 649-5555
UL	Underwriters Laboratories Inc. <a href="http://www.ul.com">www.ul.com</a>	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association <a href="http://www.uni-bell.org">www.uni-bell.org</a>	(972) 243-3902
USGBC	U.S. Green Building Council <a href="http://www.usgbc.org">www.usgbc.org</a>	(800) 795-1747
WCLIB	West Coast Lumber Inspection Bureau <a href="http://www.wclib.org">www.wclib.org</a>	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association <a href="http://www.wcmanet.org">www.wcmanet.org</a>	(212) 297-2122
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association) <a href="http://www.windowcoverings.org">www.windowcoverings.org</a>	(800) 506-4636 (212) 297-2109

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WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) www.wicnet.org	(916) 372-9943
WIC	Woodwork Institute of California (Now WI)	
WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 570-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE	Army Corps of Engineers www.usace.army.mil	(202) 761-0011
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce www.commerce.gov	(202) 482-2000

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DOE	Department of Energy <a href="http://www.energy.gov">www.energy.gov</a>	(202) 586-9220
EPA	Environmental Protection Agency <a href="http://www.epa.gov">www.epa.gov</a>	(202) 272-0167
FCC	Federal Communications Commission <a href="http://www.fcc.gov">www.fcc.gov</a>	(888) 225-5322
FDA	Food and Drug Administration <a href="http://www.fda.gov">www.fda.gov</a>	(888) 463-6332
GSA	General Services Administration <a href="http://www.gsa.gov">www.gsa.gov</a>	(800) 488-3111
LBL	Lawrence Berkeley National Laboratory <a href="http://www.lbl.gov">www.lbl.gov</a>	(510) 486-4000
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology <a href="http://www.nist.gov">www.nist.gov</a>	(301) 975-6478
OSHA	Occupational Safety & Health Administration <a href="http://www.osha.gov">www.osha.gov</a>	(800) 321-6742 (202) 693-1999
PBS	Public Buildings Service (See GSA)	
PHS	Office of Public Health and Science <a href="http://www.osophs.dhhs.gov/ophs">www.osophs.dhhs.gov/ophs</a>	(202) 690-7694
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
TRB	Transportation Research Board <a href="http://gulliver.trb.org">http://gulliver.trb.org</a>	(202) 334-2934
USDA	Department of Agriculture <a href="http://www.usda.gov">www.usda.gov</a>	(202) 720-2791
USPS	Postal Service <a href="http://www.usps.com">www.usps.com</a>	(202) 268-2000

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and

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Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board <a href="http://www.access-board.gov">www.access-board.gov</a>	(800) 872-2253 (202) 272-0080
CFR	Code of Federal Regulations Available from Government Printing Office <a href="http://www.gpoaccess.gov/cfr/index.html">www.gpoaccess.gov/cfr/index.html</a>	(866) 512-1800 (202) 512-1800
FED-STD	Federal Standard (See FS)	
FS	Federal Specification Available from Department of Defense Single Stock Point <a href="http://dodssp.daps.dla.mil">http://dodssp.daps.dla.mil</a>  Available from Defense Standardization Program <a href="http://www.dps.dla.mil">www.dps.dla.mil</a>  Available from General Services Administration <a href="http://www.gsa.gov">www.gsa.gov</a>  Available from National Institute of Building Sciences <a href="http://www.wbdg.org/ccb">www.wbdg.org/ccb</a>	(215) 697-2664        (202) 619-8925  (202) 289-7800
FTMS	Federal Test Method Standard (See FS)	
UFAS	Uniform Federal Accessibility Standards Available from Access Board <a href="http://www.access-board.gov">www.access-board.gov</a>	(800) 872-2253 (202) 272-0080

- F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections:
  - 1. Division 01 Section "Summary" for work restrictions and limitations on utility interruptions.
  - 2. Division 31 Section "Dewatering" for disposal of ground water at Project site.
  - 3. Division 32 Section "Concrete Paving" for construction and maintenance of cement concrete pavement for temporary roads and paved areas.

#### 1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.
- B. Water Service: Pay water service use charges for water used by all entities for construction operations.
- C. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

#### 1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

## 1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Portable Chain-Link Fencing, where indicated: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails.

### 2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
  - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.

### 2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 each return air

grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section "Closeout Procedures".

- C. Air Filtration Units: HEPA primary and secondary filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
  - 1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

#### 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting

installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
1. Install electric power service overhead, unless otherwise indicated.
  2. Connect temporary service to Owner's existing power source, as directed by Owner.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install a minimum of one telephone line(s) for each field office.
1. Provide additional telephone lines for the following:
    - a. Provide a dedicated telephone line for each facsimile machine in each field office.
  2. At each telephone, post a list of important telephone numbers.
    - a. Police and fire departments.
    - b. Ambulance service.
    - c. Contractor's home office.
    - d. Architect's office.
    - e. Engineers' offices.
    - f. Owner's office.
    - g. Principal subcontractors' field and home offices.
  3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

### 3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.

2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
  2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 31 Section "Earth Moving."
  3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
  4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 32 Section "Asphalt Paving."
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Provide temporary parking areas for construction personnel.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
  2. Remove snow and ice as required to minimize accumulations.
- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
  2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    - a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.
- H. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- I. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.
- J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- K. Temporary Elevator Use: Use of elevators is not permitted.
- L. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- M. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

#### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  1. Comply with work restrictions specified in Division 01 Section "Summary."
- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and specifications.
  1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
  2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
  3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from the project site during the course of the project.
  4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

- D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- F. Site Enclosure Fence: Prior to commencing site demolition and earthwork, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
  - 1. Extent of Fence: As indicated on Drawings.
  - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- K. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
  - 1. Prohibit smoking in construction areas.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
  1. Protect porous materials from water damage.
  2. Protect stored and installed material from flowing or standing water.
  3. Keep porous and organic materials from coming into prolonged contact with concrete.
  4. Remove standing water from decks.
  5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
  1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  2. Keep interior spaces reasonably clean and protected from water damage.
  3. Periodically collect and remove waste containing cellulose or other organic matter.
  4. Discard or replace water-damaged material.
  5. Do not install material that is wet.
  6. Discard, replace or clean stored or installed material that begins to grow mold.
  7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
  1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
  2. Use permanent HVAC system to control humidity.
  3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
    - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
    - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings

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- over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
- c. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

END OF SECTION 015000



## SECTION 016000 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Sections:
  - 1. Division 01 Section "Alternates" for products selected under an alternate.
  - 2. Division 01 Section "Substitution Procedures" for requests for substitutions.
  - 3. Division 01 Section "References" for applicable industry standards for products specified.

#### 1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance,

physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

#### 1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
  - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
    - a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
    - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

#### 1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
  - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
  - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

#### 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
  3. Refer to Divisions 02 through 49. Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
  6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. Product: Where Value Based Selection process names a single manufacturer and product, provide the named product that complies with requirements.
  2. Manufacturer/Source: Where Value Based Selection process names a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
  3. Products:
    - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions will be considered by Value Based Selection.
    - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
  4. Manufacturers:
    - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions will be considered by Value Based Selection process.

- b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
  1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
  1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
  5. Samples, if requested.

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PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

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## SECTION 017300 - EXECUTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Cutting and patching.
  - 5. Coordination of Owner-installed products.
  - 6. Progress cleaning.
  - 7. Starting and adjusting.
  - 8. Protection of installed construction.
  - 9. Correction of the Work.
- B. Related Sections:
  - 1. Division 01 Section "Submittal Procedures" for submitting surveys.
  - 2. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
  - 3. Division 07 Section "Penetration Firestopping" for patching penetrations in fire-rated construction.

#### 1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor and professional engineer.

- B. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- D. Certified Surveys: Submit two copies signed by land surveyor or professional engineer.
- E. Final Property Survey: Submit 5 copies showing the Work performed and record survey data.

### 1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
  - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from the Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
  - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
    - a. Primary operational systems and equipment.
    - b. Fire separation assemblies.
    - c. Air or smoke barriers.
    - d. Fire-suppression systems.
    - e. Mechanical systems piping and ducts.
    - f. Control systems.
    - g. Communication systems.
    - h. Conveying systems.
    - i. Electrical wiring systems.
    - j. Operating systems of special construction.
  - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
    - a. Water, moisture, or vapor barriers.
    - b. Membranes and flashings.

- c. Exterior curtain-wall construction.
  - d. Equipment supports.
  - e. Piping, ductwork, vessels, and equipment.
  - f. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

## 1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- 1. For projects requiring compliance with sustainable design and construction practices and procedures, utilize products for patching that comply with requirements of Division 01 Section "Sustainable Design Requirements."
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
- 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to the Architect for the visual and functional performance of in-place materials.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and electrical systems, and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
  2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
    - a. Description of the Work.
    - b. List of detrimental conditions, including substrates.
    - c. List of unacceptable installation tolerances.
    - d. Recommended corrections.
  2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field

measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a qualified land surveyor or professional engineer to lay out the Work using accepted surveying practices.
  - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 3. Inform installers of lines and levels to which they must comply.
  - 4. Check the location, level and plumb, of every major element as the Work progresses.
  - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
  - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### 3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
  - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a qualified land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
  - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
  - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

### 3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.

2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
  4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  2. Allow for building movement, including thermal expansion and contraction.
  3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Temporary Support: Provide temporary support of work to be cut.
- C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements of Division 01 Section "Summary."
- E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
  5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  6. Proceed with patching after construction operations requiring cutting are complete.
- G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

- a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
  - b. Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
- a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
  1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
  2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

### 3.8 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Utilize containers intended for holding waste materials of type to be stored.
  4. Coordinate progress cleaning for joint-use areas where more than one installer has worked.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 Section "General Commissioning Requirements."

- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

### 3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

### 3.11 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300



## SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Salvaging nonhazardous demolition and construction waste.
  - 2. Recycling nonhazardous demolition and construction waste.
  - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Sections:
  - 1. Division 02 Section "Structure Demolition" for disposition of waste resulting from demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.
  - 2. Division 04 Section "Unit Masonry" for disposal requirements for masonry waste.
  - 3. Division 31 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

#### 1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including but not limited to the following:

1. Demolition Waste:
  - a. Asphaltic concrete paving.
  - b. Concrete.
  - c. Concrete reinforcing steel.
  - d. Brick.
  - e. Concrete masonry units.
  - f. Wood studs.
  - g. Wood joists.
  - h. Plywood and oriented strand board.
  - i. Wood paneling.
  - j. Wood trim.
  - k. Structural and miscellaneous steel.
  - l. Rough hardware.
  - m. Roofing.
  - n. Insulation.
  - o. Doors and frames.
  - p. Door hardware.
  - q. Windows.
  - r. Glazing.
  - s. Metal studs.
  - t. Gypsum board.
  - u. Acoustical tile and panels.
  - v. Carpet.
  - w. Carpet pad.
  - x. Demountable partitions.
  - y. Equipment.
  - z. Cabinets.
  - aa. Plumbing fixtures.
  - bb. Piping.
  - cc. Supports and hangers.
  - dd. Valves.
  - ee. Sprinklers.
  - ff. Mechanical equipment.
  - gg. Refrigerants.
  - hh. Electrical conduit.
  - ii. Copper wiring.
  - jj. Lighting fixtures.

- kk. Lamps.
- ll. Ballasts.
- mm. Electrical devices.
- nn. Switchgear and panelboards.
- oo. Transformers.

2. Construction Waste:

- a. Site-clearing waste.
- b. Masonry and CMU.
- c. Lumber.
- d. Wood sheet materials.
- e. Wood trim.
- f. Metals.
- g. Roofing.
- h. Insulation.
- i. Carpet and pad.
- j. Gypsum board.
- k. Piping.
- l. Electrical conduit.
- m. Packaging: Regardless of salvage/recycle goal indicated in paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

- 1) Paper.
- 2) Cardboard.
- 3) Boxes.
- 4) Plastic sheet and film.
- 5) Polystyrene packaging.
- 6) Wood crates.
- 7) Plastic pails.

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
  - 1. Material category.
  - 2. Generation point of waste.
  - 3. Total quantity of waste in tons (tonnes).
  - 4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
  - 5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
  - 6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).

7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. LEED Submittal: LEED letter template for Credit MR 2.1 and 2.2, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.
- H. Qualification Data: For waste management coordinator.

#### 1.7 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced and qualified employee of Construction Manager/General Contractor's firm, with a record of successful waste management coordination of Projects with similar requirements, Waste management coordinator may also serve as LEED coordinator.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
  1. Review and discuss waste management plan including responsibilities of waste management coordinator.
  2. Review requirements for documenting quantities of each type of waste and its disposition.
  3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
  4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.

5. Review waste management requirements for each trade.

## 1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements of this Section. Plan shall consist of waste identification, waste reduction work plan. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
  1. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
  2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
  3. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
  1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
  1. Distribute waste management plan to everyone concerned within three days of submittal return.

2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
  2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

### 3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
    - a. Inspect containers and bins for contamination and remove contaminated materials if found.
  2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
  4. Store components off the ground and protect from the weather.
  5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

### 3.3 RECYCLING DEMOLITION WASTE

- A. Recycle Demolition waste where possible, if feasible, and as required for LEED requirements.

### 3.4 RECYCLING CONSTRUCTION WASTE

#### A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

### 3.5 DISPOSAL OF WASTE

#### A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

#### B. Burning: Do not burn waste materials.

#### C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419



## SECTION 017700 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
- B. Related Sections:
  - 1. Division 01 Section "Photographic Documentation" for submitting final completion construction photographic documentation.
  - 2. Division 01 Section "Execution" for progress cleaning of Project site.
  - 3. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 4. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 5. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
  - 6. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

#### 1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
  - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  - 2. Advise Owner of pending insurance changeover requirements.
  - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  5. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
  6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  8. Complete startup testing of systems.
  9. Submit test/adjust/balance records.
  10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  11. Advise Owner of changeover in heat and other utilities.
  12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
  13. Complete final cleaning requirements, including touchup painting.
  14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Construction Manager of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Construction Manager of items, either on punchlist list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for final completion.

#### 1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
  2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report and warranty.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Construction Manager of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Construction Manager of construction that must be completed or corrected before certificate will be issued.
  1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A, or form acceptable to Owner.
  1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Construction Manager.
    - e. Page number.
  4. Submit list of incomplete items in the following format:
    - a. Three paper copies of product schedule or list, unless otherwise indicated. Architect will return two copies.

#### 1.6 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind one (1) set of warranties and bonds in heavy-duty, three-ring, white, Burkman binder, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper. Warranties binder to be separate from Operation and Maintenance binders.
  2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Construction Manager and subcontractor.
  4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document. Submit electronic media on CD-R for Owner's archive.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

- a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
- b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
- c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
- e. Remove snow and ice to provide safe access to building.
- f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- h. Sweep concrete floors broom clean in unoccupied spaces.
- i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
- j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
- k. Remove labels that are not permanent.
- l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
  - 1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
- m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
- o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- q. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.
  - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report upon completion of cleaning.

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- r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
  - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."

END OF SECTION 017700

## SECTION 017823

### OPERATION AND MAINTENANCE MANUALS

#### 1.0 GENERAL

#### 1.1 DESCRIPTION

- A. The contractor shall provide Owner with manuals for the safe and effective Operation and Maintenance (O&M) of the systems and equipment listed. O&M Manual requirements included in other Sections of this Specification are in addition to, and do not replace, those required in this Section. Refer to the Commissioning section, 019113, paragraph 1.3 for a list of equipment requiring O & M manuals.

#### 1.2 FORMAT

- A. Bind manuals in durable, locking, 3-ring binders. Binders shall be white view-type binders with clear plastic overlays to allow insertion of title pages for binder identification.
- B. Use 8-1/2" x 11" sheets, except that larger sheets up to 11" x 17" may be used when double folded to this size and used as a pull-out. Documents which are larger than 11" x 17" shall be reduced to 11" x 17" for inclusion in the manuals except where this compromises legibility (for drawings that are to scale, add a graphic scale prior to reduction). Documents that cannot be reduced will be folded and inserted in plastic envelopes inserted in the binders so that the folded documents are securely bound into the binders. Loosely inserted documents or documents inserted into pockets in the inside covers of the binders shall not be acceptable.
- C. Each binder shall be labeled on both cover and spine to indicate project name and Owner's project number, submitting contractor, date, general contents, volume number and total number of volumes in set.
- D. At the front of each binder include the following information:
- 1 Master Table of Contents (TOC) identifying chapter headings and numbers for all O&M Manual volumes provided by the submitting contractor.
  - 2 Detailed TOC for the current volume listing, in order, the sections and subsections within each chapter of that specific manual.
  - 3 Contact sheet for the submitting contractor listing appropriate contact names, addresses, phone numbers, and email addresses
  - 4 Introduction including a brief description of project and purpose of the manual.
- E. Manuals shall be divided into chapters based on specification sections. Chapters shall be identified using both the specification section number and name (i.e. 232123 Hydronic Pumps). Manual chapters shall be further subdivided into sections and sub-sections as appropriate for clarity of organization and to facilitate use by Owner.

Chapters shall be separated by index tabs labeled with the covered specification name and number. Chapter division tabs shall be identical to each other in style and appearance, but different than the section division tabs.

Major sections within a chapter shall be separated by index tabs, which indicate the equipment or

material covered. Section division tabs shall be identical to each other in style and appearance, but different than the chapter division tabs.

Provide a complete bill of materials in matrix format.

- F. In addition to the hard copy O&M manuals, provide one full set of electronic O&M manuals for each set of hard copies. The electronic format shall be of the owner's choice (i.e. DVD, CD).

### 1.3 SUBMITTALS

- A. Format Submittal. The Contractor shall submit four (4) copies of their proposed O&M Manual format including a detailed outline of contents within ninety (90) days after approval of final submittals. Owner will require ninety (90) days for format review.
- B. Preliminary Submittal. Two (2) copies of the draft manuals shall be submitted to Owner for review no less than 3 months prior to the anticipated start of operator training. One copy will be returned to the Contractor within sixty (60) days after submittal and, if required, shall be revised and resubmitted within thirty (30) days.
- C. Final Submittal. Four (4) complete sets of manuals and electronic copies shall be furnished to Owner thirty (30) days prior to the anticipated start of operator training.

## 2.0 REQUIREMENTS

### 2.1 PURPOSE

- A. The Operation and Maintenance manuals are for the training of, and use by, Owner's employees in the operation and maintenance of the systems and equipment as specified below. The manuals shall consist of instruction on systems and equipment. A separate manual or set of manuals shall be prepared for each class of components, equipment or systems as specified.

### 2.2 CONTENT

- A. Each chapter shall contain the following, information in addition to the requirements specified elsewhere in these specifications.
  - 1 Contact list identifying vendors providing equipment and systems covered in the current chapter. This information shall include vendor name, address, name of contact person(s), phone numbers (including 24 hour service numbers where appropriate), fax numbers, and email addresses.
  - 2 Equipment/material schedule(s) for all covered equipment and systems showing equipment identification (tag) number, manufacturer, model number, serial number, quantities, area/system served, equipment location, etc.
  - 3 Safety Precautions. This subsection shall comprise a listing of safety precautions and instructions to be followed during operation and before, during, and after repairs or adjustments are made.
- B. Each chapter shall describe the procedures necessary for Owner's personnel to operate and maintain the systems and equipment covered in that chapter.
- C. References shall be made, as appropriate, to drawings, schematics, sequences of operation and other information included as part of the construction contract drawings and specifications that show distribution system layout, equipment arrangements and items of control.

- D. All information included in the final O&M Manuals, including equipment schedules, manufacturer's literature, drawings, etc. shall represent the "as-built" condition.
- E. Manufacturer's literature and other information provided in the O&M Manuals shall be for the actual equipment installed under contract for the particular facility. Where literature (standard product catalogs, cut-sheets, etc.) contains data pertaining to parts, equipment or options other than those specifically provided for this project, the contractor shall clearly indicate the specific products, model numbers, and options provided. Mark-ups made by the contractor for this purpose shall be made in a manner that will clearly photocopy (no highlighters).
- F. A brief description of each type of required information follows:
- 1 Warranty information
    - a. Provide copies of all warranty certificates from equipment manufacturers
    - b. If not included on warranty certificate, provide the start/end dates of warranty period, descriptions of what is and isn't covered and contact information for warranty claims (if different from contact list described above).
    - c. Provide information of an operations or maintenance nature covering warranty items that have not been discussed elsewhere.
  - 2 Product Information.
    - a. Provide manufacturers' standard, published product literature describing covered materials, equipment and devices including illustrations, exploded views, dimensions, weights, application data, etc.
    - b. Where manufacturer's product information (catalog cut-sheets, etc.) contain data pertaining to parts, equipment or options other than those specifically provided for this project, the contractor shall clearly indicate the specific products, model numbers, and options provided. Mark-ups made by the contractor for this purpose shall be made in a manner that will clearly photocopy (no highlighters).
    - c. Provide manufacturer's standard, published Installation, Operation & Maintenance bulletins pertaining to the specific equipment installed.
    - d. Provide performance curves and rating data, specific to the equipment installed on the project such as fan and pump curves, chiller selection sheets, sound data, etc.
    - e. Provide a copy of all approved shop drawings covering approval of equipment for the project with the product information. Include all data concerning changes made during construction.
  - 3 Preventive Maintenance Procedures & Schedules
    - a. Provide written preventive maintenance procedures describing each required PM task. Procedures shall include lists of tools and parts required and all safety precautions to be taken.
    - b. State, preferably in tabular form, the recommended frequency for each preventive maintenance task (cleaning, inspection, lubrication, scheduled overhauls, etc.). Task schedules shall be grouped and sorted by frequency (daily, weekly, quarterly, annually, etc.)
    - c. Procedures for lubrication of equipment shall indicate both the type and quantity of lubricant to be used.
    - d. If periodic inspection of equipment is required for operation, cleaning, or other reasons, indicate the items to be inspected and give the inspection criteria. Examples of equipment requiring inspections include, but are not limited to, the following:

1) Motors

- 2) Controls
  - 3) Filters
  - 4) Heat exchangers
  - 5) Emergency Generator and associated fuel system
  - 6) ATS and associated systems
  - 7) TVSS and associated systems
- e. Provide instruction for the proper handling, disposal and/or removal of hazardous or otherwise special materials such as used filters, refrigerant, oils, chemicals, etc.
- f. Provide instruction for minor repairs or adjustments required for preventive maintenance routines. Minor repair and adjustment shall be limited to repairs and adjustments that may be performed without special tools or test equipment and that require no special training or skills. Identify test points and give values for each.
- 4 Corrective Maintenance Procedures
- a. Corrective Maintenance. Corrective maintenance instructions shall be predicated upon a logical effect-to-cause troubleshooting philosophy and a rapid replacement procedure to minimize equipment downtime. Instructions and data shall appear in the normal sequence of corrective maintenance, for example, troubleshooting first, repair and replacement of parts second, and then the parts list.
  - b. Troubleshooting. This information shall describe the general procedure for locating malfunctions and shall give, in detail, any specific remedial procedures or techniques. The data shown are intended to isolate only the most common equipment deficiencies. Troubleshooting tables, charts, or diagrams may be used to present specific procedures. A guide to this type shall be a three-column chart. The columns shall be entitled Malfunction, Probable Cause, and Recommended Action. The information shall be alphabetically arranged by component, and each component shall, in turn, list deficiencies that may be expected. Each deficiency shall contain one or more problems with a recommended correction.
  - c. Repair and Replacement. Indicate the repair and replacement procedures most likely to be required in the maintenance of the systems and equipment. Information included here shall consist of step-by-step instructions for repair and replacement of defective items. Include all information required to accomplish repair or replacement, including information such as torque values. Identify all tools, special equipment, and materials that may be required. Identify uses for maintenance equipment. The paragraphs shall contain headings to identify the topics covered.
- 5 Spare Parts Lists.
- a. Provide a list of all spare parts for the covered equipment. The parts list shall include a tabulation of descriptive data for each part including part number and manufacturer. Where available, provide an exploded diagram of the equipment identifying parts listed in the spare parts list.
  - b. Provide a list of recommended spare parts to be kept in inventory by the Owner's maintenance staff for performance of preventive maintenance and typical corrective maintenance tasks.
- 6 System Descriptions:
- a. Provide a narrative, (both typewritten and electronic format), describing, in general terms, the covered equipment / system. Topics to be covered in this narrative shall include theory

of operation, overall system layout, description of major components, interconnections with utilities and other systems, description of control system layout and operation, identification of unusual features or functions, and major safety precautions. This information should correlate with information provided in the manufacturers' standard published literature.

- b. Provide the following data (if not already being provided under the other requirements in this specification):
  - 1) Detailed illustrations and schematic diagrams of each system showing major components, piping, valves, controls, utility connections, and other components, where applicable.
  - 2) Wiring and control diagrams with data to explain detailed operation and control of each component.
  - 3) Control sequences describing start-up, all modes of operation, and shut down.
  - 4) Corrected shop drawings.
  - 5) Copies of approved certifications and laboratory test reports (where applicable).
- 7 Operating Instructions:
  - a. Provide, (both typewritten and electronic format), condensed instructions for operation of the covered system / equipment. Where more than one (1) common unit is installed, one set of instructions is adequate. The instructions shall provide procedures for:
    - 1) Starting up the equipment/system.
    - 2) Shutting down the equipment/system.
    - 3) Normal operating procedures.
    - 4) Procedures for operating the equipment / system in emergency or unusual conditions.
    - 5) Safety precautions.
    - 6) Procedures for both short-term and long-term equipment lay-up.
    - 7) Other pertinent data applicable to the operation of particular systems or equipment.
    - 8) The instructions shall be suitable for posting adjacent to the equipment concerned.
- 8 Factory Test Reports
  - a. Provide copies of factory test reports specified in the covered section of the specifications.
  - b. Test reports should include a brief description of the test procedures used, test date, names of personnel performing test, names of personnel witnessing test (if any), test results and comparison of test results with specified acceptance criteria.
- 9 Field Test Reports
  - a. Provide copies of field test reports specified in the covered section of the specifications. Samples of field testing include, but are not limited to, leak testing of piping and ductwork and megger testing of electrical distribution systems.
  - b. Test reports shall clearly indicate the type of test performed, test procedures used, system being tested, section or area of equipment being tested, date of test, signatures of personnel performing and witnessing the test, test results and comparison of test results with specified acceptance criteria.

10 Posted Operating Instructions and Diagrams:

a. Operating Instructions: (Provide both, typewritten and electronic format)

- 1) Where specified, copies of operating instructions shall be posted in the near vicinity of each piece of applicable equipment. The instructions shall be mounted neatly in frames under Plexiglas, where they can be easily read by operating personnel. Instructions mounted outdoors shall be suitably protected from weather.
- 2) Coordinate with owner regarding size and location of posted operating instructions.

b. Systems Diagrams: (Provide both, typewritten and electronic format)

- 1) Simplified one (1) line diagrams of HVAC heating, cooling, and airflow systems shall be developed and posted neatly under Plexiglas in the main or most appropriate equipment room for easy reference by operating and maintenance personnel.
- 2) These drawings shall be done in a professional manner, which is acceptable to the Owner's Facility Management staff. The diagrams shall show each component including all valves installed in the system, with name and identifying number. If space does not permit valve numbers on the diagrams, valve charts shall be provided. Explanatory notes, where needed, shall be provided.
- 3) Coordinate with owner regarding locations of posted operating instructions.
- 4) These diagrams shall be suitable for reduction in size and use in the operating manual system descriptions previously covered.

END OF SECTION 017823

## SECTION 017839 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.
  - 5. Electronic media submittal requirements on CD-R.
- B. Related Sections:
  - 1. Division 01 Section "Execution" for final property survey.
  - 2. Division 01 Section "Closeout Procedures" for general closeout procedures.
  - 3. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 4. Divisions 02 through 49 Sections for specific requirements for project record documents of the Work in those Sections.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit copies of record Drawings as follows:
    - a. Initial Submittal: Submit one paper copy set of marked-up record prints. Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal: Architect will submit one paper copy set and electronic files of corrected record drawings.
- B. Record Specifications: Submit one paper copy of marked-up Project's Specifications, including addenda and contract modifications.

- C. Record Product Data: Submit one paper copy and annotated PDF electronic files and directories of each submittal.
  - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report weekly indicating items incorporated in Project record documents concurrent with progress of the Work, including modifications, concealed conditions, field changes, product selections, and other notations incorporated.

## PART 2 - PRODUCTS

### 2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.
  - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding archive photographic documentation.
  - 2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations below first floor.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Change Directive.

- k. Changes made following Architect's written orders.
  - l. Details not on the original Contract Drawings.
  - m. Field records for variable and concealed conditions.
  - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

## 2.2 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file on CD-R, and paper copy of marked-up Product Data.
  1. Include record Product Data directory organized by specification section number and title, electronically linked to each item of record Product Data.

## 2.3 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file and paper copy of marked up miscellaneous record submittals.
  1. Include miscellaneous record submittals directory organized by specification section number and title, electronically linked to each item of miscellaneous record submittals.

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### PART 3 - EXECUTION

#### 3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

## SECTION 017900

### OPERATIONAL AND MAINTENANCE TRAINING

#### 1.0 GENERAL

##### 1.1 DESCRIPTION

- A. The Contractor shall train Owner's personnel in the operation and maintenance of systems and equipment listed in this Section and as mentioned in other sections. Where applicable, contractors shall coordinate with the Commissioning Team for developing the hours of instruction and scope of material to be covered. Training of Owner's personnel shall not begin until Owner has approved the final submittal copy of the operation and maintenance manuals and training programs, and the building systems and equipment are complete and operational.
- B. Schedule Submittal. The proposed scope of training, training materials and instruction schedule shall be submitted for review and approval approximately 30 days before the scheduled completion of the work for which training is to occur. Mutually agreeable dates for training shall be arranged with Owner, but the training shall be completed before the Final Operational Test. Training shall not begin until the Contractor's proposed training plan and schedule have been approved by the owner.
- C. The required training/demonstration indicated in the technical sections of the specifications is supplemental or in addition to the training required in this Section (where not a duplication).

##### 1.2 COORDINATED EFFORT

- A. The Contractor or Contractor provided professional training firm shall work closely with Owner's personnel in the development and implementation of the training program. This includes preliminary meetings to map out the direction the training will take and development, with Owner's approval, of the written training materials.
- B. The Commissioning Team will provide sample training session guidelines and agendas for use by the Contractors in developing their training programs where applicable.

#### 2.0 REQUIREMENTS

##### 2.1 SCOPE OF TRAINING

- A. Training must include both classroom and on-the-job (hands-on) instruction by qualified manufacturer's representatives, vendors, installation/service technicians and operation personnel having the necessary knowledge, experience, and teaching skills.
- B. The training shall provide comprehensive instruction on the operation and maintenance of building components, equipment, controls, and systems including procedures for startup, shutdown, normal operation, abnormal operation, preventive maintenance, troubleshooting, and corrective maintenance.
- C. The classroom portion of each training session shall be based on the information contained in the approved O&M Manuals and will use copies of these manuals for reference. This shall include the following items as applicable:
  - Content and organization of appropriate O&M Manual materials
  - Overall equipment / system layout and configuration
  - Locations and tag numbers of major components

- Theory of Operation / Design Intent
  - Startup and Shutdown Procedures
  - Normal Operating Procedures
  - Non-normal Operating Procedures (unoccupied, seasonal operation, etc.)
  - Emergency procedures
  - Health and Safety issues (both to O&M personnel and Building occupants)
  - Energy Efficiency Issues
  - Occupant Comfort and IAQ Issues
  - Control System Sequence of Operation
  - Preventive Maintenance Procedures
  - Diagnostic & Troubleshooting Procedures
  - Corrective Maintenance & Repair Procedures
- D. The field portion of each training session shall at a minimum cover the following items as applicable:
- Walk-down of covered equipment and systems
  - Demonstration of startup, shutdown and operating procedures
  - Demonstration of diagnostic, service, maintenance and repair procedures
- E. All training sessions will be videotaped by the contractor and one (1) copy of the recording provided to Owner at the conclusion of the training session. Format for submitted video recording (VHS, DVD, other) shall be determined by Owner.
- F. Follow-up or post-occupancy training, where specified, shall be planned, scheduled and conducted per the requirements of this specification. This training will focus on seasonal issues that could not be addressed during the initial training and on addressing operational and maintenance issues identified by the Owner since turnover.

## 2.2 RESPONSIBILITY OF TRAINING

- A. The Contractor provided training will be directed at a group of Owner's personnel who will act as a training cadre.
- B. The Contractor is responsible for providing training to this cadre in all systems and equipment needed to operate and maintain the Facility.
- C. This cadre will then be responsible for training other personnel assigned to the Facility.

## 2.3 LEVEL OF EXPERTISE OF INSTRUCTORS

- A. Contractor may use professional training firms.
- B. Credentials of training instructors are subject to review and approval by Owner.
1. Instructors must have knowledge and experience with the equipment on which they are providing training
  2. Instructors must be familiar with the organization and content of Operation and Maintenance Manuals for the equipment on which they are providing training.
  3. Instructors for controls must be knowledgeable and familiar with the specific controls equipment, project applications, and specific sequences of operation for this project.

## 2.4 TRAINING PROGRAM AND MATERIALS

- A. The training program, in its entirety, shall be furnished by the Contractor and shall become the property of Owner. This includes but is not limited to:
1. All lesson plans, teachers' guides or training aids used to instruct the students. One complete set shall be given to Owner.
  2. All written materials. e.g. workbooks, manufacturers' instructions, brochures, student tests, charts or other printed or photographed visual aids. Three (3) sets with one complete reproducible master shall be given to Owner.
  3. All audio visual materials e.g. video tapes, 35mm slides, film and audio cassettes, overhead projector transparencies, software files of presentations, or other audio visual medium. Three sets shall be given to Owner.
- C. The Contractor shall provide all equipment related to the conveyance of the training program e.g. VHS video cassette recorders, color TV monitors, slide projectors, movie projectors, cassettes players, overhead projector, or other related equipment. Non-permanent mounted white boards, cork board and projector screens. Equipment of this nature provided by the contractors for use during training sessions does NOT become the property of Owner. Contractors shall promptly remove said equipment at the end of the training session(s).

## 2.5 CLASSROOM TRAINING

- A. Locations for classroom training sessions shall be coordinated with Owner. All training shall be conducted on-site except by prior arrangement and approval by Owner.
- B. Classroom space provided by the contractors for off-site training shall meet the following requirements:
1. The classroom shall be free of exterior visual and noise interference.
  2. The classroom shall be lighted and climate controlled with ventilation, air conditioning and heating.
  3. The classroom shall be lockable with secure or patrolled parking adjacent to the building.
  4. Restroom and drinking water facilities shall be on the premises and food services nearby or provided on site.
  5. The classroom shall facilitate the training of thirty (30) students. Tables, chairs and storage of audio-visual equipment and class written materials shall be provided.
- C. Any pre-approved off-site training shall include transportation, lodging and meals as appropriate.

## 3.0 TRAINING PERIOD

### 3.1 TIME PERIOD OF TRAINING

- A. The minimum specific hours of training time provided for each category of major equipment and systems shall be in accordance with the specification sections pertaining to this equipment or systems.
- B. OWNER retains the option of redistributing training time, subject to the total time specified. This may include repetition of selected training sessions or provision for follow-up training sessions after occupancy.

- C. Training must be presented on an 8-hour per day, 5-day per week schedule, with all reading assignments and review to be within this period. (Note: eight (8) hour training days include 1/2 hour lunch and travel time.)
- D. Specific schedules for all training sessions must be coordinated in advance with Owner.

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**END OF SECTION 017900**

## SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain LEED Gold certification based on LEED-NC, Version 2.2.
  - 1. Other LEED prerequisites and credits needed to obtain LEED certification depend on material selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
  - 2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
  - 3. A copy of the LEED Project checklist is attached at the end of this Section for information only.
- B. Related Sections:
  - 1. Divisions 01 through 33 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.

#### 1.3 DEFINITIONS

- A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-FSC-accredited certification body.
- B. LEED: Leadership in Energy & Environmental Design.
- C. Rapidly Renewable Materials: Materials made from plants that are typically harvested within a 10-year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.

- D. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
- E. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles (800 km) from Project site. Manufacturing refers to the final assembly of components into the building product that is installed at Project site.
- F. Regionally Extracted and Manufactured Materials: Regionally manufactured materials made from raw materials that are extracted, harvested, or recovered within a radius of 500 miles (800 km) from Project site.
- G. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
  - 1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
  - 2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.
- H. Recycled Content: The percentage by weight of constituents that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer), or after consumer use (post-consumer).
  - 1. Spills and scraps from the original manufacturing process that are combined with other constituents after a minimal amount of reprocessing for use in further production of the same product are not recycled materials.
  - 2. Discarded materials from one manufacturing process that are used as constituents in another manufacturing process are pre-consumer recycled materials.

#### 1.4 SUBMITTALS

- A. General: Submit additional LEED submittals required by other Specification Sections.
- B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, then no additional copies are required.
- C. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
  - 1. Furniture.
  - 2. Plumbing.
  - 3. Mechanical.

4. Electrical.
  5. Specialty items such as elevators and equipment.
  6. Wood-based construction materials.
- D. LEED Action Plans: Provide preliminary submittals within 30 days of date established for the Notice to Proceed indicating how the following requirements will be met:
1. Credit MR 2.1 and Credit MR 2.2: Waste management plan complying with Division 01 Section "Construction Waste Management and Disposal."
  2. Credit MR 4.1 and Credit MR 4.2: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
  3. Credit MR 5.1 and Credit MR 5.2: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
  4. Credit MR 5.1 and Credit MR 5.2: List of proposed regionally manufactured materials and regionally extracted and manufactured materials.
    - a. Identify each regionally manufactured material, including its source and cost.
    - b. Identify each regionally extracted and manufactured material, including its source and cost.
  5. Credit MR 7: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
  6. Credit EQ 3.1: Construction indoor-air-quality management plan.
- E. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:
1. Credit MR 2.1 and Credit MR 2.2: Waste reduction progress reports complying with Division 01 Section "Construction Waste Management and Disposal."
  2. Credit MR 3: Salvaged and refurbished materials.
  3. Credit MR 4.1 and Credit MR 4.2: Recycled content.
  4. Credit MR 5.1 and Credit MR 5.2: Regionally manufactured materials and regionally extracted and manufactured materials.
  5. Credit MR 7: Certified wood products.
- F. LEED Documentation Submittals:
1. Credit EA 5: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over a period of time of not less than one year of postconstruction occupancy.
  2. Credit MR 2.1 and Credit MR 2.2: Comply with Division 01 Section "Construction Waste Management and Disposal."
  3. Credit MR 3: Receipts for salvaged and refurbished materials used for Project, indicating sources and costs for salvaged and refurbished materials.

4. Credit MR 3.1 and Credit MR 3.2: Receipts for salvaged and refurbished materials used for Project, indicating sources and costs for salvaged and refurbished materials.
5. Credit MR 4.1 and Credit MR 4.2: Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
6. Credit MR 5.1 and Credit MR 5.2: Product data indicating location of material manufacturer for regionally manufactured materials. Include statement indicating cost for each regionally manufactured material and for each regionally extracted and manufactured material.
  - a. Include statement indicating distance from manufacturer to Project for each regionally manufactured material.
  - b. Include statement indicating location of and distance from Project to point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials.
7. Credit MR 7: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
8. Credit EQ 3.1:
  - a. Construction indoor-air-quality management plan.
  - b. Product data for temporary filtration media.
  - c. Product data for filtration media used during occupancy.
  - d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
9. Credit EQ 3.2:
  - a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
  - b. Product data for filtration media used during flush-out and during occupancy.
  - c. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.
10. Credit EQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.
11. Credit EQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating chemical composition and VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.

12. Credit EQ 4.4: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

## 1.5 QUALITY ASSURANCE

- A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.

## PART 2 - PRODUCTS

### 2.1 RECYCLED CONTENT OF MATERIALS

- A. Credit MR 4.1 and Credit MR 4.2: Provide building materials with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 20 percent of cost of materials used for Project.
  1. Cost of post-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
  2. Cost of pre-consumer recycled content of an item shall be determined by dividing weight of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
  3. Do not include furniture, plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

### 2.2 REGIONAL MATERIALS

- A. Credit MR 5.1 and Credit MR 5.2: Provide a minimum of 20 percent of building materials (by cost) that are regional materials.
- B. Credit MR 5.1: Provide a minimum of 20 percent of materials (by cost) that are regionally manufactured materials.
- C. Credit MR 5.2: Provide a minimum of 10 percent of materials (by cost) that are regionally extracted and manufactured materials.

### 2.3 CERTIFIED WOOD

- A. Credit MR 7: Provide a minimum of 50 percent (by cost) of wood-based materials that are produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
  - a. Rough carpentry.
  - b. Miscellaneous carpentry.
  - c. Finish carpentry.
  - d. Architectural woodwork.
  - e. Wood paneling.
  - f. Wood veneer wall covering.
  - g. Wood flooring.
  - h. Wood cabinets.
  - i. Furniture.

## 2.4 LOW-EMITTING MATERIALS

- A. Credit EQ 4.1: For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D:
  1. Wood Glues: 30 g/L.
  2. Metal to Metal Adhesives: 30 g/L.
  3. Adhesives for Porous Materials (Except Wood): 50 g/L.
  4. Subfloor Adhesives: 50 g/L.
  5. Plastic Foam Adhesives: 50 g/L.
  6. Carpet Adhesives: 50 g/L.
  7. Carpet Pad Adhesives: 50 g/L.
  8. VCT and Asphalt Tile Adhesives: 50 g/L.
  9. Cove Base Adhesives: 50 g/L.
  10. Gypsum Board and Panel Adhesives: 50 g/L.
  11. Rubber Floor Adhesives: 60 g/L.
  12. Ceramic Tile Adhesives: 65 g/L.
  13. Multipurpose Construction Adhesives: 70 g/L.
  14. Fiberglass Adhesives: 80 g/L.
  15. Contact Adhesive: 80 g/L.
  16. Structural Glazing Adhesives: 100 g/L.
  17. Wood Flooring Adhesive: 100 g/L.
  18. Structural Wood Member Adhesive: 140 g/L.
  19. Special Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, rubber or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
  20. Top and Trim Adhesive: 250 g/L.
  21. Plastic Cement Welding Compounds: 250 g/L.
  22. ABS Welding Compounds: 325 g/L.
  23. CPVC Welding Compounds: 490 g/L.
  24. PVC Welding Compounds: 510 g/L.
  25. Adhesive Primer for Plastic: 550 g/L.
  26. Plastic Cement Welding Compounds: 350 g/L.

27. ABS Welding Compounds: 400 g/L.
  28. CPVC Welding Compounds: 490 g/L.
  29. PVC Welding Compounds: 510 g/L.
  30. Adhesive Primer for Plastic: 650 g/L.
  31. Sheet Applied Rubber Lining Adhesive: 850 g/L.
  32. Aerosol Adhesive, General Purpose Mist Spray: 65 percent by weight.
  33. Aerosol Adhesive, General Purpose Web Spray: 55 percent by weight.
  34. Special Purpose Aerosol Adhesive (All Types): 70 percent by weight.
  35. Other Adhesives: 250 g/L.
  36. Architectural Sealants: 250 g/L.
  37. Nonmembrane Roof Sealants: 300 g/L.
  38. Single-Ply Roof Membrane Sealants: 450 g/L.
  39. Other Sealants: 420 g/L.
  40. Sealant Primers for Nonporous Substrates: 250 g/L.
  41. Sealant Primers for Porous Substrates: 775 g/L.
  42. Modified Bituminous Sealant Primers: 500 g/L.
  43. Other Sealant Primers: 750 g/L.
- B. Credit EQ 4.2: For field applications that are inside the weatherproofing system, use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D and the following chemical restrictions:
1. Flat Paints, Coatings, and Primers: VOC not more than 50 g/L.
  2. Nonflat Paints, Coatings, and Primers: VOC not more than 150 g/L.
  3. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
  4. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
  5. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
  6. Floor Coatings: VOC not more than 100 g/L.
  7. Shellacs, Clear: VOC not more than 730 g/L.
  8. Shellacs, Pigmented: VOC not more than 550 g/L.
  9. Stains: VOC not more than 250 g/L.
  10. Flat Interior Topcoat Paints: VOC not more than 50 g/L.
  11. Nonflat Interior Topcoat Paints: VOC not more than 150 g/L.
  12. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
  13. Clear Wood Finishes, Varnishes and Sanding Sealers: VOC not more than 350 g/L.
  14. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
  15. Floor Coatings: VOC not more than 100 g/L.
  16. Shellacs, Clear: VOC not more than 730 g/L.
  17. Shellacs, Pigmented: VOC not more than 550 g/L.
  18. Stains: VOC not more than 250 g/L.
  19. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
  20. Dry-Fog Coatings: VOC not more than 400 g/L.
  21. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
  22. Pretreatment Wash Primers: VOC not more than 420 g/L.
  23. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

24. Restricted Components: Paints and coatings shall not contain any of the following:

- a. Acrolein.
- b. Acrylonitrile.
- c. Antimony.
- d. Benzene.
- e. Butyl benzyl phthalate.
- f. Cadmium.
- g. Di (2-ethylhexyl) phthalate.
- h. Di-n-butyl phthalate.
- i. Di-n-octyl phthalate.
- j. 1,2-dichlorobenzene.
- k. Diethyl phthalate.
- l. Dimethyl phthalate.
- m. Ethylbenzene.
- n. Formaldehyde.
- o. Hexavalent chromium.
- p. Isophorone.
- q. Lead.
- r. Mercury.
- s. Methyl ethyl ketone.
- t. Methyl isobutyl ketone.
- u. Methylene chloride.
- v. Naphthalene.
- w. Toluene (methylbenzene).
- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

C. Credit EQ 4.4: Do not use composite wood or agrifiber products or adhesives that contain urea-formaldehyde resin.

### PART 3 - EXECUTION

#### 3.1 REFRIGERANT AND CLEAN-AGENT FIRE-EXTINGUISHING-AGENT REMOVAL

- A. Prerequisite EA 3: Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC based. Replace or adjust existing equipment to accommodate new refrigerant as described in Division 23 Sections.
- B. Credit EA 4: Remove clean-agent fire-extinguishing agents that contain HCFCs or halons and replace with agent that does not contain HCFCs or halons. See Division 21 Section "Clean-Agent Fire Extinguishing Systems" for additional requirements.

### 3.2 MEASUREMENT AND VERIFICATION

- A. Credit EA 5: Implement measurement and verification plan consistent with Option D: Calibrated Simulation, Savings Estimation Method 2 in the EVO's "International Performance Measurement and Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction," and as further defined by the following:
- B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.
- C. Evaluate energy performance and efficiency by comparing actual to predicted performance.
- D. Measurement and verification period shall cover at least one year of postconstruction occupancy.

### 3.3 CONSTRUCTION WASTE MANAGEMENT

- A. Credit MR 2.1 and Credit MR 2.2: Comply with Division 01 Section "Construction Waste Management and Disposal."

### 3.4 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

- A. Credit EQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
  - 1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
  - 2. Replace all air filters immediately prior to occupancy.
- B. Credit EQ 3.2:
  - 1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. (4 300 000 L) of outdoor air per sq. ft. (sq. m) of floor area while maintaining an internal temperature of at least 60 deg F (16 deg C) and a relative humidity no higher than 60 percent.
    - a. (To be provided with Bid Package # 3.)
  - 2. Air-Quality Testing:
    - a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor

Air," and as additionally detailed in the USGBC's "LEED-NC: Reference Guide."

- b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
  - 1) Formaldehyde: 50 ppb.
  - 2) Particulates (PM10): 50 micrograms/cu. m.
  - 3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
  - 4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
  - 5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
- c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.
- d. Air-sample testing shall be conducted as follows:
  - 1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
  - 2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
  - 3) Number of sampling locations will vary depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. (2300 sq. m) or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.
  - 4) Air samples shall be collected between 3 and 6 feet (0.9 and 1.8 m) from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

END OF SECTION 018113

## SECTION 019113

### GENERAL COMMISSIONING REQUIREMENTS

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## 1.0 GENERAL

### 1.1 THE COMMISSIONING PROCESS

#### A. Definition

- 1 Commissioning (Cx) is a systematic quality assurance process which helps ensure that selected equipment and systems are installed and operate per the contract documents and project's design intent.
- 2 The commissioning process consists of a series of procedures which start as soon as commissioned equipment and systems start being installed and continues thru the end of the construction process.

#### B. Commissioning Agent:

- 1 The Cx process for systems covered by the Cx specifications will be led by independent commissioning agent(s) (CxA).

#### C. Commissioning Team

- 1 The Cx process will be a team effort and will encompass and coordinate the traditionally separate functions of system documentation, system installation, equipment start-up, control system calibration, testing, balancing, verification, and performance checkouts.
- 2 The General Contractor (CM/GC) and Sub-contractors installing and/or furnishing equipment and systems listed in Section 1.3 - Scope of Work including their subcontractors, suppliers, vendors and the TAB Contractors will be part of the Cx Team.

#### D. Impact on Contractor Responsibility:

- 1 The Cx Process does not reduce the responsibility of the installing contractors to provide a finished and fully functioning product. The Cx Process also does not alter any obligation the Contractors have for operation and maintenance manuals, training or any other contractual requirements.
- 2 The CxA does not have the authority to provide direction to the Contractors. Any issues arising during the Commissioning Process which impact schedules, costs or contractual obligations should be addressed to the CM/GC for resolution.

#### E. Commissioning Process Overview:

As part of the commissioning process, the contractors shall participate in the following Commissioning Activities:

- 1 Pre-Functional Procedures (PFPs) consist of a series of field observations conducted during the installation of commissioned equipment to verify that equipment is installed per the contract documents and is ready for startup.
- 2 Contractor Pre-Startup Testing consists of normally specified contractor testing such as leak testing of ductwork and piping and megger testing of electrical equipment. The commissioning process is used to ensure that this testing is rigorously executed and documented in preparation for equipment startup.
- 3 Equipment Startup Procedures ensure that startup is performed per the equipment manufacturer's recommended procedures and startup activities and data are documented for future reference.
- 4 Contractor Post-Startup Testing consists of normally specified contractor testing activities occurring after startup including, but not limited to, TAB of ventilation and hydronic systems, control system point-to-point testing and testing of BAS sequences of operation, individual room thermostat operation, emergency generator testing, etc. The

commissioning process provides oversight during the execution and documentation of these tests to ensure successful system operation.

- 5 Functional Performance Procedures (FPPs) determine if equipment, sub-systems and major systems operate in accordance with the design intent and the contract documents. Specific issues, which will be evaluated in these procedures, include equipment capacity & efficiency, operation of safeties and interlocks, control system operation stability and tuning.
- 6 Fire Life Safety Procedures (FLSPs) evaluate interactive operation of building systems in response to simulated fire conditions.
- 7 Emergency System Procedure (ESP) evaluates integrated operation of building systems in response to a simulated electric utility power failure. The ESP checks the operation of both the emergency power system(s) and all other building systems specified to operate under emergency power conditions.

## 1.2 DEFINITIONS AND ABBREVIATIONS:

- A. Abbreviations and definitions of common commissioning process terms are attached as Appendix 1 to this specification.

## 1.3 SCOPE OF WORK

- A. The following procedures and requirements apply to all contractors, sub-contractors, suppliers and vendors furnishing and/or installing components, equipment and systems covered by the commissioning scope as outlined below.

- B. Covered Systems:

- 1 The commissioning scope will include all the equipment and systems listed in the spec divisions below:

21 00 00	Fire Suppression
22 00 00	Plumbing
23 00 00	HVAC & DDC
26 00 00	Electrical

- 2 A detailed list of equipment to be commissioned can be found in Appendix 3 of this Spec section.

## 1.4 CONTRACTOR PARTICIPATION

- A. General

- 1 Contractors providing and/or installing equipment and systems included in Section 1.3 'Scope of Work' above are required to participate fully in the Commissioning Process.
- 2 Participating Contractors shall include all costs to complete the Cx requirements in their contract price including all costs for sub-contractors, vendors and suppliers.
- 3 Participating Contractors shall ensure acceptable representation, with the means and authority to prepare, coordinate and execute the Commissioning Process as described in the contract documents.
- 4 Core/Shell and Build-out Contractors shall cooperate fully with each other and the Commissioning Process.

- B. Contractor's Commissioning Representative (CCR)

- 1 Each contractor participating in the Cx Process will each designate a single-point contact person to work with the CxA and the Commissioning Team to coordinate commissioning activities, ensure timely execution of Cx Procedures and prompt resolution of commissioning issues.
- 2 The CCR shall be the contractor's Project Manager, Field Superintendent or similar with authority to do the following:
  - a. Make decisions regarding commissioning activities and issues
  - b. Schedule technicians for participation in commissioning activities
  - c. Interface between the Commissioning Team and the contractor's sub-contractors, vendors and suppliers.
  - d. Commit to commissioning schedules and completion dates.
- 3 The CCR will be responsible for coordinating the contractor's participation in the Cx Process. As part of this role, the CCR shall
  - a. Attend all Commissioning Meetings
  - b. Keep the CM/GC and CxA apprised of the contractor's progress, schedules and other matters impacting execution of the Commissioning Procedures.
  - c. Coordinate the contractor's work schedules and staffing to ensure that the qualified technician(s) are available and present during the agreed upon schedules and for sufficient duration to complete procedures, tests, adjustments, and/or problem resolutions.
  - d. Ensure that the contractors Commissioning Notebook(s) and Contractor Commissioning Documents are being maintained on-site, well organized and current as required in item 1.6 'Commissioning Documentation' of this specification.

#### C. Field Technicians

- 1 The Contractor shall provide qualified field technicians who are trained and familiar with installation, operation and troubleshooting of systems and equipment being commissioned for participation in the commissioning activities outlined in this document.
- 2 These same technicians shall be made available to assist the CxA in resolving commissioning Field Observation Notes (FONs®) issues and for repeat and follow-up commissioning tasks as required.
- 3 Contractors shall arrange for and provide technicians from their sub-contractors, vendors and suppliers where specified and where contractor's own personnel lack the required training or experience necessary to ensure that all commissioned equipment and systems are correctly installed and fully functional.
- 4 System performance problems and discrepancies may require additional technician time, CxA time, reconstruction of systems, and/or replacement of system components. The additional technician time will be made available for subsequent Cx periods at no cost to the Owner until the required system performance is obtained.

### 1.5 COORDINATION & SCHEDULING

#### A. Commissioning Meetings

- 1 Commissioning Orientation Meeting
  - a. The CxA will conduct an initial Commissioning Orientation Meeting for the Contractors and selected Sub-contractors to familiarize all parties with the Cx process, and to ensure that the roles and responsibilities of each party are clearly understood.

- b. This meeting will be scheduled by the CM/GC and CxA after awarding of contracts but prior to the start of materials installation.
  - 2 On-going Commissioning Progress Meetings
    - a. The CxA will conduct regularly scheduled Commissioning Progress Meetings for the duration of the project construction phase.
    - b. The purpose of these meetings will be to coordinate and schedule Cx activities, review Cx activity status, and discuss status and resolution of Cx issues (i.e. Field Observation Notes®).
    - c. Cx Progress Meetings will start soon after installation of commissioned systems begins and will occur as appropriate.
  - 3 Emergency System Procedure Planning Meetings
    - a. In addition to the on-going meetings described above, the CxA will conduct a series of meetings attended by the full Commissioning Team to coordinate and plan the Emergency System Procedures (ESP).
    - b. It is anticipated that this activity will require approximately 4 meetings lasting 1-2 hours each. Additional meetings will be added to this schedule if necessary to ensure fully developed and coordinated procedures prior to ESP execution.
- B. Scheduling of Cx Activities
  - 1 The Contractors will work with the CM/GC and CxA to schedule the Cx activities using established protocols. Most of this work will be conducted as part of the On-Going Commissioning Meetings. Once scheduled, the commissioning activities will be integrated into the master schedule by the CM/GC.
  - 2 Coordination, scheduling and completion of Contractor commissioning activities described in this specification are the responsibility of the Contractor(s) and the CM/GC. Note that the Cx schedule relies on the progress of the construction schedule, for which the CM/GC and Contractor(s) are also responsible.
  - 3 Scheduling problems will be brought to the attention of the CxA and CM/GC in a timely manner in order to expedite the Cx Process and to minimize interruption to both the construction and commissioning schedules.
  - 4 Commissioning of systems will proceed per the criteria established in the specific sections that follow, with activities to be performed on a timely basis.
  - 5 In general, Pre-functional Procedures and Contractor Pre-startup Testing will be completed and documented prior to equipment startup. Exceptions to this requirement may be allowed, with prior agreement by the Commissioning Team and CM/GC. if needed to expedite progress.
  - 6 Equipment Startup Procedures and Contractor Post-startup Testing (including TAB, Control Contractor Point-to-Point Testing and Control Contractor Sequence Checkouts) will be successfully completed, and fully documented prior to initiation of Functional Performance Procedures and Integrated System Procedures.
  - 7 Issues identified during execution of the Commissioning Process and documented by the CxA on the Field Observation Notes® will be addressed promptly to minimize the potential for schedule disruptions and to prevent the accumulation of large numbers of outstanding issues as the job progresses.
- C. Notification of Field Activities
  - 1 Many of the Commissioning Procedures which will be performed by the Contractors need to be witnessed and signed-off by either the CM/GC and/or Commissioning Team. Selected Commissioning Procedures may also be witnessed by the Owner.

- 2 To facilitate witnessing of these procedures, the Contractor(s) must provide advance notice to the CM/GC and Commissioning Team prior to procedure execution. The amount of advance notice required will be jointly agreed to by the CM/GC, Cx Team and Contractor. Typical intervals are 48 – 72 hours, but in no case will notification be less than 24 hours prior to procedure execution.
- 3 Any procedures may be witnessed by the CM/GC, CxA or other appropriate member of the Cx Team. It is the contractor's responsibility to coordinate with the CM/GC in advance of each procedure to ensure that the appropriate personnel will be available to witness as desired. Procedures which have been conducted without adequate notice will be deemed incomplete and will be re-tested by the contractors (with witnesses present) at no cost to the Owner and without delay to either the construction or commissioning schedules.

## 1.6 COMMISSIONING DOCUMENTATION

### A. General

- 1 Timely and accurate documentation of commissioning activities is essential for the commissioning process to be effective. To this end, all commissioning activities conducted by the contractors shall be documented as outlined below and in Part 3 Execution of this specification.
- 2 Contractor Commissioning Documents which will be completed by the contractors include the following:
  - a. Prefunctional Checklists
  - b. Pre-startup Contractor Test Forms
  - c. Equipment Startup Plans and Forms
  - d. Post-startup Contractor Test Forms & Reports
- 3 All Contractor Commissioning Documents prepared by the contractors will be fully completed in a neat and workmanlike manner so as to be fully legible. Documentation which, at the Commissioning Team's discretion, is incomplete, inaccurate or less than fully legible shall be deemed unacceptable.
- 4 Commissioning procedures and tests, which are rejected by the team due to incomplete, inaccurate or illegible contractor documentation, shall be repeated by the contractor and new Contractor Commissioning Documents shall be prepared to the Commissioning Team's satisfaction at no additional cost to the Owner.
- 5 Procedures deemed unacceptable by the Commissioning Team after being repeated due to inadequate documentation may be subject to completion by the CxA, as outlined in item 3.8 'Cost of Re-Evaluation' below.
- 6 All Contractor Commissioning Documents will be completed on the job-site, concurrent with the activities being documented. Remedial documentation of commissioning activities either off-site or after the procedures have been completed is unacceptable.
- 7 All Contractor Commissioning Documents will be submitted to the Commissioning Team for review and acceptance upon completion.

### B. Contractor Commissioning Process Status Tracking System

- 1 Contractors shall be responsible for maintaining a tracking system to monitor the progress of their commissioning activities. This tracking system will include spreadsheet-based tracking forms and/or sets of drawings which will be marked-up by the contractor to indicate status of specified commissioning activities.
- 2 The CxA will assist the contractor in developing and setting up their tracking system.

- 3 The contractors shall regularly update their tracking system forms and/or drawings as commissioning activities are completed so as to provide a readily available summary of the current status of the contractor's commissioning activities.
- 4 Tracking forms and marked-up drawings shall be kept in the Contractor's Commissioning Notebook(s) as outlined below and made available to the CM/GC and Cx Team on request for review.
- 5 Sample tracking system forms are included as Appendix 2 to this specification. These sample forms are provided for reference only to assist contractors in preparing their bids for this project. The actual forms used on this project will be similar in scope and format to the sample forms, but the specific content will differ somewhat from the sample forms to specifically reference the requirements of this project.

C. Commissioning Notebook(s)

- 1 All Contractor Commissioning Documents (including both in-progress and completed documentation) and Contractor Commissioning Process Status Tracking System forms shall be kept on-site in the contractor's field office, neatly organized, in 3-ring notebooks known as Commissioning Notebooks. The Contractor will keep the material in the Notebooks up-to-date on a daily basis as commissioning tasks occur.
- 2 Commissioning Notebooks shall be labeled on both cover and spine to indicate the contractor's name, the project name and the notebook's contents.
- 3 The CxA will assist the contractors in setting up and organizing their Commissioning Notebooks.
- 4 Commissioning Notebooks shall be kept available to the Cx Team and CM/GC for their review

D. Record Drawings

- 1 Contractors shall regularly update a 'redlined' set of record drawings showing commissioned systems as work is being installed so that the drawings remain current with the field work, and as required in Division 01 of the project specifications.
- 2 Redlining record drawings at the end of construction shall not be acceptable
- 3 The Contractors up-to-date, in-progress redlines shall be kept on-site in the Contractor's field office and available for review by the Cx Team.

E. Access to Contractor Documentation

- 1 Contractors shall provide the CxA with access to shop drawings, coordination drawings, equipment cut-sheets, schematics, in-progress record drawings, etc. to assist the CxA in execution of the Cx process.

## 2.0 PRODUCTS

### 2.1 TEST EQUIPMENT

A. General

- 1 The party responsible for each Commissioning Procedure shall furnish all tools, equipment and instrumentation required for execution of that Procedure.
- 2 Testing equipment and instrumentation used for execution of Commissioning Procedures will be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the specifications. If not otherwise noted, the following minimum requirements apply:

- a. Temperature sensors and digital thermometers: certified calibration within the past year to an accuracy of 1.0 °F and a resolution of + or - 0.1°F.
  - b. Pressure sensors: accuracy of + or - 2.0% of the value range being measured (not full range of meter) and calibrated within the last year.
  - c. Electrical meters (voltage, current, etc.) shall be true RMS and shall have been calibrated within the last year.
  - d. Specialty meters (db, RF, etc.) shall be calibrated with the last year.
  - e. Other sensors used for testing, (RH, CO, CO<sub>2</sub>, etc.) shall have been calibrated within the last 6 months.
- 3 All test equipment and instrumentation used for Commissioning Procedures will be calibrated according to the manufacturer's recommended intervals and when dropped or damaged.
  - 4 Calibration tags will be affixed or certificates readily available.

**B. Proprietary Test Equipment**

- 1 Proprietary test equipment, interface devices and software required by any contractor, vendor or equipment manufacturer for programming, start-up, or other commissioning activity whether specified or not, shall be provided by the manufacturer of the equipment for use during commissioning.
- 2 The Contractor or Manufacturer providing such equipment will demonstrate its use, and assist in the Cx process as needed.
- 3 Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents will be included in the base bid price to the Contractor and left on site, except for stand-alone data logging equipment that may be used by the CxA.

**2.2 BAS HARDWARE AND SOFTWARE SUPPORT**

**A. Field Panel Software and Hardware**

- 1 The BAS Contractor shall furnish the CxA with one (1) copy of all hardware and software needed to connect to, communicate with and command the BAS field panels and controllers at no additional charge to the CxA. This hardware and software will be used by the CxA for execution of the commissioning process. Software and hardware provided to the CxA for this purpose, does not include any provisions for use by the Project Test & Balance Contractor (PTB).
- 2 Hardware and software covered under this requirement includes, but is not limited to:
  - a. Latest versions of proprietary software of Andover Continuum.
  - b. Communication modules, software keys, and similar hardware needed for communication from a laptop computer, PDA or similar device to field panels or controllers
  - c. Proprietary cables required for communication between laptop computers or PDAs to field panels or controllers
  - d. Passwords, access levels and similar software permissions necessary for execution of the Cx Process.
  - e. Software and hardware manuals for all control system hardware and software provided to the CxA.

- 3 This requirement is not meant to include provision of standard hardware such as laptop computers and PDAs nor provision of standard software such as Windows or MS Explorer.
- 4 At the conclusion of the Commissioning Process, this hardware and software will be turned over to the Owner's Facility Management personnel for their use in operating and maintaining the building.

**B. Front-End Software & Hardware**

- 1 The BAS Contractor shall furnish the CxA with one (1) copy of their front-end software and associated hardware as needed to connect to, communicate with and command the BAS at no additional charge to the CxA or the project.
- 2 Hardware and software covered under this requirement includes, but is not limited to:
  - a. Proprietary software needed to communicate to field panels or controllers of Andover Continuum equipment. Revision levels for all software shall be identical with the revision level being provided to the project for the front-end operator workstation(s).
  - b. Communication modules, software keys, and similar hardware needed for operation of the software or to communicate with the BAS.
  - c. Proprietary cables required for communication between laptop computers and the BAS.
  - d. Passwords, access levels and similar software permissions necessary for execution of the Cx Process.
  - e. Software and hardware manuals for all control system hardware and software provided to the CxA.
- 3 This requirement is not meant to include provision of standard hardware such as laptop computers nor provision of standard software such as Windows or MS Explorer.

**C. Operator Workstation Access**

- 1 The BAS Contractor shall provide the CxA with software and hardware needed for accessing the BAS' front-end operator workstation(s). At a minimum, this shall include appropriate level user identification names and passwords. Access level shall allow the CxA to fully execute all commissioning procedures and will include the ability to:
  - a. View system operation
  - b. Override set-points
  - c. Command digital and analog output points
  - d. View BAS programming source code (read-only)
  - e. View and print graphics
  - f. Create, view, modify, print and download trend logs, histories and reports

**D. Technical Support**

- 1 The BAS Contractor shall also provide technical support to the CxA as reasonably requested by the CxA regarding setting up and operating BAS hardware and software to support successful execution of the Cx Process.

**E. Duration of Support**

- 1 Use of hardware and software provided under this section may be limited to the duration of the Cx Process at the BAS Contractors discretion, but shall not be terminated until final completion of the Cx Process including resolution of all outstanding construction phase

FONs® issues and successful execution of Post-Occupancy phase commissioning activities.

## 2.3 ELECTRICAL MONITORING SYSTEM HARDWARE AND SOFTWARE SUPPORT

- A. The contractor providing the Electrical Monitoring System shall provide the CxA with software and hardware as outlined in section 2.2 above, where applicable, to support commissioning of the electrical monitoring and distribution systems.

## 3.0 EXECUTION

### 3.1 PRE-FUNCTIONAL PROCEDURES

#### A. Scope

- 1 The Pre-functional Procedures (PFP) consists of a series of field observations and documentation conducted during the installation of commissioned equipment to verify the following:
  - a. Installed equipment matches the specifications and approved submittals
  - b. Equipment is installed per the specifications, drawings, manufacturer's recommendations, and good current practice
  - c. Utility connections to equipment, such as electrical, steam, chilled water, etc. have been successfully completed
  - d. Equipment is ready for start-up
- 2 Contractors should expect to complete one (1) Pre-functional Checklist for each major piece of equipment covered by the commissioning process such as pumps, fans, air handling units, control panels, switchgear, substations, and electrical distribution panels.
- 3 Additional checklists will be required to verify installation of distribution systems such as piping, ductwork, electrical wire and conduit, etc. The number of required Pre-functional Checklists will vary from system to system, and may be limited to one form per system per zone (or possibly per floor) for repetitive items.
- 4 See Appendix 3 for a list of Pre-functional Checklists that will be completed by the contractors as part of this project.

#### B. Pre-functional Checklists

- 1 A selection of sample Pre-functional Checklists are included at the end of this specification as Appendix 4. These sample forms are provided for reference only to assist contractors in preparing their bids for this project. The actual forms used on this project will be similar in scope and format to the sample forms, but the specific content will differ somewhat from the sample forms to specifically reference the requirements of this project.
- 2 The Pre-functional Checklists used for this project will be finalized by the CxA after receipt of equipment Installation, Operation & Maintenance (IOM) Manuals from the Contractors (see item C1 below)
- 3 Pre-functional Checklists shall be completed and maintained on-site per the requirements of this specification, Section 1.6 'Commissioning Documentation'.

#### C. Contractor Requirements

- 1 The Contractors shall provide the CxA with one (1) copy of the equipment manufacturer's standard Installation, Operation and Maintenance (IOM) Manuals within 60 days after

- approval of submittals. The CxA will use the installation recommendations included in these documents to finalize the Pre-functional Checklists.
- 2 The contractors furnishing and/or installing the equipment being commissioned will be responsible for the execution of the Pre-functional Procedures and accurate completion of the Pre-functional Checklists for that equipment.
  - 3 The CxA will provide oversight and assistance to the contractors during the execution of the Pre-functional Procedures and will periodically review the contractors in-progress Pre-functional Checklists for accuracy, completeness and to verify that checklists are being kept up-to-date.
  - 4 Contractors shall begin execution of the Pre-functional Procedures as soon as the affected equipment arrives on the job site, by verifying nameplate information matches the specifications and approved submittals.
  - 5 During installation, the contractors shall regularly review and update the appropriate Pre-functional Checklists so that potential installation issues are identified as early in the construction process as possible. The CxA will periodically review the contractor's in-progress Pre-functional Checklists to verify that they are current with the project status.
  - 6 Issues observed during the PFPs will be immediately reported to the CM/GC and CxA in accordance with the procedures outlined in this specification, Section 3.8 'Issue Resolution'.
  - 7 PFP's will be substantially complete, reviewed and accepted by the CxA prior to equipment start-up. Exceptions to this requirement will be allowed at the CxA's discretion, but will be limited to minor items, such as labeling of equipment, which will not impact start-up or subsequent equipment operation.
  - 8 Contractors shall regularly update their Contractor Commissioning Process Status Tracking System to indicate current PFP status.
  - 9 The Contractor shall furnish all tools, test equipment and instrumentation required for completion of the PFPs. All instruments shall meet the requirements of Part 2 of this specification.

### 3.2 CONTRACTOR PRE-STARTUP TESTING

#### A. Scope

- 1 Commissioning activities and requirements related to contractor/vendor pre-startup testing for commissioned equipment and systems will follow the process described in this section. This process does not reduce the contractor's responsibility for successfully completing and documenting all testing requirements outlined in other sections of the specifications.
- 2 The goals of these activities are to help ensure that the specified testing is rigorously executed using sound test procedures and that all tests are thoroughly documented.

#### B. Contractor Pre-startup Test Forms

- 1 The Contractor Pre-startup Testing shall be documented using test forms which, at a minimum, will record the following information:
  - a. Type of test being performed (hydrostatic leak test, pneumatic leak test, megger test, db, RF, flows, etc.)
  - b. System or equipment being tested
  - c. Technician(s) performing the test
  - d. Test date and time
  - e. Detailed description of section of system being tested (if applicable)

- f. All data collected during the test to quantify test performance (static and differential pressures, test duration, radio frequency, electrical resistance, etc.)
  - g. Signature of technician(s) performing test
  - h. Signature of CM/GC or Cx Team member witnessing the test
- 2 Contractors and vendors may use their standard testing forms; providing these forms meet the requirements outlined above and have been previously reviewed and approved by the Cx Team.
- 3 If standard test forms are not available, the CxA will assist the Contractors and Vendors in developing test forms for the Contractors and Vendors use.
- 4 All test forms will be fully completed and maintained by the contractor per the requirements of this specification, Section 1.6 'Commissioning Documentation'.
- 5 All test forms will be submitted to the CM/GC for review and acceptance by the Cx Team upon completion.

#### C. Contractor Requirements

- 1 Prior to initiating any of the Pre-startup Testing covered by this specification the contractor will meet with the CxA to review the contractor's proposed test procedures and test forms.
- 2 The contractor shall be responsible for successful completion and documentation of all specified pre-startup testing.
- 3 The CM/GC and/or the Cx Team will witness selected Pre-startup Tests to ensure that approved procedures are being followed and that tests are being properly documented.
- 4 Any Pre-startup Tests may be witnessed by the CM/GC, CxA or other appropriate member of the Cx Team. It is the contractor's responsibility to coordinate with the CM/GC in advance of each test to ensure that the appropriate personnel will be available to witness the test as desired. Tests which have been conducted without adequate notice will be deemed incomplete and will be re-tested by the contractors.
- 5 Issues observed during the Contractor Pre-startup Testing will be immediately reported to the CM/GC and CxA in accordance with procedures outlined in this specification, Section 3.8 'Issue Resolution'.
- 6 All Contractor Pre-startup Testing shall be substantially complete, reviewed and accepted by the CxA prior to equipment start-up. Exceptions to this requirement will be allowed at the CxA's discretion, but will be limited to minor items, which will not impact start-up or subsequent equipment operation.
- 7 Contractors shall regularly update their Contractor Commissioning Process Status Tracking System to indicate current status of their Pre-startup Testing. The CxA will periodically review the contractor's in-progress test forms and tracking system for accuracy, completeness and to verify that checklists are being kept up-to-date.
- 8 The Contractor shall furnish all tools, test equipment and instrumentation required for completion of the Pre-startup Testing. All instruments shall meet the requirements of Part 2 of this specification.

### 3.3 CONTRACTOR START-UP PROCEDURES

#### A. Scope

- 1 Commissioning activities and requirements related to Equipment Startup are meant to help ensure the following:
  - a. Equipment installation and Pre-startup Testing has been fully completed and documented prior to startup

- b. Startup procedures meet the equipment manufacturer's recommendations
    - c. Startup activities are fully documented
  - 2 Equipment Startup requirements covered by this section of the commissioning specification include the following:
    - a. All commissioned equipment requiring startup by the equipment manufacturer, vendor or representative
    - b. All rotating equipment including, but not limited to, pumps, fans, compressors, and generators with a motor or engine size of 5hp or greater or serving critical equipment.
    - c. All electrical equipment including, but not limited to switchgear, substations, transformers and distribution panels operating at 460V or greater
    - d. Where required in the specifications regardless of size or voltage.

**B. Equipment Startup Plan**

- 1 At least 30 days prior to scheduled Equipment Startup, the responsible contractor shall prepare and submit a written Startup Plan which, at a minimum, will include the following:
  - a. Personnel required for startup including vendors, other trades, etc.
  - b. Prerequisites required for startup (utility connections, PFP's, Pre-startup Testing, and other as applicable)
  - c. Proposed startup procedures
  - d. Proposed forms to be used for documenting startup procedures
  - e. Proposed preventive maintenance forms and procedures (if equipment to be kept in service after startup)
- 2 Where available, the equipment manufacturer's standard startup procedures and forms should be used as the basis of the contractor's Startup Plan. Where equipment manufacturer's standard startup procedures and/or forms are not available, the Cx Team will assist the contractors in developing the necessary procedures and forms.
- 3 The Cx Team will review the contractor's proposed Startup Plan(s) and will recommend revisions as appropriate prior to scheduling of startup activities.
- 4 Startup of covered equipment shall be documented using Startup Forms which have been previously reviewed and approved as part of the contractor's Startup Plan.
- 5 All Startup Forms will be fully completed and maintained by the contractor per the requirements of this specification, Section 1.6 'Commissioning Documentation'.
- 6 All Startup Forms will be submitted to the CM/GC for review, and acceptance by the Cx Team upon completion.

**C. Contractor Requirements**

- 1 The Contractor(s) will coordinate with the CM/GC to schedule startup activities. This will include the following:
  - a. Ensuring that all PFP's and contractor Pre-startup Testing are completed and documented prior to startup
  - b. Ensuring that all required utilities are available prior to startup
  - c. Ensuring that appropriate personnel have been identified and scheduled to participate including vendors, manufacturer's representatives, other trades, etc.
  - d. Tools, test equipment and/or instrumentation required for startup will be available

- 2 No unscheduled and/or inappropriate startups shall be allowed.
- 3 The use of startup forms, procedures, or documents that have not been previously approved by the Cx Team, as part of the Equipment Startup Plan, will not be accepted as startup documentation.
- 4 The Cx Team and/or CM/GC will witness selected startups to ensure that approved procedures are being followed and that activities are being properly documented.
- 5 Any Startup procedures may be witnessed by the CM/GC, CxA or other appropriate member of the Cx Team. It is the contractor's responsibility to coordinate with the CM/GC in advance of each procedure to ensure that the appropriate personnel will be available to witness the test as desired. Procedures which have been conducted without adequate notice will be deemed incomplete and will be re-tested.
- 6 Issues observed during execution of the Startup Procedures will be immediately reported to the CM/GC and CxA in accordance with procedures outlined in this specification, Section 3.8 'Issue Resolution'.
- 7 Contractors shall regularly update their Contractor Commissioning Process Status Tracking System to indicate current status of their Startup Procedures. The CxA will periodically review the contractor's Startup Forms and tracking system for accuracy, completeness and to verify that documentation is being kept up-to-date.
- 8 The Contractor shall furnish all tools, test equipment and instrumentation required for completion of the Startup Procedures. All instruments shall meet the requirements of Part 2 of this specification.
- 9 Equipment which will not be left in operation after startup shall be laid-up by the contractor per the manufacturer's recommended procedures.
- 10 Equipment kept in use after startup, shall be operated and maintained by the responsible Contractor per the equipment manufacturer's published O&M procedures.
- 11 All maintenance activities performed by the Contractor(s) will be documented on pre-approved maintenance work order forms. These forms may be furnished by the Owner's Facilities Management Department; otherwise the contractors will develop appropriate forms and submit them for review and approval as part of their startup plan.
- 12 Completed maintenance work order forms shall be submitted to the CM/GC for review and acceptance by the Cx Team upon completion.

### 3.4 CONTRACTOR POST-STARTUP TESTING

#### A. Scope

- 1 Commissioning activities and requirements related to Contractor Post-startup Testing for commissioned equipment and systems will follow the process described in this section. This process does not reduce the contractor's responsibility for successfully completing and documenting all testing requirements outlined in other sections of the specifications.
- 2 The goal of these activities are to augment the testing requirements listed elsewhere in the specifications and to help ensure that the specified testing is rigorously executed using sound test procedures and that all tests are thoroughly documented.

#### B. Contractor Post-startup Test Reports

- 1 The Contractor Post-startup Testing shall be documented using test forms which, at a minimum, will record the following information:
  - a. Type of test being performed (duct traverse, point-to-point checkout, etc.)
  - b. System or equipment being tested
  - c. Technician(s) performing the test

- d. Test date and time
  - e. Detailed description of system or section of system being tested
  - f. All data collected during the test to quantify test performance (pressures, flow rates, rpm, volts, amps, temperatures, etc.)
  - g. Signature of technician(s) performing test
  - h. Signature of CM/GC or Cx Team member witnessing the test (where applicable)
- 2 Contractors may use their standard testing forms; providing these forms meet the requirements outlined above and have been previously reviewed and approved by the Cx Team.
  - 3 The use of Post-startup testing forms, procedures, or documents that have not been previously approved by the Cx team, will not be accepted as Post-startup testing documentation.
  - 4 All test forms will be fully completed and maintained by the contractor per the requirements of this specification, Section 1.6 'Commissioning Documentation'.
  - 5 All test forms will be submitted to the CM/GC for review and acceptance by the Cx Team upon completion.

#### C. General Requirements

- 1 Prior to initiating any of the Post-startup Testing covered by this specification, the contractor shall meet with the CxA to review the contractor's proposed test procedures and test forms.
- 2 The contractor shall be responsible for successful completion and documentation of all specified Post-startup Testing.
- 3 The CxA will provide oversight and assistance to the contractors in developing their test procedures and test forms.
- 4 The CM/GC and/or Cx Team will witness selected Post-startup Tests to ensure that approved procedures are being followed and that tests are being properly documented.
- 5 Issues observed during the Contractor Post-startup Testing will be immediately reported to the CM/GC and CxA in accordance with procedures outlined in this specification, Section 3.8 'Issue Resolution'.
- 6 Contractors shall regularly update their Contractor Commissioning Process Status Tracking System to indicate current status of their Post-startup Testing. The CxA will periodically review the contractor's in-progress test forms and tracking system for accuracy, completeness and to verify that checklists are being kept up-to-date.
- 7 The Contractor shall furnish all tools, test equipment and instrumentation required for completion of the Post-startup Testing. All instruments shall meet the requirements of Part 2 of this specification.
- 8 The Contractor shall provide a written list of instrumentation which will be used for Post-startup Testing indicating instrument make, model number, serial number, range, accuracy and calibration date to the CxA prior to the start of testing.

#### D. HVAC Test and Balance

- 1 Project Test and Balance Contractor (PTB) Requirements:
  - a. The PTB shall be responsible for successful completion and documentation of all TAB activities specified in Div 23 and elsewhere in these specifications as appropriate.
  - b. Prior to the start of TAB activities, the PTB shall submit proposed TAB procedures and documentation to the CxA for review.

- c. After this review, and prior to start of field work, the PTB will attend one or more planning meetings as required with the Commissioning Team to review and discuss outstanding issues relating to TAB procedures and forms, discuss resolution of issues identified during the PTB's plan review and field inspections, and to coordinate field work.
- d. Prior to the start of field work, the PTB shall issue a final set of TAB procedures and TAB forms incorporating comments received from the Commissioning Team review
- e. The PTB will notify the Commissioning Team a minimum of two (2) weeks in advance of the time for start of TAB work to allow the CxA time to assess system readiness.
- f. The PTB will work cooperatively with the CxA
- g. The PTB shall coordinate with the controls contractor to ensure that changes made to the control system during TAB (flow coefficients, duct areas, etc.) are archived and become the default or initial values for these parameters.
- h. The PTB shall ensure that all areas of the project are balanced to the appropriate air pressure relationships for those areas (negative or positive pressure).
- i. The PTB shall provide daily lists of issues and/or problems identified during TAB work to the CM/GC and CxA for follow-up & resolution with the appropriate contractors.
- j. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the CxA for verification or diagnostic purposes.
- k. The TAB Final Acceptance Inspection specified in Div 23 shall be conducted by the CxA and will include a field verification of up to 10% of the PTB's field readings.
  - l. The PTB will provide technicians and instrumentation to support the field verification.
  - m. Instruments used for the field verification shall be the same instruments (by model and serial number) that were used for the original TAB work.
  - n. Failure of an item during the TAB field verification is defined as:
    - 1) For all readings other than sound, a deviation of more than 10 percent from the reported value.
    - 2) For sound pressure readings, a deviation of 3 decibels. (Note: variations in background noise must be considered).
  - o. A failure of more than 10 percent of the readings tested during the field verification shall result in the rejection of the final TAB report and require re-balancing of the system(s) in question.

#### E. Controls & Instrumentation Testing

- 1 Prior to start of control system Functional Performance Procedures, the Building Automation System (BAS) Contractor shall verify and document that all control systems are installed and operating properly including the following:
  - a. Control Panels & Hardware Installation shall be fully verified and the appropriate Pre-Functional checklists completed prior to proceeding to subsequent installation/checkout steps.
  - b. Point-to-Point Checkout shall be completed and documented per the requirements specified in Div 23 and elsewhere in these specifications as appropriate, and item 3 below.

- c. Control Sequence Checkout. Contractor shall verify that operation of control system programming matches all specified sequences of operation. For these checkouts, the Contractor shall, as much as possible, simulate actual operating conditions for the various operating modes being tested (heating, cooling, emergency power, etc) by false-loading systems, adjusting setpoints and similar techniques. The CxA will make the control sequence FP Checklists available to the BAS Contractor for use in these checkouts.
      - d. Tune all Control Loops to obtain the fastest stable response without unreasonable hunting, offset or overshoot. Record tuning parameters and response test results for each control loop and provide trend reports to document results. Trend logs shall show both steady-state operation and response to setpoint changes as specified in Div 23 and elsewhere in these specifications as appropriate.
      - e. Test All Alarms and Safeties. Record all alarm parameters and alarm messages. Document all alarms and safeties have been tested and are functioning properly.
- 2 The BAS Contractor shall work with the TAB Contractor(s) to make sure that changes to the BAS made during TAB, such as flow coefficients, flow setpoints and duct areas are permanently archived in the BAS and become the initial or default values for their respective controllers. If BAS adjustments made by the TAB Contractor(s) get lost or overwritten prior to archiving, it shall be the BAS Contractor's responsibility to re-enter this data at no additional cost to the Owner.
- 3 Point-to-Point Checkout Requirements
  - a. Items described in this section apply to and augment the Field Points Testing requirements as specified in Div 23 and elsewhere in these specifications as appropriate.
    - 1) These procedures will verify the following for each physical control point:
    - 2) Field device is installed per the manufacturer's recommendations and the project drawings and specifications
    - 3) Field verify calibration of all analog inputs and outputs
    - 4) Verify labeling of controllers, field devices, and wiring
    - 5) Physical points are correctly addressed and communicating properly between its controller and the field device.
  - b. Detailed written procedures for execution of Point-to-Point Checkouts shall be submitted to the CxA and Engineer by the Contractor for review and approval prior to the start of testing. Proposed procedures shall be based on the manufacturer's recommendations and good current practice. Include proposed test forms as part of this submittal.
  - c. The Contractor shall provide all tools and instrumentation necessary for execution of this testing. All instrumentation must be in calibration and meet the requirements of Part 2 of this specification.
  - d. The CxA reserves the right to field verify up to 10% of the Contractor's Point-to-Point Checkout testing. The Contractor shall provide the technicians and instrumentation used for the original testing to assist the CxA with this field verification.

### 3.5 FUNCTIONAL PERFORMANCE PROCEDURES

#### A. Scope

- 1 Functional Performance Procedures (FPP) are executed after commissioned equipment and systems have been installed, started-up and balanced. The goal of these

- procedures is to verify that commissioned equipment, sub-systems and major systems operate and perform per the design intent and the project specifications.
- 2 Equipment-level FPPs will be used to verify operation and capacity of selected equipment such as boilers, chillers cooling towers, pumps, exhaust fans, air handling units, etc.
  - 3 System-level FPPs will verify the following aspects of system operation
    - a. System operation under both normal and alternate operating conditions and modes
    - b. Interactions between equipment and sub-systems
    - c. Operation of safeties and interlocks
    - d. Control system operation, response time, stability and tuning
    - e. System response to abnormal and/or emergency conditions such as equipment failure and power outages
    - f. Prepare for execution of Integrated System Procedures
  - 4 See Appendix 3 for a list of Functional Performance Procedures that will be completed for this project.
- B. Functional Performance Checklists
- 1 A selection of sample Functional Performance Checklists are included at the end of this specification as Appendix 5. These sample forms are provided for reference only to assist contractors in preparing their bids for this project. The actual procedures and forms used for this project will be similar in scope and format to the samples, but the specific content will differ somewhat to specifically address the requirements of this project.
  - 2 The Functional Performance Procedures and Checklists used for this project will be finalized by the CxA after receipt of approved contractor submittals, including equipment Installation – Operations & Maintenance bulletins.
- C. Contractor Requirements
- 1 The CM/GC will coordinate and schedule FPP activities in conjunction with the contractors and other members of the Cx Team.
  - 2 Scheduling of FPPs will be contingent on notification from the affected contractor(s) to the CM/GC and CxA that equipment and systems are ready for checkout.
  - 3 Other prerequisites for execution of FPPs shall include the following
    - a. All PFP's, Contractor Pre-startup Testing and Startup Procedures have been completed and documented
    - b. TAB has been completed
    - c. Field Observation Notes® affecting equipment or system performance or operation have been resolved
  - 4 Prior to claiming readiness for FPP, the controls contractor shall ensure that the following items are completed and documented:
    - a. Point-to-point checkouts
    - b. Verify that network communication between all devices and systems is established
    - c. Sequence of Operation checkouts
    - d. Printed and annotated trend logs and histories establishing acceptable operation including
      - 1) Stable control

- 2) Recovery from upset/changes (e.g., from setback)
  - 3) Special and/or seasonal modes
  - 4) Emergency and alarm modes including loss/restoration of power
- 5 Execution of the FPPs will be led by the CxA with assistance from the contractors providing and installing the equipment and systems being commissioned.
6. Typical contractor activities during FPP execution may include the following
- a. Starting/stopping equipment
  - b. Energizing/de-energizing electrical distribution gear
  - c. Opening/closing valves and dampers
  - d. Manipulating BAS inputs, outputs and setpoints
  - e. Setup, collection and downloading of BAS trend data

Alternately, these activities may be performed directly by the CxA with prior permission from the appropriate contractor(s). In either case, the Contractor(s) shall maintain full responsibility for the facility, equipment and systems operated during the FPPs, maintain all guarantees and warranties, and shall repair any damage to the facility caused during the FPPs.

7. Contractors shall provide the services of vendor's technicians at the CxA's request to assist in commissioning of major equipment such as chillers, boilers and emergency generators.
8. Tools, test equipment and instrumentation required for completion of the FPPs shall be provided by the CxA except for special-purpose or proprietary tools, test equipment and instrumentation which will be provided by the contractors. All instruments provided by the contractor shall meet the requirements of Part 2 of this specification.

### 3.6 FIRE LIFE SAFETY PROCEDURES

#### A. Scope

- 1 The Fire / Life Safety Procedures (FLSPs) will verify and document operation of commissioned systems in response to simulated fire conditions.
- 2 Operation of various systems and sub-systems that are part of the response to fire will, in many cases, be functionally verified during the FPP process prior to these interactive tests.
- 3 The object of these procedures is to check that all systems affected by a fire operate interactively as specified in the contract documents and as required to meet the needs of the Owner.
- 4 A typical FLSP will consist of the following steps:
  - a. Simulate a fire condition by tripping one or more Fire Alarm System (FAS) initiating devices (smoke/heat detectors, flow switches, pull stations, etc.)
  - b. Verify FAS operation including, but not limited to:
    - 1) Operation of visual and audible notification devices including speakers, horns, bells, strobes, beacons, etc.
    - 2) Receipt of alarms at all FAS control panel(s), annunciator panel(s), alarm printers, etc.

- 3) Operation of FAS controlled hardware such as magnetic hold-opens, overhead fire doors, WON doors, etc.
- 4) Operation of interfaces between FAS and other building systems such as BAS, security, architectural dimming controls, conference center audio systems, overhead paging, emergency response staff communication, etc.
- c. Verify operation of HVAC smoke management system(s) including, but not limited to the following:
  - 1) Operation of air handling units
  - 2) Return / exhaust fan operation
  - 3) Operation of fire/smoke dampers, including proper indication of damper position to BAS.
  - 4) Verify differential static pressures between smoke zone(s) and adjacent zones
  - 5) Verify containment and evacuation of smoke from selected areas
- d. Verify operation of fire door hardware (measurement of door opening forces, latching of doors while smoke management systems are operational, etc.)
- e. Verify Security System operation (release of electric door locks, interaction with infant abduction protection system, etc.)
- f. Verify operation of vertical transport system (elevator recall, alternate floor recall, etc)
- g. Verify operation of other building systems connected to the FAS (architectural dimming and audio systems, etc).
- h. Reset FAS and verify return of all affected systems (FAS, BAS, HVAC, Security, Vertical transport, etc.) to normal operation.
- 5 Specific requirements for some FLSPs may vary somewhat from the 'typical' list outlined above to match the specified system operation in each area of the project (i.e. requirements for lab areas will differ somewhat from requirements for the lobby).

#### B. General Requirements

- 1 Scheduling and execution of the FLSPs will be contingent on notification from all affected Contractors that their equipment and systems are complete, fully operational, and ready for checkout
- 2 Other prerequisites for execution of FLSPs shall include the following:
  - a. Affected building systems shall be fully operational and running under normal automatic control.
  - b. All specified contractor testing and FPPs have been successfully completed and documented
  - c. Field Observation Notes® affecting equipment or system performance and operation have been resolved
- 3 FLSPs shall be completed prior to Owner Training and the Final Operation Orientation / Demonstration phases of the project.
- 4 Where possible, FLSPs will be scheduled during normal working hours. However, due to the disruptive nature of some FLSPs the contractors should be prepared to execute some of these procedures either at night or on weekends.

#### C. Contractor Requirements

- 1 The Commissioning Team will, as a joint effort, refine, coordinate, schedule and direct the execution of the FLSPs.
- 2 The CxA will develop checklists and other documentation requirements for the FLSPs.
- 3 Typical contractor activities during FLSP execution may include the following
  - a. Tripping of FAS initiating devices
  - b. Observing and documenting equipment and system operation
  - c. Resetting of fire alarm devices, fire doors, etc.
  - d. Setup, collection and downloading of BAS trend data
- 4 Contractors supplying and/or installing the following equipment & systems shall participate in all FLSPs:
  - a. Fire Alarm System
  - b. Building Automation System
  - c. Magnetic door hold-opens
  - d. Door hardware
  - e. Security
  - f. Test and Balance (TAB) contractor
- 5 Contractors supplying and/or installing the following equipment & systems shall participate in selected FLSPs designed to verify operation of their equipment and systems.
  - a. Vertical Transportation
  - b. Other Systems (dimming systems, etc.)
- 6 A detailed list of FLSPs will be developed by the Cx Team during construction. For budgeting purposes, contractors involved in all FLSPs, as listed above, should plan on participating in one FLSP per smoke zone. Contractors participating in selected FLSPs should plan on participating in six (6) FLSPs each.
- 7 Tools, test equipment and instrumentation required for completion of the FLSPs will be provided by the CxA except for special-purpose or proprietary tools, test equipment and instrumentation which will be provided by the contractors. All instruments will meet the requirements of Part 2 of this specification.

### 3.7 EMERGENCY SYSTEM PROCEDURE

#### A. Scope

- 1 The Emergency System Procedure (ESP) will verify and document operation of commissioned systems in response to simulated electrical utility power failures.
- 2 Operation of various systems and sub-systems that are part of the response to power loss will, in many cases, be functionally verified during the FPP process prior to these interactive tests.
- 3 Objectives of the ESP include verifying operation of the emergency power system and interactive operation of all commissioned systems and equipment fed by the emergency power system.
- 4 Systems which will be evaluated during the ESP include:
  - a. Electrical Systems including normal, emergency and critical power
  - b. Fire/Life Safety Systems
  - c. Mechanical Systems

- d. Lab & Medical Systems
  - e. Building Automation System
  - f. Plumbing Systems
  - g. Telecommunications
  - h. Security Systems
  - i. All other systems specified to operate on emergency power
- 5 Aspects of system operation which will be verified as part of the ESP include the following:
- a. System interactions will be observed for potential conflicts or operating problems.
  - b. Communication between systems will be verified to be properly sent, received, and result in the intended action. This will include routing and printing of alarm messages and operation of remote monitoring and notification systems.
  - c. Transition between operating modes will be verified to be smooth and free of anomalous behavior which might negatively impact occupants, jeopardize building operation or result in unnecessary wear and tear on building systems.
- 6 A typical ESP will consist of the following steps:
- a. Simulate a utility power failure by disconnecting incoming electrical power from the local utility.
  - b. Verify / demonstrate operation of emergency power systems including, but not limited to:
    - 1) Emergency generators
    - 2) Paralleling switchgear
    - 3) Automatic transfer switches
    - 4) Double-ended switchboards
    - 5) Generator shedding
    - 6) Load shedding and prioritization
    - 7) Remote alarming & monitoring systems
  - c. Verify and document operation of building systems on emergency power:
    - 1) Check equipment/system status on normal power prior to simulated power failure
    - 2) Observe transition from normal to emergency power, document any anomalous or unexpected operational issues
    - 3) Verify equipment/system operation on emergency power.
    - 4) Simulate selected equipment failures and fire alarm conditions; evaluate equipment & system response to these conditions while operating on emergency power.
  - d. Restore normal utility power. Observe and document operation of all affected building systems during transition from emergency back to normal power.
- 7 A detailed ESP plan will be developed by the CxA and refined by the Cx Team during construction to meet the specified requirements of this project.

## B. General Requirements

- 1 Scheduling and execution of the ESP will be contingent on notification from all affected Contractors that their equipment and systems are complete, fully operational, and ready for checkout
- 2 Other prerequisites for execution of the ESP shall include the following
  - a. Affected building systems shall be fully operational and running under normal automatic control.
  - b. All specified contractor testing, FPPs and FLSPs have been successfully completed and documented
  - c. Field Observation Notes® affecting equipment or system performance and operation have been resolved
- 3 The ESP shall be completed prior to Owner Training and the Final Operation Orientation / Demonstration phases of the project.
- 4 Due to the disruptive nature of the ESP, contractors should be prepared to execute these procedures either at night or on weekends.

C. Contractor Requirements

- 1 The Commissioning Team will, as a joint effort, refine, coordinate, schedule and direct the execution of the ESP. The contractors are expected to participate in this effort as outlined above.
- 2 Typical contractor activities during ESP execution may include the following
  - a. Observing and documenting equipment and system operation
  - b. Manipulation of equipment and systems to simulate various operating modes. This will include starting/stopping equipment, tripping FAS devices, etc.
  - c. Resetting of fire alarm devices, fire doors, etc.
  - d. Setup, collection and downloading of BAS trend data
- 3 It is anticipated that the ESP shall be executed on 2 consecutive evenings, or over a single weekend. Duration of testing on each of the 2 days is expected to be approximately 12-14 hours per day.
- 4 The Electrical Contractor(s) shall work with the CM/GC and the Electric Utility Provider to plan and coordinate electrical service interruptions to the building as required for execution of the ESP.
- 5 Contractors shall include the cost for 2 attempts at completion of the ESP in their proposals to allow for potential repeats of procedures which are unsuccessful on the first attempt.
- 6 Tools, test equipment and instrumentation required for completion of the ESP will be provided by the CxA except for special-purpose or proprietary tools, test equipment and instrumentation which will be provided by the contractors. All instruments provided by the contractors will meet the requirements of Part 2 of this specification.

3.8 ISSUE RESOLUTION

A. Scope

- 1 The CxA will maintain and periodically publish a Field Observation Notes (FONs®) Report, which will be used to document issues identified during the commissioning process.
- 2 The contractor(s) shall promptly respond to the FONs® Reports in writing concerning the status of each open issue identified as their responsibility during execution of the

commissioning process. Contractor responses shall include the following information as appropriate:

- a. Explanations of any questions or disagreements (issue responsibility incorrectly assigned, issue outside of contractor's scope, etc.)
  - b. Actions taken to resolve issue
  - c. Proposed actions including completion dates
- 3 The Contractors, including their sub-contractors, vendors and suppliers are responsible for resolution of all issues identified during execution of the commissioning process. The CxA will be available to work with the contractors and facilitate issue resolution.
  - 4 Contractors shall responded to the FONs® issues in a timely manner, typically within 72 hours of notification, to avoid impact to the construction schedule including the commissioning process.
  - 5 The information reported in the FONs® shall not be construed to authorize any changes in contractual requirements, schedules or project costs. Any such questions will be promptly directed to the CM/GC or other parties as designated in the contract documents.

**B. Contractor Requirements**

- 1 During Pre-functional Procedures, Pre-startup Testing, Startup Procedures and Post-startup Testing:
  - a. Issues identified by the contractors during execution of Pre-functional Procedures, Pre-Startup Testing, Startup Procedures or Post Startup Procedures shall be clearly noted on the appropriate Pre-functional Checklist, Startup Form, Test Form, or noted on a separate sheet and attached to the appropriate Checklist or Form.
  - b. Outstanding items of the PFP, Pre-startup Testing, Startup Procedures or Post-startup Testing that were not completed successfully shall also be noted at the bottom of the appropriate Checklist, Form or on an attached sheet.
  - c. Contractors shall notify the CM/GC, with a copy to the CxA, of any outstanding issues or deficiencies in writing within (2) two days of issue identification.
  - d. The CxA will review the issue notification reports and submit any comments and questions to the CM/GC, contractor or A/E as appropriate.
  - e. The contractor(s), including appropriate sub-contractors, vendors and suppliers will work with the CxA to correct and re-evaluate issues or uncompleted items.
  - f. As soon as outstanding items have been corrected, the contractor(s) shall:
    - 1) Notify the CM/GC and CxA that the issue has been resolved by updating and resubmitting their issue notification report.
    - 2) Resubmit updated Checklists, Startup Forms and/or Test Forms as applicable
  - g. Issues identified during Prefunctional Procedures and Pre-startup Testing shall be resolved prior to Startup of the affected equipment or system.
  - h. Items left incomplete, which later cause deficiencies or delays during execution of FPPs, FLSPs or ESP may result in back-charges to the responsible party. Also see "Failure Due to Manufacturer Defect" procedures in this section.
- 2 During Functional Performance Procedures, Fire Life Safety Procedures and Emergency Systems Procedures
  - a. Issues noted during execution of FPPs, FLSPs or ESP will be noted on the test forms by the CxA.
  - b. Minor issues may be corrected immediately on identification and prior to proceeding with the procedure being executed at the discretion of the CxA. The

CxA's decision will be based on what impact the issue has on the procedure being executed, and the expected time required to resolve the new issue. Issues resolved in this manner, will be documented on the appropriate form or checklist.

- c. CxA will endeavor to expedite the checkout process and minimize unnecessary delays, while not compromising the integrity of the procedures.
  - d. Once any questions are resolved on an issue and the contractor(s) accepts responsibility to correct it:
    - 1) The CxA will document the issue on the FONs® Report and the contractor response and intentions and then go on to another procedure or sequence.
    - 2) The contractor(s) will correct the issue, and submit a written statement of correction certifying that the equipment is ready to be re-evaluated to the CxA.
    - 3) The contractor reschedules the re-evaluation with the CM/GC and CxA and the checkout is repeated once. If satisfactory performance is not achieved during the second procedure, the cost of additional procedures will be billed in accordance with the paragraphs below "Cost of Re-Evaluation".
  - e. If there are questions about an issue, regarding whether it is an issue, who is responsible, or how to resolve it:
    - 1) The CxA will document the issue on the FONs® Report with the contractor's response and a copy will given to the CM/GC and contractor representative(s) assumed to be responsible.
    - 2) The CxA will document the resolution process on the FONs® Report.
    - 3) Once the interpretation and resolution have been decided, the appropriate party will correct the issue, sign a statement of correction and submit it to the CxA.
    - 4) The contractor reschedules the checkout with the CxA and the checkout is repeated once. If satisfactory performance is not achieved during the second procedure, the cost of additional procedures will be billed in accordance with the paragraphs below "Cost of Re-Evaluation".
- 3 If issues are identified by the CxA during spot-checks of completed contractor Cx Procedures (Pre-functional Procedures, Pre-Startup Testing, Startup Procedures or Post Startup Procedures); it shall be the contractors responsibility to demonstrate that the identified issues are not widespread and pervasive for all similar systems and equipment installed for this project. This may require re-execution of all affected Cx Procedures as determined by the Commissioning Team.
- C. Cost of Re-Evaluation
- 1 The cost for Contractors to re-execute any Commissioning Procedure due to open issues shall be borne by the contractors.
  - 2 The CxA will be available for two attempts of any Commissioning Procedure (one initial and one re-try) with minimal follow-up where necessary (due to deficiencies, systems not ready, etc.) to try to accomplish each checkout as part of the contract. When additional work is required because systems are not ready or because they do not successfully pass Commissioning Procedures after they have been indicated as ready, the contractor will be charged for the additional costs. Additional fees will be paid to the CxA by the Owner/CM/GC and shall be reimbursed by the Contractor.
  - 3 Any required re-testing by any contractor shall not be allowed as a justified reason for a claim of delay or for a time extension by the contractor.
- D. Failure Due to Manufacturer Defect

- 1 If 2%, or ten, whichever is greater, of similar types (size alone does not constitute a difference) of equipment from one manufacturer or supplier fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing, handling, or similar defect, not allowing it to meet its submitted performance spec, all similar units may be considered unacceptable by the A/E or CM/GC. In such case, the contractor(s) shall provide the Owner with the following:
  - a. Within one week of notification from the A/E or CM/GC, the contractor shall cause the manufacturer's representative to examine 10% of other identical units making a record of the findings. The findings shall be provided to the A/E and CM/GC within two weeks of the original notice.
  - b. Within two weeks of the original notification, the manufacturer, through the contractor, shall provide a signed and dated, written explanation of the issue, cause of failures, etc. and all proposed solutions, which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
- 2 The A/E and CM/GC will determine whether a replacement of all identical units or a repair is acceptable.
- 3 Sufficient examples to allow adequate evaluation of the proposed solution will be installed by the contractor, and the CxA and A/E will be allowed to perform PFPs and FPPs on the installations for sufficient time to determine the performance, upon which the A/E and CM/GC will, with recommendations by the CxA, decide whether to accept the solution.
- 4 After such procedures are performed and the results have been accepted as noted above, the contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun.
- 5 The replacement/repair work shall proceed with reasonable speed beginning within one week from when units or parts can be obtained.

### 3.9 ACCEPTANCE

Only after the satisfactory completion of the Pre-Functional Installation, Start-Up/Testing, Functional Performance and System Performance Checkouts will the system be ready for acceptance. At no time will acceptance be made for individual pieces of equipment. Final acceptance will only be for systems that will operate as intended in the basis of design and the design intent.

### 3.10 APPENDICES

APPENDIX 1 – ABBREVIATIONS AND DEFINITIONS.

APPENDIX 2 – SAMPLE COMMISSIONING TRACKING FORMS

APPENDIX 3 – LIST OF REQUIRED PRE-FUNCTIONAL AND FUNCTIONAL CHECKLISTS

APPENDIX 4 – SAMPLE PRE-FUNCTIONAL CHECKLISTS

APPENDIX 5 – SAMPLE FUNCTIONAL PERFORMANCE CHECKLISTS

- END OF SECTION -

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## APPENDIX 1 – COMMISSIONING ABBREVIATIONS AND DEFINITIONS

The following are common abbreviations used in the Commissioning Specifications

Abbrev.	Description	Abbrev.	Description
A/E	Architect/Engineer	IOM	Installation, Operation & Maintenance Manual
BAS	Building Automation System	ISP	Integrated Systems Procedure
CxA	Commissioning Agent	IT	Information Technology
CC	Prime Controls Contractor	ME	Mechanical Engineer
CCR	Contractor's Commissioning Representative	MC	Prime Mechanical Contractor
Cx	Commissioning	O&M	Operation and Maintenance
EC	Prime Electrical Contractor	PF	Pre-Functional
EE	Electrical Engineer	PFP	Pre-Functional Procedure
ESP	Emergency Systems Procedure	PM	Owner's Project Manager
FLSP	Fire Life Safety Procedure	PTB	Project Test & Balance Contractor
FM	Owner's Facilities Management	Subs	Subcontractors
FMP	Failure Mode Procedure	TAB	Test, Adjust and Balance
FONs®	Field Observation Notes®		
FP	Functional Performance		
FPP	Functional Performance Procedure		
CM/GC	General Contractor/Construction Manager		

Note that the terms Contractor, MC, EC, CC, or PTB as used in the Commissioning Specification should be understood to include both the associated Contractor and any sub-contractors, vendors and suppliers providing services or equipment to the General Contractor.

### Definitions

**Acceptance Phase:** Final phase of the construction occurring after successful execution of all required Cx Procedures and Final Operational Testing during which system installation and operation is demonstrated to the Owner and Authority Having Jurisdiction for the purposes of achieving occupancy and accreditation.

**Approval:** acceptance that a document, piece of equipment or system has been reviewed and found to be properly installed and is functioning in the tested modes according to the contract documents.

**Architect Engineer (A/E):** the prime consultant (architect) and sub-consultants who comprise the design team, generally the mechanical designer/engineer and the electrical designer/engineer.

**Building Automation System (BAS)** central DDC control system used to control and monitor operation of the buildings mechanical systems.

**Commissioning Agent (CxA):** an independent person, company or agent retained by the owner and not otherwise associated with the A/E team members or contracting team members. The CxA implements the overall commissioning process and carries out or observes the tasks necessary to

complete the commissioning process. The CxA does not take an oversight role like the owner's representative or construction manager.

Commissioning Report: the document that records the results of the commissioning process, including the as-built performance of the MEP system and documents all sign-offs.

Commissioning Specifications: the contract document that details the contractor's role and responsibilities for execution of the Cx process.

Commissioning Team: those people responsible for working together in carrying out the commissioning process.

Contract Documents: the documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, etc.)

Contractor: refers to all contractors or authorized representatives and all applicable subs, vendors, and suppliers contracted through that (those) contractors as well as any vendors or suppliers contracted directly to the Owner. This defines any and all General Contractor, Prime or Trade Labor Contractor as "Contractor(s)" whether or not self-performing work.

Control system: systems which provide control and monitoring functions for associated mechanical, electrical, plumbing and specialty systems.

Datalogging: monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers separate from the control or BAS systems.

Design Narrative or Design Documentation: sections of either the Design Intent or Basis of Design, generally included in early A/E submittals to describe proposed systems.

Emergency Systems Procedures (ESPs): A scripted test of facility electrical, mechanical, and other building systems designed for the facility and performed under simulated failure of utility power. Procedures include, failure of utility power while monitoring critical back-up systems and the systems that they power, verification of automatic re-start procedures and performance after restoration of power, and documentation of equipment operating status and parameters during all phases of the test.

Factory Testing: testing of equipment by the equipment manufacturer's personnel usually conducted at the manufacturer's factory or assembly plant. Factory testing is often witnessed by an Owner's representative and/or other members of the Cx Team prior to releasing the equipment for delivery to the job site.

Field Observation Notes® (FONs®): Electronic database or spreadsheet tracking method used by the CA for monitoring the status of issues raised during execution of the Cx Process.

Fire Life Safety Procedures: Part of the ISPs used to evaluate interactive operation of building systems under simulated fire conditions. Typical procedures include tripping selected smoke detectors and verify operation of HVAC systems, elevator systems, fire doors, security systems, etc. May also include evaluation of smoke evacuation from selected spaces using smoke bombs, theatrical fog generators or similar smoke substitutes.

Functional Performance Checklist: the document containing a list of items developed by the CA to record the performance of the equipment or system in question during Functional Performance Procedures.

Functional Performance Procedures (FPPs): A series of evaluations developed by the CxA to verify operation of equipment and systems using manual (direct observation) or monitoring methods. FPPs are performed after completion of the Prefunctional Procedures, Startup Procedures, Contractor Pre-startup and Post-startup Testing and serve as a prerequisite for the ISPs.

Equipment level FPPs verify the capacity, performance and efficiency of commissioned equipment relative to the manufacturer's published (submitted) equipment data and the contract documents. System-level FPPs evaluate dynamic operation of systems and sub-systems under various operating conditions (heating, cooling, etc.) as outlined in the Sequence of Operations. Emphasis in the system-level FPPs is on programming and operation of the BAS.

General Contractor/Construction Manager: the contractor responsible for overall day-to-day management and coordination of the project. The CM/GC serves as the bridge between the Owner and the Prime Trade Contractors.

Integrated Systems Procedures: A series of procedures including Fire Life Safety Procedures and Emergency System Procedures used to evaluate building-wide operation of commissioned systems under simulated fires and power failure conditions. During the ISP's emphasis is placed on evaluating interactions between building systems and transition of building systems between different operating modes.

Issue: (or Open Issue) a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the contract documents (that is, does not perform properly or is not complying with the design intent).

Manual Procedures: Cx Procedures which use hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

Monitoring: the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.

Non-Compliance: see Issue.

Non-Conformance: see Issue.

Over-written Value: writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50F to 75F to verify economizer operation). See also "Simulated Signal."

Owner-Contracted Tests: tests paid for by the Owner outside the Contractor's contract and for which the CxA does not oversee. These tests will not be repeated during functional tests if properly documented.

Pre-Functional Checklist: An inspection list that is used to document that equipment is installed correctly and is ready for startup. These checklists are developed by the CxA and are completed by the Contractors with oversight and assistance from the CxA.

Pre-Functional Procedures (PFPs): A series of static inspections used to verify equipment installation and to prepare the equipment or system for initial operation (e.g., belt tension, oil levels, etc.). The word "Pre-Functional" refers to before Startup. Even without a commissioning process, contractors typically perform some, if not many, of the PFP items a CxA will recommend. However, few contractors document in writing the execution of these items. Therefore, for most equipment, the contractors execute the PFP on their own. The CxA only requires that the procedures be documented in writing, and does not witness much of the PFP, except for larger or more critical pieces of equipment.

Project Manager (PM): the contracting and managing authority for the owner over the design and/or construction of the project.

Project Test and Balancing Contractor: the contractor(s) who is responsible for Testing, Adjusting and Balancing the facilities HVAC systems.

Sampling: functionally testing only a fraction of the total number of identical or near identical pieces of equipment. Typically used for devices such as VAV boxes.

Seasonal Performance Checkouts: functional checkouts that are deferred until the system(s) will experience conditions closer to their design conditions.

Simulated Condition: condition that is created for the purpose of testing the response of a system (e.g., applying a hair drier to a room temperature sensor to see the response in a VAV box).

Simulated Signal: disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.

Specifications: the construction specifications of the Contract Documents, may be abbreviated as spec or specs.

Startup Procedures: Procedures followed for the initial energizing or starting of equipment, following a pre-approved Startup Plan. Startup Procedures occur after successful execution of Prefunctional Procedures and Contractor Pre-startup Testing.

Startup Plan. A set of written procedures used to prepare for and startup of a piece of equipment. Startup Plans are typically based on standard procedures and documentation provided by the equipment manufacturer.

Subs: the subcontractors to the contractor(s) or vendors who provide and/or install building components and systems.

Testing Contractors: a Sub, responsible for various contractor-required system testing (e.g., generator load tests, ATS testing, telecom loop testing, etc.).

Test Procedures: the step-by-step process which must be executed to fulfill the test requirements. Test procedures typically include documentation requirements which also must be completed to constitute a completed procedure.

Test Requirements: requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures. The test requirements are specified in the Contract Documents (Sections 15997; 16997, etc.). Examples include duct leakage, hydro, megger testing and other similar tests.

Trending: monitoring of equipment and system operation using the Building Automation System.

Vendor: supplier of equipment.

**APPENDIX 2 – SAMPLE COMMISSIONING TRACKING FORMS**

**Commissioning Status Tracking Report**

Updated on: 12/13/01 Updated by: MVS

Equip. Tag	Description	Location	BY E-CUBE		BY CONTRACTOR (Insert Date Complete)										BY E-CUBE		Notes
			PF Forms	% PF Cx Completed	Start-up Done	Start-up Report	Submittals	Manuf I-OM Manuals	Test and Balance	T&B Report	O&M Manuals	Functional Forms	% FF Cx Complete				
<b>Air-Handling Units</b>																	
AHU-1	1st Flr AHU	2nd Flr Mech (2-21)															Awaiting completion of controls
AHU-2	2nd & 3rd Flr AHU	2nd Flr Mech (2-39)															Awaiting completion of controls
AHU-3	Kitchen/Dining Rm AHU	2nd Flr Mech (2-39)															
AHU-4	Gymnasium AHU	2nd Flr Mech (2-21)															Awaiting completion of controls
MAU-1	Kitchen Hood Unit	Roof															
<b>Air Conditioning Unit</b>																	
AC-1	MDF Room Unit																
ACC-1	AC-1 Condensing Unit	Roof															
<b>Fans</b>																	
TE-1	Toilet Exhuast	Rm 2-21															
TE-2	Toilet Exhuast	Roof															
ER-1	AHU-1 Exh	Mech Room 2-21															Need to check fan pressures
ER-2	AHU-2 Exh	Mech Room 2-39															
ER-3	AHU-3 Exh	Mech Room															
DE-1	Dishwasher Exh	Roof															
KE-1	Kitchen Exh	Roof															Need to check fan pressures
<b>Terminal Units</b>																	
FPBs	Fan Powered	General															Awaiting completion of Controls
VAVs	Variable Air Volume	General															Awaiting completion of Controls
CVBs	Constant Volume	General															
<b>Air Cooled Chillers</b>																	
CH-1	Air Cooled Chiller	Roof															To be re-tested in Spring 2002
CH-2	Air Cooled Chiller	Roof															To be re-tested in Spring 2002

Sample, E-Cube ©

**APPENDIX 3 – LIST OF REQUIRED PRE-FUNCTIONAL & FUNCTIONAL CHECKLISTS**

System Description	Equipment Description	Cx PFP Requirement			Cx FP Requirement			Notes & Comments
		1 Each (a)	1/Flr	Other	1 Each (a)	1/Flr	Other	
<b>Division 21, 22, 23 - Mechanical Systems</b>		<b>By Contractor</b>			<b>By E Cube</b>			
Chilled Water System	Chillers	X			X			
	CHW Pumps	X			X			
	CHW Pump VFD's	X			X			
	Refrigerant Detection	X			X			
	Cooling Coils	X			X			
	CHW Piping		X					
	Chemical Treatment	X			X			
Condenser Water System	Cooling Tower	X			X			
	CW Pumps	X			X			
	CW Piping		X					
	CW filtration/treatment	X			X			
Heating System	Steam Boilers	X			X			
	Deaerator and Pumps	X			X			
	Blow Down Separator	X			X			
	Automatic Pump Traps	X			X			
	Condensate Receiver	X			X			
	Steam Traps & PRVs	X			X			
	Water/Water P&F Hx	X			X			
	Steam/Water S&T Hx	X			X			
	Expansion Tanks	X			X			
	Air Separators	X			X			
	HW Pumps	X			X			
	Heating Coils	X			X			
	Reclaim coil systems	X			X			
	HW Pump VFD's	X			X			
	Unit Heaters	X			X			
		HW & Steam Piping		X				
	Chemical Treatment	X			X			
HVAC Systems	Air Handlers	X			X			
	Supply Fans	X			X			
	Exhaust and Relief Fans	X			X			
	Exhaust Valves, Hood & Gen.	X			X			
	VAV Supply and Ex. Boxes	X			X			
	Lab Supply Valves	X			X			
	Evaporative Coolers	X			X			
	Dry Cooler	X			X			
	Fluid to Air Heat Pumps	X			X			
	Fan Coil Units	X			X			
		Ductwork		X				
	Plumbing Systems	HW Storage Tanks	X			X		
Circulator Pumps		X			X			
Vacuum Pumps		X			X			
Air Compressors & Air Dryer		X			X			
Acid Neutralization Equip.		X			X			
Dom PRVs & Exp. Tank		X			X			
RO/DI Water Equip.		X			X			
Water Softener Equip.		X			X			
Emergency Eyewash/Shower		X			X			
		DHW, DCW Piping		X				
		LV, LA, LG, DI, RO Piping		X				
		CO2, ICW, IHW, TW Piping		X				
		Process Steam & Cooling Piping		X				
		Seam & Condensate Piping		X				
		Natural Gas Piping		X				
		Sanitary DWV Piping		X				
		Acid Waste and Vent Piping		X				

**APPENDIX 3 – LIST OF REQUIRED PRE-FUNCTIONAL & FUNCTIONAL CHECKLISTS**  
 (Continued)

System Description	Equipment Description	Cx PFP Requirement			Cx FP Requirement			Notes & Comments
		1 Each (a)	1/Fir	Other	1 Each (a)	1/Fir	Other	
<b>Division 21, 22, 23 - Mechanical Systems</b>		<b>By Contractor</b>			<b>By E Cube</b>			
Building Automation Control System (s)	Chilled Water Systems	X			X			(b)
	Condenser Water Systems	X			X			(b)
	Steam Heating Systems	X			X			(b)
	Hot Water Heating Systems	X			X			(b)
	Air Handling Units	X			X			(b)
	Exhaust Fans	X			X			(b)
	Exhaust Valves, Hood & Gen.	X			X			(b)
	VAV Supply and Ex. Boxes	X			X			(b)
	Lab Supply Valves	X			X			(b)
	Dry Cooler	X			X			(b)
	Fluid to Air Heat Pumps	X			X			(b)
	Fan Coil Units	X			X			(b)
	Occupancy Sensors	X			X			(b)
	Lighting Controls	X			X			(b)
	Wiring & Conduit			X				(b)
	Controllers	X			X			(b)
	Space Temperature	X			X			(b)
	Generator & ATS Interface	X			X			(b)
	Utility Monitoring	X			X			(b)
	Air Compressor	X			X			(b)
BAS Operator Workstation	X			X			(b)	
Fire Suppression System	Fire Pump	X			X			
	Jockey Pump	X			X			
Fire System	Wiring & Conduit			X	X			(b)
	Smoke Detectors			X	X			(b)
<b>Division 26, 27 - Electrical Power Systems</b>		<b>By Contractor</b>			<b>By E Cube</b>			
Emergency	Emergency Generator	X			X			
	Alarm Monitoring	X			X			
	Generator Emission	X			X			
Power System	Paralleling Switchgear	X			X			
	Auto Transfer Switches	X			X			
	Transformers	X			X			
	Panel & Switchboards	X			X			
	TVSS & DMM	X			X			
	Grounding Systems	X			X			
	Raceways & Cableways			X				
	Occupancy Sensors	X			X			
	Lightening Control system	X			X			
	Lighting			X			X	
	Lighting Controls	X			X			
	Wiring & Conduit			X				
	Exit Signs	X						
MCC's	X			X				
Fire Alarm	Fire Alarm (b)	X			X			(b)
Security System	Access System (b)	X			X			(b)
Communications	Tel/Com System	X			X			(b)

- (a) 1 per every piece of equipment
- (b) Forms created by Contactor or Vendor, reviewed by CxA

**APPENDIX 4 – SAMPLE PRE-FUNCTIONAL CHECKLISTS**

PROJECT NAME		
Pump - Prefunctional Checklist		
<b>System(s):</b>		<b>Unit ID:</b>
<b>Location:</b>		<b>Ref Dwgs:</b>
<b>Name / Company / Date(s):</b>		
<b>Instructions:</b> Check off items as completed. Work in progress should be left blank until done. Note comments, problems, etc. in spaces provided. Installing contractor to sign-off form when complete.		
<b>Nameplate Data:</b>		
Pump: Manuf:	Model #:	Serial #:
GPM:	HD:	HP:
Imp Size:	Pump Type:	RPM:
Motor: Manuf:	Model #:	Serial #:
HP:	Volts/Amps:	RPM:
SF:	PF:	EFF:
Frame:	Encl:	Insul Class:
Starter: Manuf:	Type:	Size:
Htr Manuf:	Size:	Manual Reset:
ITEM	OK	COMMENTS
<b>Storage / Handling</b>		
Protected against dirt / debris during storage		
Motor protected from water/moisture		
Pump openings covered until pipe connected		
<b>Labeling and Identification</b>		
Unit labeled w/ engraved plastic nameplate		
Pump and motor mfg. nameplate installed, readable		
<b>General Installation</b>		
Located per plans		
Pump/motor nameplate data matches equipment schedule		
Pump installed on 4" housekeeping pad		
Installed level and plumb		
Adequate clearance for service / maintenance		
No visible sign of leaks		
Coupling installed, no noticable play		
Pump/motor shafts rotate freely		
OSHA approved coupling installed		
Flow direction correct		
Baseplate grouted with Embeco non-shrinking grout		
Foundation bolts tightened		
Final alignment done after grouting and bolts tightened		
<b>Pump Motor</b>		
1.15 Service Factor		
ODP Enclosure		
Rated for inverter duty, class H insulation w/ VFD		
Motor base adjustable for alignment		
<b>Notes:</b>		

**APPENDIX 4 – SAMPLE PRE-FUNCTIONAL CHECKLISTS**  
 (continued)

ITEM	OK	COMMENTS
<b>Vibration Isolation</b>		
Pump mounted on steel/concrete inertia base		
Vib isolation per spec 15240		
Pump base placed on blocks prior to isol. Install		
2" clearance between inertia base and housekeep pad		
Weight transferred to springs after piping done, system filled		
Inertia base free to move, springs not bottomed-out		
Trash/debris removed from under inertia base		
Flex conns. installed on suc/disch (per manuf instr)		
Piping within 50' of pumps isolated		
<b>Piping Connections</b>		
Piping supported separately from pump		
Piping installed level and plumb		
Suction/discharge isolation vlvs installed, accessible		
Y-strainer w/ blowoff valve in pump suction line		
Check valve and manual balancing valve in discharge		
5 dia of straight pipe @ inlet to end suction pump		
Air separator/strainer at pump suction		
Low point drains on pump discharge installed		
Press guage across suction & across pump		
Guage piping installed @ tapped holes in pump flanges		
Pump base drain valved and run to nearest floor drain		
Exp. tanks installed @ pump suction, air charge OK		
<b>Insulation</b>		
Cold water pumps (< 60F) insulated with armafex		
Armafex fitted to pump, removable w/ velcro closures		
Insulation doesn't cover nameplates		
<b>Electrical Connections</b>		
Electrical connections complete		
Final connection to motor w/ flex		
Power available from MCC or VFD		
Local disconnect switch installed (if applicable)		
Starter, VFD and/or local disconnect labeled		
Conduit routing & support OK		
Conduit and wire size per code/spec.		
Fuses and motor overloads installed		
Fuse sizing correct, overload size/setting correct		
Overloads set for manual reset (not auto)		
<b>Notes:</b>		
<b>Signatures:</b>		
Installing Contractor / Vendor:		Date:

**APPENDIX 5 – SAMPLE FUNCTIONAL PERFORMANCE CHECKLISTS**

PROJECT NAME				
PUMP - FUNCTIONAL PERFORMANCE CHECKLIST				
Location:		Equipment ID:		
Participants (name, company, phone, date(s)):		Installing Contractor:		
		Reference Dwgs:		
<b>Manufacturer / Nameplate:</b>				
<b>Operating Conditions:</b>				
<b>Testing Instruments Used:</b>				
FUNCTIONAL PERFORMANCE				
ITEM	OK/Value	COMMENTS		
<i>General</i>				
Hand / Off / Auto operation OK				
Start / Stop vibration and noise acceptable				
Run vibration / noise / cavitation acceptable				
Pump rotation correct				
No visible leaks				
Flow proving				
Motor Temperature OK				
<i>Shut-Off Pressures</i>				
	Measured	Gauge	TAB	
Suction pressure				
Discharge pressure				
Differential pressure (Design = _____)				
Impeller size OK				
Local gauges correct				
<i>Operating Flows &amp; Pressures</i>				
	Measured	Gauge	TAB	
Suction pressure				
Discharge pressure				
Differential pressure (Design = _____)				
Flow Rate (Design = _____ GPM)				
<i>Electrical Measurements</i>				
Volts (Design = _____ +/- 10%)		A/B:	A/C:	B/C:
Amps (FLA = _____) (SFA = _____)		A:	B:	C:
Power (kW)		W1:	W2:	
Power Factor				
Heater size / settings correct				
Heaters set for manual reset				
<i>Companion Equipment</i>				
Differential Pressure switches functional				
Diff. Press switches indicate positive flow				
Flow switch functional				
CT sensor functional				
<b>COMMENTS AND OBSERVATIONS:</b>				

END OF SECTION 01 91 13

design development

ustar building #2, utah state university

**Life Sciences Research Center**

logan, utah

project manual  
volume two

December 9, 2008

*prepared for:*

state of utah

department of facilities construction management

4110 state office building, salt lake city, utah 84111

project no. 06292770

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project no. 0818



Design Development  
VOLUME TWO  
PROJECT MANUAL TABLE OF CONTENTS

UTAH STATE UNIVERSITY  
USTAR – Life Sciences Lab Design  
Logan, Utah

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SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

- 1. Footings.
- 2. Foundation walls.
- 3. Slabs-on-grade.
- 4. Suspended slabs.

- B. Related Sections:

- 1. Division 03 Section "Architectural Concrete" for general building applications of specially finished formed concrete.
- 2. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
- 3. Division 32 Section "Concrete Paving" for concrete pavement and walks.
- 4. Division 32 Section "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: fly ash and other pozzolans; subject to compliance with requirements.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. LEED Submittals:

- 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
  - a. Include statement indicating costs for each product having recycled content.

2. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements, and for equivalent concrete mixtures that do not contain portland cement replacements.
- 
- C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
1. Indicate amounts of mixing water to be withheld for later addition at Project site.
  2. Include Concrete Mix Design compressive strength histories.
- D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints is subject to approval of the Architect.
- F. Samples: For waterstops and vapor retarder.
- G. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
  2. Admixtures.
  3. Curing compounds.
  4. Floor and slab treatments.
  5. Bonding agents.
  6. Adhesives.
  7. Vapor retarders.
  8. Repair materials.
- H. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- I. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- J. Field quality-control reports.
- K. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade I, according to ACI CP-1 or an equivalent certification program.
  2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: The Owner will engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Preinstallation Conference: Conduct conference at Project site.
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete subcontractor.

- e. Special concrete finish subcontractor.
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
  - B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Plywood, metal, or other approved panel materials.
  - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. High-density overlay, Class 1 or better.
    - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
    - c. Structural 1, B-B or better; mill oiled and edge sealed.
    - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

- F. Chamfer Strips: Wood, metal, PVC, or rubber strips, dimensions as indicated, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- G. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

## 2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- D. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.
- E. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.
- F. Deformed-Steel Wire: ASTM A 496/A 496M.
- G. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- H. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

## 2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

## 2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class F.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.
  1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal.
  2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

## 2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## 2.6 FIBER REINFORCEMENT

- A. Synthetic Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fibrillated Micro-Fibers:
      - 1) Axim Italcementi Group, Inc.; Fibrasol F.

- 2) Euclid Chemical Company (The), an RPM company; Fiberstrand F.
- 3) Grace Construction Products, W. R. Grace & Co.; Grace Fibers.
- 4) Nycon, Inc.; ProConF.
- 5) Propex Concrete Systems Corp.; Fibermesh 300.
- 6) Sika Corporation; Sika Fiber PPF.

## 2.7 WATERSTOPS

- A. Flexible Rubber Waterstops, where indicated: CE CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, the following:
    - a. Greenstreak.
    - b. Williams Products, Inc.
    - c. Approved Equal.
  2. Profile: Flat, dumbbell with center bulb.
  3. Dimensions: 6 inches by 3/8 inch thick (150 mm by 10 mm thick); nontapered.

## 2.8 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
    - b. Fortifiber Building Systems Group; Moistop Ultra 15.
    - c. Grace Construction Products, W. R. Grace & Co.; Florprufe 120.
    - d. Insulation Solutions, Inc.; Viper VaporCheck 16.
    - e. Meadows, W. R., Inc.; Perminator 15 mil.
    - f. Reef Industries, Inc.; Griffolyn 15 mil Green.
    - g. Stego Industries, LLC; Stego Wrap 15 mil Class A.

## 2.9 FLOOR AND SLAB TREATMENTS

### 2.10 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:

- a. Conspec by Dayton Superior; Intraseal.
- b. Curecrete Distribution Inc.; Ashford Formula.
- c. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
- d. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
- e. Kaufman Products, Inc.; SureHard.
- f. L&M Construction Chemicals, Inc.; Seal Hard.
- g. Meadows, W. R., Inc.; LIQUI-HARD.
- h. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
- i. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.

## 2.11 CURING MATERIALS

- A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- B. Water: Potable.
- C. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
    - b. BASF Construction Chemicals - Building Systems; Kure 200.
    - c. ChemMasters; Safe-Cure Clear.
    - d. Conspec by Dayton Superior; W.B. Resin Cure.
    - e. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
    - f. Kaufman Products, Inc.; Thinfilm 420.
    - g. Lambert Corporation; AQUA KURE - CLEAR.
    - h. L&M Construction Chemicals, Inc.; L&M Cure R.
    - i. Meadows, W. R., Inc.; 1100-CLEAR.
    - j. Nox-Crete Products Group; Resin Cure E.
    - k. Right Pointe; Clear Water Resin.
    - l. SpecChem, LLC; Spec Rez Clear.
    - m. Symons by Dayton Superior; Resi-Chem Clear.
    - n. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
    - o. Vexcon Chemicals, Inc.; Certi-Vex Envlocure 100.

## 2.12 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulose fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

## 2.13 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
  4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

## 2.14 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.

2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
4. Maximum coarse aggregate size: 1-1/2-inch (38-mm) nominal maximum aggregate size.

B. Foundation Walls, mat footings and piers: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Maximum coarse aggregate size: 1 inch (25-mm) nominal maximum aggregate size.
4. Slump Limit: 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19-mm) nominal maximum aggregate size in exterior foundation walls and piers and other locations subject to freeze/thaw conditions..

C. Slabs-on-Grade: Proportion interior slabs on grade normal-weight concrete mixture proportioned for minimal curling and shrinkage as follows:

1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
2. Maximum Cementitious Materials Content: 470 lb/cu. yd. (279 kg/cu. m), including fly ash.
3. Maximum Water-Cementitious Materials Ratio: 0.48.
4. Aggregate: 1 1/2 inch, minus, minimum 500 lbs/cu.yd.
5. Total aggregate: Minimum 1725 lbs/cu.yd.
6. Shrinkage Reducing Admixture: 1.5 gallons/cu.yd.
7. Mid-range Water-reducing Admixture: ASTM C494. Choose from one of the following:
  - a. W.R. Grace - WRDA.
  - b. Master Builders - Glenium.
8. Workability shall be improved with admixtures, not by adding water. Do not add water on site.
9. Curing Compound: Mono-molecular curing compound applied per manufacturer's recommendations after finishing concrete.

D. Suspended Slabs: Proportion normal-weight concrete mixture over metal deck as follows:

1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
2. Maximum Water-Cement Materials Ratio: 0.50.
3. Maximum coarse aggregate size: 3/4 inch.

4. Slump Limit: 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
5. Air Content: 3 percent, plus or minus 1.0 percent at point of delivery for  $\frac{3}{4}$  inch nominal maximum aggregate size.

## 2.16 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.17 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
  1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
  1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
  3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
  1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.

2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

### 3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

### 3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
  3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
  2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

### 3.7 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect

exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

### 3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
  1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Maintain reinforcement in position on chairs during concrete placement.
  3. Scream slab surfaces with a straightedge and strike off to correct elevations.
  4. Slope surfaces uniformly to drains where required.
  5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

### 3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where required for formed surface remediation, as directed by Architect:

1. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.
1. Apply scratch finish to surfaces to receive concrete floor toppings, to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
  2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
  3. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch (4.8 mm).
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated and where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

### 3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

### 3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

### 3.13 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment, where indicated: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  2. Do not apply to concrete that is less than 28 days' old.
  3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

### 3.14 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

### 3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-

- tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  2. After concrete has cured at least 14 days, correct high areas by grinding.
  3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
1. Steel reinforcement placement.
  2. Steel reinforcement welding.
  3. Headed bolts and studs.
  4. Verification of use of required design mixture.
  5. Concrete placement, including conveying and depositing.
  6. Curing procedures and maintenance of curing temperature.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
  2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
  5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  6. Compression Test Specimens: ASTM C 31/C 31M.
    - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample (for Mat Foundations only).
  7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days (for Mat Foundations only).
    - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
  8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
  10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
  11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
  13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

### 3.17 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

## SECTION 033300 - ARCHITECTURAL CONCRETE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section specifies cast-in-place architectural concrete including form facings, reinforcement accessories, concrete materials, concrete mixture design, placement procedures, and finishes.
- B. Related Sections include the following:
  - 1. Division 03 Section "Cast-In-Place Concrete" for formwork; material, fabrication, and installation requirements for steel reinforcement; and field quality control.
  - 2. Division 07 Section "Joint Sealants" for elastomeric joint sealants in contraction and other joints in cast-in-place architectural concrete.
  - 3. Division 32 Section "Concrete Paving" for concrete pavement and flatwork finishes.
  - 4. Division 32 Section "Decorative Concrete Paving" for surface-imprinted concrete pavement and finishes.

#### 1.3 DEFINITIONS

- A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.
- D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
  - 2. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements and for equivalent concrete mixtures that do not contain portland cement replacements.
- C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- D. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.
- E. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.
- F. Samples: For each of the following materials:
  - 1. Form-facing panel.
  - 2. Form ties.
  - 3. Chamfers and rustications.
- G. Qualification Data: For manufacturer.
- H. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
- I. Material Certificates: For each of the following, signed by manufacturer:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Form materials and form-release agents.
  - 4. Repair materials.
- J. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. **Testing Agency Qualifications:** An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
  2. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- C. **Source Limitations for Cast-in-Place Architectural Concrete:** Obtain each color, size, type, and variety of concrete material and concrete mixture from one manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.
- D. **ACI Publications:** Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5 and Section 6, "Architectural Concrete."
  2. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."
- E. **Mockups:** Before casting architectural concrete, build mockups to verify selections made under sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
  2. Build mockups of typical exterior wall of cast-in-place architectural concrete as shown on Drawings.
  3. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
  4. In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
  5. Obtain Architect's approval of mockups before casting architectural concrete.
  6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management And Coordination."
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Cast-in-place architectural concrete subcontractor.
  2. Review concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural concrete.

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for formwork and other form-facing material requirements.
- B. Form-Facing Panels for As-Cast Finishes: Steel, glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that will provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- C. Form-Facing Panels for As-Cast Finishes: Exterior-grade plywood panels, nonabsorptive, that will provide continuous, true, and smooth architectural concrete surfaces, medium-density overlay, Class 1, or better, mill-applied release agent and edge sealed, complying with DOC PS 1, or Finnish phenolic overlaid birch plywood.
- D. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will provide surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- F. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, dimensions as indicated; nonstaining; in longest practicable lengths.
- G. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inch (6 mm) thick.

- H. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or S, Grade NS, that adheres to form joint substrates.
- I. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.
- J. Form-Release Agent: Commercially formulated colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- K. Surface Retarder: Chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.
- L. Form Ties: Factory-fabricated, glass-fiber-reinforced plastic internally disconnecting or removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish ties with tapered tie cone spreaders that, when removed, will leave holes 1 inch (25 mm) in diameter on concrete surface.
  - 2. Furnish internally disconnecting ties that will leave no metal closer than 1-1/2 inches (38 mm) from the architectural concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

## 2.2 STEEL REINFORCEMENT AND ACCESSORIES

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.
- B. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufacture according to CRSI's "Manual of Standard Practice."
  - 1. Where legs of wire bar supports contact forms, use gray, all-plastic or CRSI Class 2, stainless-steel bar supports.

## 2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type I/II, **gray. Supplement with the following:**

- a. Fly Ash: ASTM C 618, Class (C) (F).
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.
  - 1. Maximum Coarse Aggregate Size: 3/4 inch (19 mm).
  - 2. Gradation: Gap graded.
- C. Normal-Weight Fine Aggregate: ASTM C 33 or ASTM C 144, manufactured or natural sand, from same source for entire Project.
- D. Water: Potable, complying with ASTM C 94/C 94M except free of wash water from mixer washout operations.

## 2.4 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## 2.5 CURING MATERIALS

- A. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
  - 1. For integrally colored concrete, curing compound shall be approved by color pigment manufacturer.
  - 2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

## 2.6 REPAIR MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.
- B. Proportion concrete mixtures as follows:
  1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
  2. Maximum Water-Cementitious Materials Ratio: 0.46.
  3. Slump Limit: 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
  4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19-mm) nominal maximum aggregate size.
- C. Cementitious Materials: For cast-in-place architectural concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- E. Admixtures: Use admixtures according to manufacturer's written instructions.
- F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

## 2.8 CONCRETE MIXING

- A. Ready-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
  1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
  2. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for formwork, embedded items, and shoring and reshoring.
- B. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.
- C. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
  - 1. Class B, 1/4 inch (6 mm).
- D. Fabricate forms to result in cast-in-place architectural concrete that complies with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.
  - 1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
  - 2. Do not use rust-stained steel form-facing material.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exterior corners and edges of cast-in-place architectural concrete.
- H. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

### 3.2 REINFORCEMENT AND INSERTS

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.
- B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

### 3.3 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
  - 1. Schedule form removal to maintain surface appearance that matches approved mockups.
  - 2. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.
- B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

### 3.4 JOINTS

- A. Construction Joints: Install construction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
  - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete. Align construction joint within rustications attached to form-facing material.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

- B. Contraction Joints: Form weakened-plane contraction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

### 3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
  3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
  4. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

### 3.6 FINISHES, GENERAL

- A. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.
  1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.
- C. Maintain uniformity of special finishes over construction joints, unless otherwise indicated.

### 3.7 AS-CAST FORMED FINISHES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding specified limits on formed-surface irregularities.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Do not repair and patch tie holes.
- C. Rubbed Finish: Apply the following to smooth-form-finished as-cast concrete where required for surface remediation, as directed by Architect:
  1. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match surrounding concrete. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

### 3.8 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.
- B. Begin curing cast-in-place architectural concrete immediately after removing forms from concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:
  - 1. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

### 3.9 FIELD QUALITY CONTROL

- A. General: Comply with Division 03 Section "Cast-In-Place Concrete" for field quality-control requirements.

### 3.10 REPAIRS, PROTECTION, AND CLEANING

- A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
  - 1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.
- B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
- C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.
- D. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
- E. Wash and rinse surfaces according to concrete finish applicator's written recommendations. Protect other Work from staining or damage due to cleaning operations.
  - 1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

END OF SECTION 033300

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Miscellaneous masonry accessories.

B. Related Sections:

1. Division 07 Section "Water Repellents" for water repellents applied to unit masonry.
2. Division 07 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to IBC Section 2105.2.2.1.
  2. Determine net-area compressive strength of masonry by testing masonry prisms according to IBC Section 2105.2.2.2.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
  2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength.
  3. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
  4. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.
  5. Prism Test: For each type of construction required, according to IBC Section 2105.2.2.2.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
1. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
- C. Shop Drawings: For the following:
1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
  2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
  3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- D. Material Certificates: For each type and size of the following:
1. Masonry units.
    - a. Include data on material properties.
    - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
  2. Cementitious materials. Include brand, type, and name of manufacturer.
  3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  4. Grout mixes. Include description of type and proportions of ingredients.
  5. Reinforcing bars.

6. Anchors, ties, and metal accessories.

E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

F. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables IBC Section 2105.2.2.1.

G. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

#### 1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

#### 1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

#### 1.9 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## PART 2 - PRODUCTS

### 2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

### 2.2 CONCRETE MASONRY UNITS

- A. Regional Materials: Provide CMUs that have been manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  - 2. Provide square-edged units for outside corners unless otherwise indicated.
- C. CMUs: ASTM C 90.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
  - 2. Density Classification: Lightweight.
  - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions indicated.
  - 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
  - 5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

### 2.3 MASONRY LINTELS

- A. General: Provide one of the following:
- B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

## 2.4 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Provide aggregate for mortar and grout, cement, and lime that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- E. Masonry Cement: ASTM C 91.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Capital Materials Corporation; Flamingo Color Masonry Cement.
    - b. Cemex S.A.B. de C.V.; Citadel Type S or Dixie Type S.
    - c. Essroc, Italcementi Group; Brixment or Velvet.
    - d. Holcim (US) Inc.; Mortamix Masonry Cement.
    - e. Lafarge North America Inc.; Magnolia Masonry Cement or Lafarge Masonry Cement.
    - f. Lehigh Cement Company; Lehigh Masonry Cement.
    - g. National Cement Company, Inc.; Coosa Masonry Cement.
- F. Mortar Cement: ASTM C 1329.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.
- G. Aggregate for Mortar: ASTM C 144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  - 2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
- H. Aggregate for Grout: ASTM C 404.
- I. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.

- J. Refractory Mortar Mix: Ground fireclay or non-water-soluble, calcium aluminate, medium-duty refractory mortar that passes ASTM C 199 test; or an equivalent product acceptable to authorities having jurisdiction.
- K. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Euclid Chemical Company (The); Accelguard 80.
    - b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
    - c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.
- L. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent by same manufacturer.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ACM Chemistries; RainBloc for Mortar.
    - b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
    - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
- M. Water: Potable.

## 2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

## 2.6 MISCELLANEOUS ANCHORS

- A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- B. Postinstalled Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.

3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
4. See drawings for acceptable manufacturers.

## 2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or urethane.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
    - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
    - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
    - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

## 2.8 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
  1. Do not use calcium chloride in mortar or grout.
  2. Use portland cement-lime, masonry cement or mortar cement mortar unless otherwise indicated.
  3. For exterior masonry, use portland cement-lime, masonry cement or mortar cement mortar.
  4. For reinforced masonry, use portland cement-lime, masonry cement or mortar cement mortar.
  5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
  - 1. For reinforced masonry, use Type S.
  - 2. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
  - 3. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
  - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  - 2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
  - 3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
  - 2. Verify that foundations are within tolerances specified.
  - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.

- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
  - 1. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

### 3.3 TOLERANCES

#### A. Dimensions and Locations of Elements:

- 1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
- 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
- 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

#### B. Lines and Levels:

- 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
- 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
- 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
- 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
- 5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
- 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
- 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

#### C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

### 3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout as indicated under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
  3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
  4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
1. For glazed masonry units, use a nonmetallic jointer 3/4 inch (19 mm) or more in width.
- C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

### 3.6 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
1. Provide an open space not less than 1 inch (25 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.

### 3.7 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
  2. Install preformed control-joint gaskets designed to fit standard sash block.
  3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
  4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
- C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch (10 mm).
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

### 3.8 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  - 2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

### 3.9 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
  - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

### 3.10 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  - 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
  - 7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
  - 8. Clean stone trim to comply with stone supplier's written instructions.
  - 9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

### 3.11 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property according to Division 01 Section "Construction Waste Management".

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END OF SECTION 042000

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## SECTION 051200 - STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Grout.

B. Related Sections:

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 05 Section "Steel Decking" for field installation of shear connectors through deck.
3. Division 05 Section "Metal Fabrications" for steel lintels not attached to structural-steel frame, miscellaneous steel fabrications and other metal items not defined as structural steel.
4. Division 05 Section "Metal Stairs."
5. Division 09 Section "High Performance Painting" for surface-preparation and priming requirements for exposed exterior structural steel. Coordinate with Architect prior to Bid Package #3.

#### 1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches (38 mm).
  2. Welded built-up members with plates thicker than 2 inches (50 mm).
  3. Column base plates thicker than 2 inches (50 mm).

D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

#### 1.4 PERFORMANCE REQUIREMENTS

A. Construction: Braced frame.

#### 1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittal:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

C. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.

D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

E. Qualification Data: For qualified fabricator.

F. Welding certificates.

G. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

- H. Mill test reports for structural steel, including chemical and physical properties.
- I. Product Test Reports: For the following:
  - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
  - 2. Direct-tension indicators.
  - 3. Tension-control, high-strength bolt-nut-washer assemblies.
  - 4. Shear stud connectors.
  - 5. Shop primers.
  - 6. Nonshrink grout.
- J. Source quality-control reports.

#### 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- D. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC 303, except as indicated in General Structural Notes on Drawings.
  - 2. AISC 341 and AISC 341s1.
  - 3. AISC 360.
  - 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Preinstallation Conference: Conduct conference at Project site.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

## 1.8 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

## PART 2 - PRODUCTS

### 2.1 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
  - 1. W-Shapes: 60 percent.
  - 2. Channels, Angles, M, S-Shapes: 60 percent.
  - 3. Plate and Bar: 25 percent.
  - 4. Cold-Formed Hollow Structural Sections: 25 percent.
  - 5. Steel Pipe: 25 percent.
  - 6. All Other Steel Materials: 25 percent.
- B. W-Shapes: As indicated on Drawings.
- A. Channels, Angles, M, S-Shapes: As indicated on Drawings.
- B. Plate and Bar: As indicated on Drawings.
- C. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- D. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
  - 1. Weight Class: As indicated on Drawings.
  - 2. Finish: Black except where indicated to be galvanized.
- E. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.

- F. Steel Forgings: ASTM A 668/A 668M.
- G. Welding Electrodes: Comply with AWS requirements.

## 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- A. Unheaded Anchor Rods: As indicated on Drawings.
- B. Configuration: As indicated on Drawings.
  - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
  - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
  - 3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
  - 4. Finish: Plain.
- A. Threaded Rods: As indicated on Drawings.
- B. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
  - 1. Washers: ASTM A 36/A 36M carbon steel.
- C. Finish: As indicated on Drawings.
- D. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- E. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- F. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

## 2.3 PRIMER

- A. Primer: Comply with Division 09 Section "High-Performance Coatings" for exposed exterior steel.
- B. Primer: SSPC-Paint 23, latex primer for unexposed interior steel.

- C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat for exposed interior steel.
- D. Galvanizing Repair Paint: MPI#19.

## 2.4 GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
  - 1. Camber structural-steel members where indicated.
  - 2. Fabricate beams with rolling camber up.
  - 3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
  - 4. Mark and match-mark materials for field assembly.
  - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
  - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.

- H. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches (250 mm) o.c. unless otherwise indicated.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
  - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

## 2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: AS indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

## 2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
  - 2. Surfaces to be field welded.
  - 3. Surfaces to be high-strength bolted with slip-critical connections.
  - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  - 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  - 1. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
3. Comply with requirements of Division 09 Painting sections.

## 2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
  2. Galvanize welded door frames attached to structural-steel frame and located in exterior walls.

## 2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
1. Liquid Penetrant Inspection: ASTM E 165.
  2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
  3. Ultrasonic Inspection: ASTM E 164.
  4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
  2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
  - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
  - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Weld plate washers to top of baseplate.
  - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: As indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
  3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

- a. Liquid Penetrant Inspection: ASTM E 165.
  - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
  - c. Ultrasonic Inspection: ASTM E 164.
  - d. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
- 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
  - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- F. Non-Shrink grouting of base plates will be visually inspected.

### 3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION 051200



## SECTION 052100 - STEEL JOIST FRAMING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. K-series steel joists.
  - 2. K-series steel joist substitutes.
  - 3. Joist accessories.
- B. Related Sections include the following:
  - 1. Division 04 Section "Unit Masonry" for installing bearing plates in unit masonry.

#### 1.3 DEFINITIONS

- A. SJI "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
- B. Design special joists to withstand design loads with live load deflections no greater than the following:
  - 1. Roof Joists: Vertical deflection as indicated in General Structural Notes.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product indicated.
- B. LEED Submittal:

1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
  - a. Include statement indicating costs for each product having recycled content.
- C. Shop Drawings: Show layout, designation, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, joist accessories; splice and connection locations and details; and attachments to other construction.
  1. Indicate locations and details of bearing plates to be embedded in other construction.
  2. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.
- D. Welding certificates.
- E. Manufacturer Certificates: Signed by manufacturers certifying that joists comply with requirements.
- F. Mill Certificates: Signed by bolt manufacturers certifying that bolts comply with requirements.
- G. Field quality-control test and inspection reports.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables of SJI "Specifications."
  1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. SJI Specifications: Comply with standard specifications in SJI's "Specifications" that are applicable to types of joists indicated.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.8 SEQUENCING

- A. Deliver steel bearing plates to be built into masonry construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel: Comply with SJI's "Specifications" for web and steel-angle chord members.
1. Recycled Content: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Steel Bearing Plates: ASTM A 36/A 36M.
- C. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
1. Finish: Plain, uncoated.
- D. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
1. Finish: Plain.
- E. Welding Electrodes: Comply with AWS standards.

2.2 PRIMERS

- A. Primer: Provide shop primer that complies with Division 09 "Interior Painting" and "High-Performance Coatings."

2.3 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
1. Joist Type: K-series steel joists.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

- D. Provide holes in chord members for connecting and securing other construction to joists.
- E. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."
- F. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
- G. Do not camber joists.
- H. Camber joists according to SJI's "Specifications."
- I. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

#### 2.4 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Fabricate steel bearing plates with integral anchorages of sizes and thicknesses indicated. Shop prime paint.
- C. Steel bearing plates with integral anchorages are specified in Division 05 Section "Metal Fabrications."
- D. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

#### 2.5 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.
- C. Apply 1 coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick.
- D. Shop priming of exposed joists and joist accessories is specified in Division 09 painting Sections.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
  - 1. Before installation, splice joists delivered to Project site in more than one piece.
  - 2. Space, adjust, and align joists accurately in location before permanently fastening.
  - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
  - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads have been applied.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts.
- E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.
- B. Field welds will be visually inspected according to AWS D1.1/D1.1M.
- C. In addition to visual inspection, field welds will be tested according to AWS D1.1/D1.1M and the following procedures, as applicable:

USTAR Building # 2  
Utah State University  
Life Sciences Research Center  
Logan, Utah

1. Radiographic Testing: ASTM E 94.
2. Magnetic Particle Inspection: ASTM E 709.
3. Ultrasonic Testing: ASTM E 164.
4. Liquid Penetrant Inspection: ASTM E 165.

- D. Bolted connections will be visually inspected.
- E. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."
- F. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
- G. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

#### 3.4 REPAIRS AND PROTECTION

- A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
  2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 052100

## SECTION 053100 - STEEL DECKING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:

- 1. Roof deck.
- 2. Composite floor deck.

- B. Related Sections include the following:

- 1. Division 03 Section "Cast-in-Place Concrete" for concrete fill.
- 2. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
- 3. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
- 4. Division 09 painting Sections for repair painting of primed deck.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.

- B. LEED Submittal:

- 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
  - a. Include statement indicating costs for each product having recycled content.

- C. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

- D. Product Certificates: For each type of steel deck, signed by product manufacturer.

- E. Welding certificates.

- F. Field quality-control test and inspection reports.

- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

- 1. Power-actuated mechanical fasteners.

- H. Research/Evaluation Reports: For steel deck.

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.
- B. Source Limitations for Electrified Cellular Floor Deck: Obtain cellular floor-deck units and compatible electrical components, such as preset inserts, activation kits, afterset inserts, service fittings, header ducts, and trench header ducts, from same manufacturer.
- C. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- D. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- E. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.
- F. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
  - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Steel Deck:
    - a. ASC Profiles, Inc.
    - b. Canam Steel Corp.; The Canam Manac Group.
    - c. Consolidated Systems, Inc.
    - d. DACS, Inc.
    - e. D-Mac Industries Inc.
    - f. Epic Metals Corporation.
    - g. Marlyn Steel Decks, Inc.
    - h. New Millennium Building Systems, LLC.
    - i. Nucor Corp.; Vulcraft Division.
    - j. Roof Deck, Inc.
    - k. United Steel Deck, Inc.
    - l. Valley Joist; Division of EBSCO Industries, Inc.
    - m. Verco Manufacturing Co.
    - n. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

### 2.2 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 (230) minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
    - a. Color: Gray top surface with white underside.
  2. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230) Z275) zinc coating.
  3. Profile Depth: As indicated on Drawings.
  4. Design Uncoated-Steel Thickness: As indicated on Drawings.
  5. Span Condition: Triple span or more.
  6. Side Laps: Interlocking seam.

## 2.3 COMPOSITE FLOOR DECK

- A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 (230) minimum, with top surface phosphatized and unpainted and underside surface shop primed with manufacturers' standard gray or white baked-on, rust-inhibitive primer.
  2. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating.
  3. Profile Depth: As indicated on Drawings.
  4. Design Uncoated-Steel Thickness: As indicated on Drawings.
  5. Span Condition: Triple span or more.

## 2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 30 for overhang and slab depth.
- F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- G. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- H. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and level recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.
- I. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.
- J. Galvanizing Repair Paint: ASTM A 780 or SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

- K. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

### 3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck with written approval by Structural Engineer. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

### 3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
  - 1. Weld Diameter: 3/4 inch (19 mm), nominal.

2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated on Drawings.
  3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or as indicated on Drawings.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches (51 mm), with end joints as follows:
1. End Joints: Lapped 4 inches (102 mm) minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches (305 mm) apart with at least one fastener at each corner.
1. Install reinforcing tubes or angles in ribs to span between supports and weld as indicated on Drawings.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

#### 3.4 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
1. Weld Diameter: 3/4 inch (19 mm), nominal.
  2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches (305 mm) apart, but not more than 18 inches (457 mm) apart.
  3. Weld Spacing: Space and locate welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span as indicated on Drawings, and as follows:
1. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches (51 mm), with end joints as follows:

1. End Joints: Lapped.

- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
  - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
  - 2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Division 09 Section "Interior Painting."
- C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Division 09 Section "Interior Painting."
- D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100



## SECTION 054000 - COLD-FORMED METAL FRAMING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:

1. Exterior load-bearing wall framing.
2. Interior load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Ceiling joist framing.

- B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for masonry shelf angles and connections.
2. Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
3. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.
2. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
3. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

- a. Upward and downward movement of 1 inch (25 mm), unless otherwise indicated.

- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
3. Roof Trusses: Design according to AISI's "Standard for Cold-Formed Steel Framing - Truss Design."

#### 1.4 SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. LEED Submittal:
  1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.
- C. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
  1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Welding certificates.
- E. Qualification Data: For professional engineer.
- F. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
  1. Steel sheet.
  2. Expansion anchors.
  3. Power-actuated anchors.
  4. Mechanical fasteners.
  5. Vertical deflection clips.
  6. Horizontal drift deflection clips
  7. Miscellaneous structural clips and accessories.
- G. Research/Evaluation Reports: For cold-formed metal framing.

## 1.5 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.
- D. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.
- E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
  - 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
  - 2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
- H. Comply with AISI's "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."
- I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
1. Allied Studco.
  2. AllSteel Products, Inc.
  3. California Expanded Metal Products Company.
  4. Clark Steel Framing.
  5. Consolidated Fabricators Corp.; Building Products Division.
  6. Craco Metals Manufacturing, LLC.
  7. Custom Stud, Inc.
  8. Dale/Incor.
  9. Design Shapes in Steel.
  10. Dietrich Metal Framing; a Worthington Industries Company.
  11. Formetal Co. Inc. (The).
  12. Innovative Steel Systems.
  13. MarinoWare; a division of Ware Industries.
  14. Quail Run Building Materials, Inc.
  15. SCAFECO Corporation.
  16. Southeastern Stud & Components, Inc.
  17. Steel Construction Systems.
  18. Steeler, Inc.
  19. Super Stud Building Products, Inc.
  20. United Metal Products, Inc.

### 2.2 MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
1. Grade: As required by structural performance.
  2. Coating: G90 (Z275), or equivalent.
- C. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
1. Grade: 50 (340), Class 1 or 2.
  2. Coating: G90 (Z275).

## 2.3 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
  2. Flange Width: 1-5/8 inches (41 mm).
  3. Section Properties: As indicated on Drawings.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
  2. Flange Width: 1-1/4 inches (32 mm).
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0677 inch (1.72 mm).
  2. Flange Width: 1-5/8 inches (41 mm).
  3. Section Properties: As indicated on Drawings.
- D. Steel Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
1. Minimum Base-Metal Thickness: 0.0677 inch (1.72 mm).
  2. Top Flange Width: 1-5/8 inches (41 mm).
  3. Section Properties: As indicated on Drawings.

## 2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
  2. Flange Width: 1-5/8 inches (41 mm).
  3. Section Properties: As indicated on Drawings.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
  2. Flange Width: 1-1/4 inches (32 mm).
- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Dietrich Metal Framing; a Worthington Industries Company.
  - b. MarinoWare, a division of Ware Industries.
  - c. SCAFCO Corporation
  - d. The Steel Network, Inc.
  
- D. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
  1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
    - a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
    - b. Flange Width: 1 inch (25 mm) plus twice the design gap for other applications.
  
  2. Inner Track: Of web depth indicated, and as follows:
    - a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
    - b. Flange Width: Dimension equal to sum of outer deflection track flange width plus 1 inch (25 mm).
  
- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.

## 2.5 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with enlarged service holes, with stiffened flanges, and as follows:
  1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
  2. Flange Width: 1-5/8 inches (41 mm), minimum.
  3. Section Properties: As indicated on Drawings.

## 2.6 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
  
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
  1. Supplementary framing.
  2. Bracing, bridging, and solid blocking.

3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

## 2.7 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 55, threaded carbon-steel hex-headed bolts, headless, hooked bolts, and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
  1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

## 2.8 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

## 2.9 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  - 1. Fabricate framing assemblies using jigs or templates.
  - 2. Cut framing members by sawing or shearing; do not torch cut.
  - 3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
  - 4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
  - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
  - 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

### 3.3 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
- D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

#### 3.4 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
  - 1. Anchor Spacing: 24 inches (610 mm).
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
  - 1. Stud Spacing: 16 inches (406 mm).
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
  2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced 48 inches (1220 mm) or as indicated on Shop Drawings. Fasten at each stud intersection.
1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.
  2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.5 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
  1. Stud Spacing: 16 inches (406 mm) or 24 inches (610 mm), as indicated.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single-leg deflection tracks and anchor to building structure.
  2. Install double deep-leg deflection tracks and anchor outer track to building structure.
  3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
  4. Connect drift clips to cold formed metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

### 3.6 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.7 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

USTAR Building #2  
Utah State University  
Life Sciences Research Center  
Logan, Utah

END OF SECTION 054000

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for ceiling-hung toilet compartments.
2. Steel framing and supports for operable partitions.
3. Steel framing and supports for overhead doors.
4. Steel framing and supports for countertops.
5. Steel framing and supports for mechanical and electrical equipment.
6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
7. Steel framing and supports (outriggers) including mounting brackets and anchorages.
8. Elevator machine beams, hoist beams, and divider beams.
9. Steel shapes for supporting elevator door sills.
10. Shelf angles.
11. Metal ladders.
12. Metal floor plate and supports.
13. Structural-steel door frames.
14. Miscellaneous steel trim including steel angle corner guards, steel edgings and loading-dock edge angles.
15. Metal bollards.
16. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Division 04 Section "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.

3. Division 05 Section "Structural Steel Framing."
4. Division 05 Section "Metal Stairs."
5. Division 05 Section "Pipe and Tube Railings."
6. Division 05 Section "Metal Gratings."
7. Division 12 Section "Site Furnishings" for bicycle racks.
8. Division 32 Section "Plants" for tree grates.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

### 1.4 SUBMITTALS

- A. Product Data: For the following:
  1. Nonslip aggregates and nonslip-aggregate surface finishes.
  2. Metal nosings.
  3. Paint products.
  4. Grout.
- B. LEED Submittals:
  1. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
- C. Shop Drawings: Show fabrication and installation details for metal fabrications.
  1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Qualification Data: For qualified professional engineer.
- F. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.

- G. Welding certificates.
- H. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

#### 1.7 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

### PART 2 - PRODUCTS

#### 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

#### 2.2 FERROUS METALS

- A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- E. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- F. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- G. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- H. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
- I. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm) or as indicated.
  - 2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, or structural steel, Grade 33 (Grade 230) where required, with G90 (Z275) coating; 0.079-inch (2-mm) nominal thickness.
  - 3. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B or structural steel, Grade 33 (Grade 230); 0.0677-inch (1.7-mm) minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.
- J. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

## 2.3 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- E. Bronze Plate, Sheet, Strip, and Bars: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).

## 2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
  2. Provide stainless-steel fasteners for fastening stainless steel.
  3. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 1 (A1).
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Eyebolts: ASTM A 489.
- G. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- H. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).
- I. Wood Screws: Flat head, ASME B18.6.1.
- J. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
- K. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- L. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- M. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- N. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
  2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

- O. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Division 09 painting Sections.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

## 2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

## 2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
1. Fabricate units from slotted channel framing where indicated.
  2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated or recommended by partition manufacturer with attached bearing plates, anchors, and braces as indicated or recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
  2. Unless otherwise indicated, provide 1/2-inch (12.7-mm) baseplates with four 5/8-inch (16-mm) anchor bolts and 1/4-inch (6.4-mm) top plates.
- E. Galvanize miscellaneous framing and supports where indicated.
- F. Prime miscellaneous framing and supports with zinc-rich primer or primer specified in Division 09 Section "High-Performance Coatings" where indicated.

## 2.8 METAL LADDERS

### A. General:

1. Comply with ANSI A14.3 unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1.

### B. Steel Ladders:

1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
2. Space siderails of elevator pit ladders 12 inches (300 mm) apart.
3. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
4. Rungs: 3/4-inch- (19-mm-) diameter steel bars.
5. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
6. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
7. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) IKG Industries, a division of Harsco Corporation; Mebac.
    - 2) SlipNOT Metal Safety Flooring, a W. S. Molnar company; SlipNOT.
8. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
9. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
10. Galvanize exterior ladders, including brackets and fasteners.
11. Prime exterior ladders, including brackets and fasteners, with primer specified in Division 09 Section "High-Performance Coatings."

## 2.9 METAL FLOOR PLATE

- A. Fabricate from rolled-steel floor plate of thickness indicated below:

1. Thickness: 3/16 inch (4.8 mm) or as indicated.
- B. Provide grating sections where indicated fabricated from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
- C. Provide steel angle supports as indicated.
- D. Include steel angle stiffeners, and fixed and removable sections as indicated.
- E. Provide flush steel bar drop handles for lifting removable sections, one at each end of each section.

#### 2.10 STRUCTURAL-STEEL DOOR FRAMES

- A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch (16-by-38-mm) steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches (250 mm) o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.
  1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.
- B. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.
- C. Galvanize exterior steel frames.
- D. Prime exterior steel frames with primer specified in Division 09 Section "High-Performance Coatings."

#### 2.11 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
  1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize exterior miscellaneous steel trim.
- D. Prime exterior miscellaneous steel trim with primer specified in Division 09 Section "High-Performance Coatings."

2.12 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
  - 1. Cap bollards with 1/4-inch- (6.4-mm-) thick steel plate.
  - 2. Where bollards are indicated to receive controls for door operators, provide necessary cutouts for controls and holes for wire.
  - 3. Where bollards are indicated to receive light fixtures, provide necessary cutouts for fixtures and holes for wire.
- B. Prime bollards with primer specified in Division 09 Section "High-Performance Coatings."

2.13 ABRASIVE METAL NOSINGS

- A. Cast-Metal Units: Cast iron, with an integral-abrasive, as-cast finish. Fabricate units in lengths necessary to accurately fit openings or conditions.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Safety Tread Co., Inc.
    - b. Balco Inc.
    - c. Barry Pattern & Foundry Co., Inc.
    - d. Granite State Casting Co.
    - e. Safe-T-Metal Company, Inc.
    - f. Wooster Products Inc.
  - 2. Nosings: Cross-hatched units, 4 inches (100 mm) wide with 1-inch (25-mm) lip, for casting into concrete steps.
- B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- C. Apply bituminous paint to concealed surfaces of cast-metal units.

2.14 CAST-IRON WHEEL GUARDS

- A. Provide wheel guards made from cast iron, 3/4 inch (19 mm) thick, hollow-core construction, of size and shape indicated. Provide holes for countersunk anchor bolts and grouting.
- B. Prime cast iron wheel guards with primer specified in Division 09 Section "High-Performance Coatings."

2.15 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.16 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.17 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime interior steel with **primers specified in Division 09 painting Sections, prime exterior steel with primers specified in Division 09 Section "High-Performance Coatings"**.
- C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
  - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 3. Items Indicated to Receive Primers Specified in Division 09 Section "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.

### 3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
  - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
  - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

### 3.3 INSTALLING METAL BOLLARDS

- A. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- B. Fill bollards solidly with concrete, mounding top surface to shed water.

### 3.4 INSTALLING PIPE GUARDS

- A. Provide pipe guards at exposed vertical pipes in parking garage where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch (19-mm) bolts at each pipe guard. Mount pipe guards with top edge 26 inches (660 mm) above driving surface.

### 3.5 INSTALLING NOSINGS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

### 3.6 INSTALLING CAST-IRON WHEEL GUARDS

- A. Anchor wheel guards to concrete or masonry construction to comply with manufacturer's written instructions. Fill cores solidly with concrete.

### 3.7 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
  - 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
  - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.8 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 055100 - METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Preassembled steel stairs with concrete-filled formed-metal treads.
2. Steel tube railings attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.
4. Railing gates at the level of exit discharge.

- B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
2. Division 05 Section "Metal Fabrications" for metal treads and nosings installed at locations other than in metal stairs.
3. Division 05 Section "Pipe and Tube Railings" for pipe and tube railings not attached to metal stairs or to walls adjacent to metal stairs.
4. Division 06 Section "Miscellaneous Wood Framing" for fire-treated wood blocking for anchoring railings.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/240 deflection ratio or 1/4 inch (6.4 mm), whichever is less.

- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Infill of Guards:
    - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    - b. Infill load and other loads need not be assumed to act concurrently.
- D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Component Importance Factor is 1.5.

#### 1.4 SUBMITTALS

- A. Product Data: For metal stairs and the following:
1. Prefilled metal-pan stair treads.
  2. Precast concrete treads.
  3. Epoxy-resin-filled stair treads.
  4. Nonslip aggregates and nonslip-aggregate finishes.
  5. Abrasive nosings.
  6. Metal floor plate treads.
  7. Paint products.
  8. Grout.
- B. LEED Submittals:
1. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- D. Samples for Initial Selection: For products involving selection of color, texture, or design.
- E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Qualification Data: For qualified professional engineer.

- G. Welding certificates.
- H. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for stairs and railings.
  - 1. Test railings according ASTM E 894 and ASTM E 935.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
  - 1. Preassembled Stairs: Commercial class.
  - 2. Industrial-Type Stairs: Industrial class.
  - 3. Ornamental Stairs: Architectural class.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

#### 1.6 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

## PART 2 - PRODUCTS

### 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

### 2.2 FERROUS METALS

- A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- F. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).
- G. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- H. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, either commercial steel, Type B, or structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

### 2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
  - 1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for stairs indicated to be galvanized.

- D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- E. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
- G. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

#### 2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Division 09 painting Sections for interior stairs and Division 09 Section "High-Performance Coatings" for exterior stairs.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.
- G. Welded Wire Fabric: ASTM A 185/A 185M, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.

#### 2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.
3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Weld exposed corners and seams continuously unless otherwise indicated.
  5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Architectural ornamental grade stairs - Type 1 welds: no evidence of a welded joint; for Commercial grade stairs - Type 2 welds: completely sanded joint, some undercutting and pinholes okay; for Industrial grade stairs - Type 3 welds: partially dressed weld with spatter removed.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

## 2.6 STEEL-FRAMED STAIRS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Alfab, Inc.
  2. American Stair, Inc.
  3. Sharon Companies Ltd. (The).
  4. Qualified local steel fabrication shop.
- B. Stair Framing:

1. Fabricate stringers of steel tubes, unless otherwise indicated.
    - a. Provide closures for exposed ends of tube stringers.
  2. Construct platforms of steel tube headers and miscellaneous framing members as needed to comply with performance requirements, or as indicated.
  3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
  4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
  5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch (1.7 mm).
1. Steel Sheet: Uncoated cold-rolled steel sheet unless otherwise indicated).
  2. Steel Sheet: Galvanized-steel sheet, where indicated.
  3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
  4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
  5. Shape metal pans to include nosing integral with riser.
  6. Attach abrasive nosings to risers.
  7. At Contractor's option, provide stair assemblies with metal-pan subtreads filled with reinforced concrete during fabrication.
  8. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
    - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits, unless otherwise indicated.

## 2.7 STAIR RAILINGS

- A. Comply with applicable requirements in Division 05 Section "Pipe and Tube Railings."
1. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
  2. Connect posts to stair framing by direct welding unless otherwise indicated.
- B. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
1. Rails and Posts: Minimum 1-5/8-inch- (41-mm-) diameter top and bottom rails and 1-1/2-inch- (38-mm-) square posts.

2. Picket Infill: 1/2-inch- (13-mm-) square pickets spaced less than 4 inches (100 mm) clear.
  3. Gates: Form gates from steel tube of same size and shape as top rails, with infill to match guards. Provide with cam-type, self-closing hinges for fastening to wall and overlapping stop with rubber bumper to prevent gate from opening in direction opposite egress.
- 
- C. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.
- D. Form changes in direction of railings as follows:
1. By bending or by inserting prefabricated elbow fittings.
- E. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- F. Close exposed ends of railing members with prefabricated end fittings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
1. Connect posts to stair framing by direct welding unless otherwise indicated.
  2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
  3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
- I. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.
- 2.8 FINISHES
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

- B. Finish metal stairs after assembly.
- C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
  - 2. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:
  - 1. Exterior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Interior Stairs, Ornamental and Commercial Grade: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 3. Interior Stairs, Industrial Grade: SSPC-SP 3, "Power Tool Cleaning."
- E. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Refer to Division 09 Painting sections.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have

been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- G. Place and finish concrete fill for treads and platforms to comply with Division 03 Section "Cast-in-Place Concrete."
- H. Install precast concrete treads with adhesive supplied by manufacturer.

### 3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.
- B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
  - 1. Use nonmetallic, nonshrink grout unless otherwise indicated.
  - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.3 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
  - 1. Anchor posts to steel by welding directly to steel supporting members.
  - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.
- B. Attach handrails to wall with wall brackets. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt at Ornamental grade stairs and with predrilled hole for exposed bolt anchorage elsewhere. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements as follows:
  - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  - 2. For hollow masonry anchorage, use toggle bolts.
  - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
  - 4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

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3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055100



SECTION 055210 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Stainless steel pipe and tube railings.
- B. Related Sections include the following:
  - 1. Division 3 Section "Cast-In-Place Concrete" for concrete stairs and ramps.
  - 2. Division 5 Section "Metal Stairs" for steel tube railings associated with metal stairs.
  - 3. Division 6 Section "Rough Carpentry" for wood blocking for anchoring railings.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
  - 1. Steel: 72 percent of minimum yield strength.
  - 2. Stainless Steel: 60 percent of minimum yield strength.
- C. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails:
    - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.

- c. Uniform and concentrated loads need not be assumed to act concurrently.

3. Infill of Guards:

- a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
- b. Uniform load of 25 lbf/sq. ft. (1.2 kN/sq. m) applied horizontally.
- c. Infill load and other loads need not be assumed to act concurrently.

- D. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

- 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

- A. Product Data: For the following:

- 1. Manufacturer's product lines of mechanically connected railings.
- 2. Grout, anchoring cement, and paint products.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

- 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- C. LEED Submittals:

- 1. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.

- D. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes on stainless steel.

- E. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

a. Show method of finishing and connecting members at intersections.

F. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

G. Welding certificates.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

#### 1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

B. Welding: Qualify procedures and personnel according to the following:

C. AWS D1.1/D1.1M, "Structural Welding Code - Steel" and AWS D1.2, "Structural Welding Code - Stainless Steel."

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.6, "Structural Welding Code - Stainless Steel."

#### 1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

#### 1.7 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor

bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

## PART 2 - PRODUCTS

### 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

### 2.2 STEEL AND IRON

- A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A 36/A 36M.

### 2.3 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 304.
- B. Pipe: ASTM A 312/A 312M, Grade TP 304.
- C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.
- D. Plate and Sheet: ASTM A 666, Type 304.
  - 1. Stainless-Steel Wire Rope and Fittings:
    - a. Cable Connection (The).
    - b. Esmet, Inc.
    - c. Feeney Wire Rope & Rigging.

- d. Hayn Enterprises, LLC.
- e. Johnson, C. Sherman, Co., Inc.
- f. Loos & Co. Inc.; Cableware Division.
- g. Ronstan International Inc.
- h. Sava Industries, Inc.
- i. Seco South, Inc.
- j. Approved equal.

- E. Wire Rope: 1-by-19 wire rope made from wire complying with ASTM A 492, Type 316.
- F. Wire-Rope Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

## 2.4 FASTENERS

- A. General: Provide the following:
  - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
  - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
  - 3. Stainless-Steel Railings: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
  - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
  - 2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
  - 3. Provide square or hex socket flat-head machine screws for exposed fasteners, unless otherwise indicated.
- D. Anchors: Provide cast-in-place anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
  - 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

## 2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections, unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- J. Form changes in direction as follows:
  1. As detailed.
  2. By bending.
- K. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of railing members with prefabricated end fittings.
- M. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.
  1. At brackets and fittings fastened to plaster or gypsum board partitions, provide fillers made from crush-resistant material, or other means to transfer wall loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- P. For railing posts set in concrete, provide steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with steel plate forming bottom closure.

## 2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

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## 2.8 STEEL AND IRON FINISHES

### A. Galvanized Railings:

1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

- D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:

1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Railings Indicated to Receive Primers Specified in Division 09 Section "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Railings: SSPC-SP 3, "Power Tool Cleaning."

- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with primers specified in Division 09 painting Sections.

## 2.9 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish.

- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

- C. Directional Satin Finish: No. 4.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.3 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches (150 mm) of post.

### 3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover anchorage joint with flange of same metal as post, attached to post with set screws.
- C. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch (3-mm) buildup, sloped away from post.
- D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
  - 1. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
  - 2. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
- E. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

### 3.5 ANCHORING RAILING ENDS

- A. Anchor railing ends to concrete and masonry with round flanges connected to railing ends and anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

### 3.6 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to wall with wall brackets. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.
  - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt at Ornamental Grade locations.
  - 2. Use type of bracket with predrilled hole for exposed bolt anchorage at Commercial Grade locations.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets to building construction as follows:
  - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  - 2. For hollow masonry anchorage, use toggle bolts.

3. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed gypsum board partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

### 3.7 ADJUSTING AND CLEANING

- A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

### 3.8 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055210



## SECTION 061050 - MISCELLANEOUS CARPENTRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following:

1. Wood blocking, and nailers.
2. Plywood backing panels.

B. Related Sections include the following:

1. Division 6 Section "Interior Architectural Woodwork" for interior woodwork not specified in this Section.
2. Division 9 Section "Painting" for field priming and painting of exposed interior wood surfaces.

#### 1.2 DEFINITIONS

A. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NELMA - Northeastern Lumber Manufacturers Association.
2. NLGA - National Lumber Grades Authority.
3. SPIB - Southern Pine Inspection Bureau.
4. WCLIB - West Coast Lumber Inspection Bureau.
5. WWPA - Western Wood Products Association.

#### 1.3 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.

2. Product Data for Credit EQ 4.4: For composite-wood products, documentation indicating that product contains no urea formaldehyde.
3. Certificates for Credit MR 7: Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body.

a. Include statement indicating costs for each certified wood product.

C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Fire-retardant-treated wood.
2. Power-driven fasteners.
3. Powder-actuated fasteners.

D. Samples for Verification:

1. For each species and cut of lumber product provide 12 inch long samples showing the general characteristics of the material to be provided.

E. Research/Evaluation Reports: Showing that fire-retardant-treated wood complies with building code in effect for Project.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

### PART 2 - PRODUCTS

#### 2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.
4. Provide dry lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

#### 2.2 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
  2. Nailers.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:
1. Hem-fir (north); NLGA.
  2. Hem-fir; WCLIB, or WWPA.
  3. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
  4. Western woods; WCLIB or WWPA.
  5. Northern species; NLGA.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
1. Hem-fir or hem-fir (north), Construction or 2 Common grade; NLGA, WCLIB, or WWPA.
  2. Spruce-pine-fir (south) or spruce-pine-fir, Construction or 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
  3. Northern species, No. 2 Common grade; NLGA.
  4. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.
- D. For blocking not used for attachment of other construction Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

### 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood).
1. Use treatment that does not promote corrosion of metal fasteners.
  2. Use Exterior type for exterior locations and where indicated.
  3. Use Interior Type A, High Temperature (HT) for enclosed roof framing, framing in attic spaces, and where indicated.
  4. Use Interior Type A, unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings, and the following:
1. Concealed blocking.
  2. Roof construction.
  3. Plywood backing panels.

## 2.4 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

## 2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
  - 1. Where carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105.
- C. Power-Driven Fasteners: CABO NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

## 2.6 MISCELLANEOUS MATERIALS

- A. Adhesives for gluing wood to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
  - 1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Flexible Flashing: Self-adhesive, rubberized-asphalt compound, bonded to a high-density, polyethylene film to produce an overall thickness of not less than 0.025 inch (0.6 mm).

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

- C. Apply field treatment complying with AWP A M4 to cut surfaces of preservative-treated lumber and plywood.
- D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- E. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
  - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
  - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- (38-mm actual-) thickness.
  - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
  - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.
- F. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.
- G. Countersink fastener heads on exposed carpentry work and fill holes with wood filler.
- H. Use fasteners of appropriate type and length. Pre-drill members when necessary to avoid splitting wood.

### 3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

### 3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061050

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Interior standing and running trim.
2. Flush wood paneling and wainscots.
3. Wood cabinets.
4. Plastic-laminate cabinets.
5. Plastic-laminate countertops.
6. Solid-surfacing-material countertops.
7. Laminated-plastic laboratory tops.
8. Closet and utility shelving.
9. Shop finishing of interior woodwork.

- B. Related Sections include the following:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
2. Division 06 Section "Wood Paneling."

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

- A. Product Data: For panel products, high-pressure decorative laminate, adhesive for bonding plastic laminate, solid-surfacing material, fire-retardant-treated materials, cabinet hardware and accessories, and finishing materials and processes.
1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show details full size.
  2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers and other items installed in architectural woodwork.
  4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
- C. Samples for Initial Selection:
1. Shop-applied transparent finishes.
  2. Plastic laminates.
  3. PVC edge material.
  4. Thermoset decorative panels.
  5. Solid-surfacing materials.
- D. Samples for Verification:
1. Lumber with or for transparent finish, not less than 5 inches (125 mm) wide by 24 inches (600 mm) long, for each species and cut, finished on 1 side and 1 edge.
  2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
  3. Veneer-faced panel products with or for transparent finish, 12 by 24 inches (300 by 600 mm), for each species and cut. Include at least one face-veneer seam and finish as specified.
  4. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish.
  5. Thermoset decorative-panels, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish.
  6. Solid-surfacing materials, 6 inches (150 mm) square.
- E. LEED Submittals:
1. Product Data for Credit EQ 4.1: For installation adhesives, including printed statement of VOC content.
  2. Product Data for Credit EQ 4.4:
    - a. For each composite-wood product used, documentation indicating that the bonding agent contains no urea formaldehyde.
    - b. For each adhesive used, documentation indicating that the adhesive contains no urea formaldehyde.
  3. Product Data for Credit(s) MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content
    - a. Include statement indicating costs for each product having recycled content.

4. Certificates for Credit MR 7: Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body.

- a. Include statement indicating costs for each certified wood product.

- F. Product Certificates: For each type of product, signed by product manufacturer.

- G. Qualification Data: For Installer.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

- B. Installer Qualifications: Fabricator of products.

- C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers.

- D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

- E. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

- F. Forest Certification: Provide interior architectural woodwork produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

- G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 17 and 50 percent during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
  - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

## 1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

## PART 2 - PRODUCTS

### 2.1 WOODWORK FABRICATORS

- A. Available Fabricators: Subject to compliance with requirements, fabricators offering interior architectural woodwork that may be incorporated into the Work include, but are not limited to, the following:

- B. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by one of the following:

## 2.2 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: Cherry, plain sawn or sliced.
- C. Wood Products: Comply with the following:
1. Recycled Content of Medium-Density Fiberboard and Particleboard: Provide products with an average recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
  2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
  3. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
  4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
  5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
- D. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
    - a. Abet Laminati, Inc.
    - b. Arborite; Division of ITW Canada, Inc.
    - c. Formica Corporation.
    - d. Lamin-Art, Inc.
    - e. Nevamar Company, LLC; Decorative Products Div.
    - f. Panolam Industries International Incorporated.
    - g. Westinghouse Electric Corp.; Specialty Products Div.
    - h. Wilsonart International; Div. of Premark International, Inc.
- F. Chemical-Resistant, High-Pressure Decorative Laminate: NEMA LD 3, Grade HGP, and as follows:
1. Laminate has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.9.5:
    - a. Nitric Acid (30 Percent): Moderate effect.

- b. Sulfuric Acid (77 Percent): Moderate effect.
- c. Hydrochloric Acid (37 Percent): Moderate effect.
- d. Phosphoric Acid (75 Percent): No effect.
- e. Acetic Acid (98 Percent): No effect.
- f. Formaldehyde: No effect.
- g. Ethyl Acetate: No effect.
- h. Ethyl Ether: No effect.
- i. Phenol (85 Percent): Moderate effect.
- j. Benzene: No effect.
- k. Xylene: No effect.
- l. Butyl Alcohol: No effect.
- m. Furfural: No effect.
- n. Methyl Ethyl Ketone: No effect.
- o. Sodium Hydroxide (25 Percent): No effect.
- p. Sodium Sulfide (15 Percent): No effect.
- q. Ammonium Hydroxide (28 Percent): No effect.
- r. Zinc Chloride: No effect.
- s. Gentian Violet: No effect.
- t. Methyl Red: No effect.

2. Products: Subject to compliance with requirements, provide one of the following:

- a. Formica Corporation; Lab Grade 840 Black.
- b. Panolam Industries International Incorporated; Pionite Chemguard.
- c. Wilsonart International, Div. of Premark International, Inc.; Chemsurf.

G. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABA Industries.
- b. Avonite, Inc.
- c. E. I. du Pont de Nemours and Company.
- d. Formica Corporation.
- e. LG Chemical, Ltd.
- f. Meganite Inc.; a division of the Pyrochem Group.
- g. Nevamar Company, LLC; Decorative Products Div.
- h. Samsung; Cheil Industries Inc.
- i. Swan Corporation (The).
- j. Transolid, Inc.
- k. Wilsonart International; Div. of Premark International, Inc.

- 3. Type: Standard type or Veneer type made from material complying with requirements for Standard type, as indicated, unless Special Purpose type is indicated.
- 4. Colors and Patterns: As selected by Architect from manufacturer's full range.

- H. Tempered Float Glass for Cabinet Shelves: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.

## 2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
- B. Butt Hinges: 2-3/4-inch (70-mm), 5-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:
1. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.
- D. Wire Pulls: Back mounted, solid metal, (4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.
- E. Catches: Push-in magnetic catches, BHMA A156.9, B03131.
- F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- G. Shelf Rests: BHMA A156.9, B04013; metal.
- H. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads, where indicated:
1. Box Drawer Slides:
    - a. Light to Medium Duty Drawers, 16" wide or less, all ball bearing, self closing, handed lever disconnect, full extension slides with 100 lb./pr. (45 kg) load rating.
      - 1) Standard finish: clear zinc.
      - 2) 50,000 cycles tested from center pull, only.
      - 3) Basis of Design: Accuride 3832SC, or approved equal.
  2. Box Drawer Slides:
    - a. Light to Medium Duty Drawers, 24" wide or less, all ball bearing, rail mount, full extension (over travel) slides, hold-in detent, with 100 lb./pr. (45 kg) load rating and progressive movement.
      - 1) Standard finish: clear zinc.
      - 2) 75,000 cycles tested from center pull, only.
      - 3) Basis of Design: Accuride 7432, or approved equal.
  3. Box Drawer Slides:
    - a. Heavy Duty Drawers, 24" wide or less, all ball bearing, rail mount, full extension +1in. (25mm) over travel slides, hold-in detent, with 150 lb./pr. (68 kg) load rating and progressive movement.
      - 1) Standard finish: clear zinc.

- 2) 75,000 cycles tested from center pull, only.
  - 3) Basis of Design: Accuride 4034, or approved equal.
4. Heavy Duty File Drawer Slides:
- a. File Drawers 42 in. wide or less, all ball bearing, rail/bracket mount, full extension + 1 inch (25 mm) over travel slides, hold-in detent, with 200 lb./pr. (90 kg) load rating and sequential movement.
    - 1) Standard finish: clear zinc.
    - 2) 75,000 cycles tested from center pull, only.
    - 3) Basis of Design: Accuride 3640, or approved equal.
5. Keyboard Tray Slide:
- a. Key board tray with adjustable tilt plate, all ball bearing, full extension slides with three position detent and an integral keyboard tray including gel palm rest, storage compartments, cable management and mouse pad
    - 1) Basis of Design: Accuride CBERGO-TRAY 300, or approved equal.
- I. Locks specified in paragraph above and below are deadbolt locks, surface mounted on inside of door or drawer with only the cylinder exposed on outside; revise either paragraph if another type of lock is required.
- J. Drawer Locks: BHMA A156.11, E07041.
- K. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
  1. Product: Subject to compliance with requirements, provide "OG series" by Doug Mockett & Company, Inc., or approved equal.
- L. Paper Slots, where indicated: 12 inches (305 mm) long by 1-3/4 inches (45 mm) wide by 1 inch (25 mm) deep; black, molded-plastic, paper-slot liner with 1/4-inch (6.4-mm) lip.
  1. Product: Subject to compliance with requirements, provide "Model CP-2" by Doug Mockett & Company, Inc., or approved equal.
- M. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
  1. Satin Stainless Steel: BHMA 630.
- N. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
  1. Satin Stainless Steel: BHMA 630.
- O. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

## 2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - 1. Wood Glues: 30 g/L.
  - 2. Contact Adhesive: 250 g/L.
- E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
  - 1. Adhesive for Bonding Edges: adhesive specified above for faces.

## 2.5 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
  - 1. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
  - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
  - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

- 1. Seal edges of openings in countertops with a coat of varnish.

## 2.6 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: Premium.
- B. Wood Species and Cut: Cherry, plain sawn.
- C. For trim items wider than available lumber, use veneered construction. Do not glue for width.
- D. For rails wider or thicker than available lumber, use veneered construction. Do not glue for width or thickness.
- E. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- F. Assemble casings in plant except where limitations of access to place of installation require field assembly.
- G. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.

## 2.7 FLUSH WOOD PANELING AND WAINSCOTS

- A. Grade: Premium.
- B. Wood Species and Cut: Cherry, plain sliced.
  - 1. Lumber Trim and Edges: At fabricator's option, trim and edges indicated as solid wood (except moldings) may be either lumber or veneered construction compatible with grain and color of veneered panels.
- C. Matching of Adjacent Veneer Leaves: Book match.
- D. Veneer Matching within Panel Face: Center-balance match.
- E. Panel-Matching Method: No matching between panels is required. Select and arrange panels for similarity of grain pattern and color between adjacent panels.
- F. Panel-Matching Method: Match panels within each separate area by the following method:
  - 1. Premanufactured sets used full width as indicted.

- G. Vertical Panel-Matching Method: Vertical book match; veneer leaves are individually book matched from lower panels to upper panels.

## 2.8 WOOD CABINETS FOR TRANSPARENT FINISH

- A. Grade: Premium.
- B. AWI Type of Cabinet Construction: Flush overlay.
- C. Reveal Dimension: As indicated.
- D. Wood Species and Cut for Exposed Surfaces: Cherry, plain sawn or sliced, match architect's sample.
  - 1. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
  - 2. Matching of Veneer Leaves: Book match.
  - 3. Vertical Matching of Veneer Leaves: End match.
  - 4. Veneer Matching within Panel Face: Center-balance match.
  - 5. Veneer Matching within Room: Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.
- E. Semiexposed Surfaces: Provide surface materials indicated below:
  - 1. Surfaces Other Than Drawer Bodies: Compatible species to that indicated for exposed surfaces, stained to match.
  - 2. Drawer Sides and Backs: Solid-hardwood lumber, stained to match species indicated for exposed surfaces.
  - 3. Drawer Bottoms: Hardwood plywood.
- F. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

## 2.9 PLASTIC-LAMINATE CABINETS

- A. Grade: Premium.
- B. AWI Type of Cabinet Construction: Flush overlay.
- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
  - 1. Horizontal Surfaces Other Than Tops: Grade HGS.
  - 2. Postformed Surfaces: Grade HGP.
  - 3. Vertical Surfaces: Grade VGS.
  - 4. Edges: Grade HGS.
- D. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.

a. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.

2. Drawer Sides and Backs: Solid-hardwood lumber.

3. Drawer Bottoms: Hardwood plywood.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

G. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

## 2.10 PLASTIC-LAMINATE COUNTERTOPS

A. Grade: Premium.

B. High-Pressure Decorative Laminate Grade: HGP.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by manufacturer's designations.
2. Match Architect's sample.

D. Edge Treatment: Same as laminate cladding on horizontal surfaces.

E. Core Material: Exterior-grade plywood.

F. Core Material at Sinks: exterior-grade plywood.

G. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of countertop substrate.

H. Paper Backing: Provide paper backing on underside of countertop substrate.

## 2.11 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Grade: Premium.

B. Solid-Surfacing-Material Thickness: 3/4 inch (19 mm).

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. As selected by Architect from manufacturer's full range.
- D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
1. Fabricate tops with shop-applied edges of materials and configuration indicated.
  2. Fabricate tops with shop-applied backsplashes or loose for field application.
- E. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

## 2.12 LAMINATED-PLASTIC LABORATORY TOPS

- A. Grade: Premium.
- B. High-Pressure Decorative Laminate: Chemical-resistant, Grade HGP.
- C. Colors and Patterns: Provide materials and products that result in colors and patterns of exposed laminate surfaces complying with the following requirements:
  1. As selected by Architect from manufacturer's full range of colors and patterns.
- D. Core Material: Exterior-grade rotary-cut lauan or closed-grain hardwood plywood.

## 2.13 CLOSET AND UTILITY SHELVING

- A. Grade: Premium.
- B. Shelf Material: 3/4-inch (19-mm) medium-density fiberboard with solid-lumber edge.
- C. Cleats: 3/4-inch (19-mm) solid lumber.
- D. Wood Species, where indicated: Any closed-grain hardwood.

## 2.14 SHOP FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation. Refer to Division 9 painting Sections for finishing architectural woodwork not indicated to be shop finished.
- C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper.

D. Transparent Finish:

1. Grade: Premium.
2. AWI Finish System: Catalyzed polyurethane.
3. Staining: Match Architect's sample.
4. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
5. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
  - a. Apply wash-coat sealer after staining and before filling.
6. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

#### 3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening.

- countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches (900 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
  2. Install wall railings on indicated metal brackets securely fastened to wall framing.
  3. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).
- G. Paneling: Anchor paneling to supporting substrate with concealed panel-hanger clips, or splined connection strips. Do not use face fastening, unless covered by trim.
1. Install flush paneling with no more than 1/16 inch in 96-inch (1.5 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.
- A. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
  2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for minimum 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips.
- B. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
  2. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
  3. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."
- C. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
- D. Refer to Division 9 Sections for final finishing of installed architectural woodwork not indicated to be shop finished.

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3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes glass-fiber reinforced plastic (FRP) wall paneling and trim accessories.
- B. Related Sections:
  - 1. Division 06 Section "Rough Carpentry" for wood furring for installing plastic paneling.
  - 2. Division 10 Section "Wall and Door Protection" for corner guards installed over plastic paneling.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content and chemical components.
  - 2. Product Data for Credit EQ 4.4: For laminating adhesive and composite wood products used in factory-laminated plastic panels, indicating that product contains no urea formaldehyde.
- C. Samples for Initial Selection: For plastic paneling and trim accessories.
- D. Samples for Verification: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 450 or less.
3. Testing Agency: Acceptable to authorities having jurisdiction.

## 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.1 PLASTIC SHEET PANELING

- A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Kemlite Company Inc.
    - b. Marlite.
    - c. Nudo Products, Inc.
  2. Nominal Thickness: Not less than 0.09 inch (2.3 mm).
  3. Surface Finish: Smooth.
  4. Color: As selected by Architect from manufacturer's full range.

### 2.2 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
  1. Color: As selected by Architect from manufacturer's full range.
- B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
- C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.
- D. Adhesive: As recommended by plastic paneling manufacturer.
  1. VOC Content: 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- E. Sealant: Single-component, mildew-resistant, neutral-curing silicone, or sealant recommended by plastic paneling manufacturer and complying with requirements in Division 07 Section "Joint Sealants."
  - 1. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
  - 1. Mark plumb lines on substrate at panel joint locations for accurate installation.
  - 2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

#### 3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.
  - 1. Drill oversized fastener holes in panels and center fasteners in holes.

2. Apply sealant to fastener holes before installing fasteners.
- D. Install factory-laminated panels using concealed mounting splines in panel joints.
- E. Install trim accessories with adhesive.
- F. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
- G. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- H. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- I. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

## SECTION 071113 - BITUMINOUS DAMPPROOFING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Cold-applied, emulsified-asphalt dampproofing.
- B. Related Sections include the following:
  - 1. Division 07 Section "Self-Adhering Sheet Waterproofing" for waterproofing.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.
- B. Material Certificates: For each product, signed by manufacturers.
- C. LEED Submittal:
  - 1. Product Data for Credit EQ 4.2: For dampproofing, including printed statement of VOC content.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

#### 1.5 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

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## PART 2 - PRODUCTS

### 2.1 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ChemMasters Corp.
  - 2. Degussa Building Systems; Sonneborn Brand Products.
  - 3. Gardner Gibson, Inc.
  - 4. Henry Company.
  - 5. Karnak Corporation.
  - 6. Koppers Inc.
  - 7. Malarkey Roofing Products.
  - 8. Meadows, W. R., Inc.
  - 9. Tamms Industries, Inc.
- B. Trowel Coats: ASTM D 1227, Type II, Class 1.
- C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
- D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
- E. VOC Content: 0.25 lb/gal. (30 g/L) or less.

### 2.2 PROTECTION COURSE

- A. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on both side(s) with plastic film, nominal thickness 1/4 inch (6 mm), with compressive strength of not less than 8 psi (55 kPa) per ASTM D 1621, and maximum water absorption by volume of 0.6 percent per ASTM C 272.

### 2.3 MISCELLANEOUS MATERIALS

- A. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.
- B. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- C. Patching Compound: Epoxy or latex-modified repair mortar of type recommended by dampproofing manufacturer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
  - 1. Proceed with dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.
  - 2. Test for surface moisture according to ASTM D 4263.

#### 3.2 PREPARATION

- A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.
- C. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

#### 3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.
  - 1. Apply additional coats if recommended by manufacturer or if required to achieve coverages indicated.
  - 2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coats.
  - 3. Allow 24 hours drying time prior to backfilling.
- B. Apply dampproofing to footings and foundation walls where opposite side of wall faces building interior. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches (150 mm) over outside face of footing.
  - 1. Extend 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
  - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.
- C. Apply dampproofing to provide continuous plane of protection on exterior face of inner wythe of exterior masonry cavity walls.

1. Lap dampproofing at least 1/4 inch (6 mm) onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
  2. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe, and lap dampproofing at least 1/4 inch (6 mm) onto shelf angles supporting veneer.
- D. Apply dampproofing to provide continuous plane of protection on interior face of above-grade, exterior concrete and masonry single-wythe masonry walls unless walls are indicated to receive direct application of paint.
1. Continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by delaying construction of intersecting walls until dampproofing is applied.
- E. On Exterior Face of Inner Wythe of Cavity Walls: Apply primer and 1 brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).
- 3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING
- A. On Concrete Foundations and Parged Masonry Foundation Walls: Apply 2 brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, 1 fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m), or 1 trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).
- B. On Unparged Masonry Foundation Walls: Apply primer and 2 brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, primer and 1 fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m), or primer and 1 trowel coat at not less than 5 gal./100 sq. ft. (2 L/sq. m).
- C. On Unexposed Face of Concrete Retaining Walls: Apply 1 brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).
- D. On Unexposed Face of Masonry Retaining Walls: Apply primer and 1 brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).
- E. On Exterior Face of Inner Wythe of Cavity Walls: Apply primer and 1 brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

### 3.5 INSTALLATION OF PROTECTION COURSE

- A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing material manufacturer's written recommendations for attaching protection course.
1. Support protection course with spot application of adhesive of type recommended by protection board manufacturer over cured coating.
  2. Install protection course within 24 hours of installation of dampproofing (while coating is tacky) to ensure adhesion.

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3.6 CLEANING

- A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

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END OF SECTION 071113



SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Modified bituminous sheet waterproofing.
  - 2. Molded-sheet drainage panels.
  - 3. Insulation.
- B. Related Sections include the following:
  - 1. Division 07 Section "Joint Sealants" for joint-sealant materials and installation.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- C. Samples: For the following products:
  - 1. 12-by-12-inch (300-by-300-mm) square of waterproofing and flashing sheet.
  - 2. 12-by-12-inch (300-by-300-mm) square of insulation.
  - 3. 4-by-4-inch (100-by-100-mm) square of drainage panel.
- D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- E. Qualification Data: For Installer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for waterproofing.
- G. Warranties: Special warranties specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is approved or licensed by waterproofing manufacturer for installation of waterproofing required for this Project.
- B. Source Limitations: Obtain waterproofing materials, protection course, and molded-sheet drainage panels through one source from a single manufacturer.
- C. Mockups: Before beginning installation, install waterproofing to 100 sq. ft. (9.3 sq. m) of wall to demonstrate surface preparation, crack and joint treatment, corner treatment, and execution quality.
  - 1. If Architect determines mockups do not comply with requirements, reapply waterproofing and reinstall overlying construction until mockups are approved.
  - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- D. Store rolls according to manufacturer's written instructions.
- E. Protect stored materials from direct sunlight.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
  - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to replace waterproofing material that does not comply with requirements or that fails to remain watertight within specified warranty period.
1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16 inch (1.6 mm) in width.
  2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Installer's Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.
1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

PART 2 - PRODUCTS

2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet: Not less than 60-mil- (1.5-mm-) thick, self-adhering sheet consisting of 56 mils (1.4 mm) of rubberized asphalt laminated to a 4-mil- (0.10-mm-) thick, polyethylene film with release liner on adhesive side and formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. American Hydrotech, Inc.; VM 75.
    - b. American Permaquik Inc.; PQ 7100.
    - c. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRI 860/861.
    - d. CETCO Building Materials Group; Envirosheet.
    - e. Grace, W. R. & Co.; Bituthene 4000.
    - f. Henry Company; Blueskin WP 200.
    - g. Meadows, W. R., Inc.; SealTight Mel-Rol.
    - h. Nervastral, Inc.; BITU-MEM.
    - i. Pecora Corporation; Duramem 700-SM.
    - j. Polyguard Products; Polyguard 650.
    - k. Progress Unlimited, Inc.; Plastiwrap 60.
    - l. Tamko Roofing Products, Inc.; TW-60.
  2. Physical Properties:
    - a. Tensile Strength: 250 psi (1.7 MPa) minimum; ASTM D 412, Die C, modified.
    - b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
    - c. Low-Temperature Flexibility: Pass at minus 20 deg F (minus 29 deg C); ASTM D 1970.
    - d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836.

- e. Puncture Resistance: 40 lbf (180 N) minimum; ASTM E 154.
- f. Hydrostatic-Head Resistance: 150 feet (45 m) minimum; ASTM D 5385.
- g. Water Absorption: 0.15 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
- h. Vapor Permeance: 0.05 perms (2.9 ng/Pa x s x sq. m); ASTM E 96, Water Method.

## 2.2 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
  - 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid waterborne primer recommended for substrate by manufacturer of sheet waterproofing material.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of sheet waterproofing material.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, asphalt-modified coating.
- F. Sheet Strips: Self-adhering, rubberized-asphalt sheet strips of same material and thickness as sheet waterproofing.
- G. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.
  - 1. Detail Tape: Two-sided, pressure-sensitive, self-adhering reinforced tape, 4-1/2 inches (114 mm) wide, with a tack-free protective adhesive coating on one side and release film on self-adhering side.
  - 2. Detail Strips: 62.5-mil- (1.58-mm-) thick, felt-reinforced self-adhesive strip, 9 inches (229 mm) wide, with release film on adhesive side.
- H. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick, predrilled at 9-inch (229-mm) centers.

## 2.3 MOLDED-SHEET DRAINAGE PANELS

- A. Molded-Sheet Drainage Panel: Comply with Division 33 Section "Subdrainage."
- B. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.425-mm) sieve laminated to one side with a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-

plastic-sheet drainage core, with a horizontal flow rate not less than 2.8 gpm per ft. (35 L/min. per m).

## 2.4 INSULATION

- A. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, square edged.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Diversifoam Products.
    - b. Dow Chemical Company (The).
    - c. Owens Corning.
    - d. Pactiv Building Products.
    - e. T. Clear Corporation.
  - 2. Type VI, 40-psi (276-kPa) minimum compressive strength.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
  - 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
  - 2. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
  - 1. Install sheet strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch (1.6 mm).
- F. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
  - 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of liquid membrane on horizontal inside corners and as follows:
    - a. At footing-to-wall intersections, extend liquid membrane each direction from corner or install membrane strip centered over corner.
- G. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

### 3.3 MODIFIED BITUMINOUS SHEET WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and according to recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure watertight installation.
  - 1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).
- D. Apply continuous sheets over sheet strips bridging substrate cracks, construction, and contraction joints.
- E. Seal exposed edges of sheets at terminations not concealed by metal counterflashings or ending in reglets with mastic.
- F. Install sheet waterproofing and auxiliary materials to tie into adjacent waterproofing.
- G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches (150 mm) beyond repaired areas in all directions.

1. Board insulation may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

- H. Correct deficiencies in or remove sheet waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

#### 3.4 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install board insulation before installing drainage panels.

#### 3.5 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.

#### 3.6 FIELD QUALITY CONTROL

- A. Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.

#### 3.7 PROTECTION AND CLEANING

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Protect installed board insulation from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071326



SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes penetrating water-repellent treatments for the following vertical and horizontal surfaces:
1. Cast-in-place concrete.
  2. Precast concrete.
  3. Concrete unit masonry.
- B. Related Sections:
1. Division 04 Section "Unit Masonry" for integral water-repellent admixture for unit masonry assemblies.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Water repellents shall meet performance requirements indicated without failure due to defective manufacture, fabrication, or installation.
1. Water Repellents: Comply with performance requirements specified, as determined by preconstruction testing on manufacturer's standard substrate assemblies representing those indicated for this Project.
- B. Water Absorption: Minimum 90 percent reduction of water absorption after 24 hours in comparison of treated and untreated specimens.
1. Cast-in Place Concrete: ASTM C 642.
  2. Precast Concrete: ASTM C 642.
  3. Concrete Masonry Units: ASTM C 140.
- C. Water-Vapor Transmission: Comply with one or both of the following:
1. Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, according to ASTM D 1653.
- D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, according to ASTM E 514.

- E. Durability: Maximum 5 percent loss of water-repellent properties after 2500 hours of weathering according to ASTM G 154 in comparison to water-repellent-treated specimens before weathering.
- F. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.
  - 1. Reduction of Water Absorption: 80 percent.
  - 2. Reduction in Chloride Content: 80 percent.

#### 1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Testing: Installed water repellents shall comply with performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard substrate assemblies by a qualified testing agency.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include manufacturer's printed statement of VOC content.
  - 2. Include manufacturer's standard colors.
  - 3. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.
  - 4. Printout of current "MPI Approved Products List" for each product category specified in Part 2 that specifies water repellents approved by MPI, with the proposed product highlighted.
- B. Product Certificates: For each type of water repellent, from manufacturer.
- C. Field quality-control reports.
- D. Warranty: Special warranty specified in this Section.

#### 1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.
- B. MPI Standards: Comply with MPI standards indicated and provide water repellents listed in its "MPI Approved Products List."

#### 1.7 PROJECT CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
  - 1. Concrete surfaces and mortar have cured for not less than 28 days.

2. Building has been closed in for not less than 30 days before treating wall assemblies.
3. Ambient temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C) and will remain so for 24 hours.
4. Substrate is not frozen and substrate-surface temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C).
5. Rain or snow is not predicted within 24 hours.
6. Not less than 24 hours have passed since surfaces were last wet.
7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.
  1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PENETRATING WATER REPELLENTS

- A. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blend with 400 g/L or less of VOCs.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Degussa Corporation; Protectosil Aqua-Trete EM.
    - b. L&M Construction Chemicals, Inc.; Aquapel Plus.
    - c. Pecora Corporation; KlereSeal 920-W.
    - d. PROSOCO, Inc.; Siloxane PD.
    - e. Sika Corporation, Inc.; Sikagard 701W.
    - f. Symons by Dayton Superior; Siloxane/Silane 10%.
    - g. Tamms Industries, Inc., Euclid Chemical Company (The); Baracade WB 244.
    - h. Tnemec Inc.; Prime-A-Pell Plus, Series V662.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
  1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in **three** representative locations by method recommended by manufacturer.

2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
  3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
  4. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:
1. Cast-in-Place Concrete, Precast Concrete, and Concrete Unit Masonry: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents according to ASTM E 1857.
- B. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.
- C. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

### 3.3 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. Apply a heavy-saturation coating of water repellent, on surfaces indicated for treatment, using 15 psi- (103 kPa-) pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply

with manufacturer's written instructions for application procedure unless otherwise indicated.

1. Precast Concrete: At Contractor's option, first application of water repellent on units may be completed before installing them. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces.
- C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

### 3.4 FIELD QUALITY CONTROL

- A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:
1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
  2. Testing agency will perform tests for compliance of water-repellent material with product requirements.
  3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor shall remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect.
- B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.
1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.
  2. Reapply water repellent until coverage test indicates complete coverage.

### 3.5 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900



## SECTION 072100 - THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Foam-plastic board insulation.
- 2. Glass-fiber blanket insulation.
- 3. Spray polyurethane foam insulation.
- 4. Vapor retarders.

- B. Related Sections:

- 1. Division 07 Section "Self-Adhering Sheet Waterproofing" for insulated drainage panels installed with waterproofing.
- 2. Division 07 Section(s) "Thermoplastic Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.
- 3. Division 07 Section "Fire-Resistive Joint Systems" for insulation installed as part of a perimeter fire-resistive joint system.
- 4. Division 09 Section(s) "Gypsum Board Shaft Wall Assemblies" for installation in wood- and metal-framed assemblies of insulation specified by referencing this Section.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. LEED Submittals:

- 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

- D. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

#### 1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
  - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
  - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

### PART 2 - PRODUCTS

#### 2.1 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. DiversiFoam Products.
    - b. Dow Chemical Company (The).
    - c. Owens Corning.
    - d. Pactiv Building Products.
  - 2. Type VI, 40 psi (276 kPa).
- B. Geotextile-Faced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type VI, 40-psi (276-kPa) minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with nonwoven geotextile filter fabric.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Owens Corning.
  - b. Approved Equal.
- C. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 1, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Atlas Roofing Corporation.
    - b. Dow Chemical Company (The).
    - c. Rmax, Inc.
- D. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

## 2.2 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. CertainTeed Corporation.
  - 2. Guardian Building Products, Inc.
  - 3. Johns Manville.
  - 4. Knauf Insulation.
  - 5. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- C. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
- D. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
- 1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
  - 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

## 2.3 SPRAY POLYURETHANE FOAM INSULATION

- A. Open-Cell Polyurethane Foam Insulation: Spray-applied polyurethane foam using water as a blowing agent, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. BaySystems NorthAmerica, LLC.
  - b. Demilec (USA) LLC.
  - c. Gaco Western Inc.
  - d. Icynene Inc.
  - e. SWD Urethane Company.
2. Minimum density of 0.4 lb/cu. ft. (6.4 kg/cu. m), thermal resistivity of 3.4 deg F x h x sq. ft./Btu x in. at 75 deg F (24 K x m/W at 24 deg C).

## 2.4 VAPOR RETARDERS

- A. Reinforced-Polyethylene Vapor Retarders: Two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 25 lb/1000 sq. ft. (12 kg/100 sq. m), with maximum permeance rating of 0.0507 perm (2.9 ng/Pa x s x sq. m).
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Raven Industries Inc.; DURA-SKRIM 6WW.
    - b. Reef Industries, Inc.; Griffolyn T-65.
    - c. Approved Equal.
- B. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: Two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nonwoven grid of nylon cord or polyester scrim and weighing not less than 22 lb/1000 sq. ft. (10 kg/100 sq. m), with maximum permeance rating of 0.1317 perm (7.56 ng/Pa x s x sq. m) and with flame-spread and smoke-developed indexes of not more than 5 and 60, respectively, per ASTM E 84.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Raven Industries Inc.; DURA-SKRIM 2FR.
    - b. Reef Industries, Inc.; Griffolyn T-55 FR.
    - c. Approved Equal.
- C. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- D. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.
- E. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.
- F. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

2.5 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
    - b. Gemco; Spindle Type.
    - c. Approved Equal.
  2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
  3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. AGM Industries, Inc.; RC150.
    - b. Gemco; Dome-Cap.
    - c. Approved Equal.
  2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
    - a. Crawl spaces and tunnels.
    - b. Ceiling plenums.
- C. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch (25 mm) between face of insulation and substrate to which anchor is attached.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Gemco; Clutch Clip.
    - b. Approved Equal.
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. AGM Industries, Inc.; TACTOO Adhesive.
    - b. Gemco; Tuff Bond Hanger Adhesive.
    - c. Approved Equal.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

### 3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

### 3.3 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical footing and foundation wall surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
  - 1. If not otherwise indicated, extend insulation a minimum of 36 inches (915 mm) below exterior grade line.
- B. On horizontal surfaces under slabs, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
  - 1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) in from exterior walls.

### 3.4 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

- B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  - 4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
  - 5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- D. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.
- E. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
  - 1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
  - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

### 3.5 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

- A. Where glass-fiber blankets are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated. Extend insulation 48 inches (1219 mm) up either side of partitions.

### 3.6 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

- A. Install board insulation on concrete and CMU substrates by adhesively attached, spindle-type insulation anchors as follows:
  - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors

- according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
  3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
  4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

### 3.7 INSTALLATION OF VAPOR RETARDERS

- A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.
  1. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches (406 mm) o.c.
  2. Before installing vapor retarders, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
  3. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

### 3.8 PROTECTION

- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Materials and installation methods for fluid applied, vapor permeable air barrier membrane system located in the non-accessible part of the wall.
2. Materials and installation methods to bridge and seal air leakage pathways in roof and foundation junctions, window and door openings, control and expansion joints, masonry ties, piping and other penetrations through the wall assembly.

- B. Related Sections include the following:

1. Division 06 Section "Sheathing" for wall sheathings, wall sheathing joint-and-penetration treatments, building paper, and building wraps.
2. Division 07 low-slope roofing Sections for roof air barriers.
3. Division 07 Section "Thermal Insulation" for foam-plastic board insulation.
4. Division 07 Section "Sheet Metal Flashing and Trim" for sheet metal flashings.
5. Division 07 Section "Joint Sealants" for joint-sealant materials and installation.

1.3 DEFINITIONS

- A. ABAA: Air Barrier Association of America.

1. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PERFORMANCE REQUIREMENTS

General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter con-

ditions without deterioration and air leakage exceeding specified limits. The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. An air barrier shall also be provided for interior partitions between conditioned space and space designed to maintain temperature or humidity levels which differ from those in the conditioned space by more than 50% of the difference between the conditioned space and design ambient conditions. The air barrier shall have the following characteristics:

1. It must be continuous, with all joints made airtight.
2. It shall have an air permeability not to exceed 0.004 cfm/sq. ft. under a pressure differential of 0.3 in. water. (1.57 psf.) (equal to 0.02L/sq. m @ 75 Pa.).
3. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
4. It shall be durable or maintainable.
5. The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
  - a. Foundation and walls.
  - b. Walls and windows or doors.
  - c. Different wall systems.
  - d. Wall and roof.
  - e. Wall and roof over unconditioned space.
  - f. Walls, floor and roof across construction, control and expansion joints.
  - g. Walls, floors and roof to utility, pipe and duct penetrations.
6. All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made airtight.
  - A. Water Vapor Permeance: Not more than 0.02 Perm; ASTM E-96, Method B.

## 1.5 SUBMITTALS

- A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.
- B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
  1. Include details of interfaces with other materials that form part of air barrier.
  2. Include details of mockups.
- C. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.
- D. Qualification Data: For Applicator.

- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

#### 1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance and has been specifically approved in writing by the manufacturer.
- B. Single-Source Responsibility: Obtain Product and Accessories from single manufacturer.
- C. Mockups: Before beginning installation of air barrier, build mockups of exterior wall assembly shown on Drawings, 150 sq. ft. (14 sq. m), incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.
  - 1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.
  - 2. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
  - 3. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
  - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site.
  - 1. Include installers of other construction connecting to air barrier, including roofing, waterproofing, architectural precast concrete, masonry, sealants, windows, glazed curtain walls, and door frames.
  - 2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Store rolls according to manufacturer's written instructions.
- D. Protect stored materials from direct sunlight.

1.8 WASTE MANAGEMENT AND DISPOSAL

- A. Separate and recycle waste materials in accordance with Division 01 Section "Construction Waste Management and Disposal", and with the Waste Reduction Work Plan.
- B. Place materials defined as hazardous or toxic in designated containers.
- C. Ensure emptied containers are stored safely away from children.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.
- B. Transition Membrane Application: Apply at ambient temperatures above 40 degrees F. unless procedure for low temperature application is followed. Do not apply during rain.

1.10 WARRANTY

- A. Material Warranty: Manufacturer's standard form in which manufacturer agrees to replace fluid-applied air barrier membrane materials, that fail within specified warranty period when installed and used in strict conformance with written manufacturer's instructions.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure to maintain air permeance rating not to exceed .004 cfm/sq. ft (0.02 L/s/sq. m.) when tested per ASTM E2178, within specified warranty period.
    - b. Failure to maintain a vapor permeance rating greater than 10 perms when tested in accordance with ATM E96, Method B.
  - 2. Warranty Period: Five years from date of Substantial Completion.
- B.

PART 2 - PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIER

- A. Fluid-Applied, Fully-Adhered, Vapor-Permeable Membrane Air Barrier, Basis of Design: Subject to compliance with requirements, provide the following:
  - 1. Single Component Acrylic Membrane: Perm-A-Barrier VP, as manufactured by Grace Construction Products, 62 Whittemore Avenue, Cambridge, MA.
- B. Physical and Performance Properties: Provide products with the following minimum properties:

1. Membrane Air Permeance: Not to exceed 0.0004 cfm/sq. ft. of surface area (at specified thickness) at 1.57-lbf/sq. ft. pressure difference (0.002 L/s x sq. m of surface area at 75-Pa) when applied to CMU wall; when tested per ASTM E2178.
  2. Membrane Vapor Permeance: Not less than 11.2 perms (649.6 ng/Pa x s x sq. m); when tested per ASTM E96.
  3. Assembly Performance: Provide a continuous air barrier assembly that has an air leakage not to exceed 0.0008 cfm/sq. ft. of surface area under a pressure differential of 0.3 in. water (1.57 pounds per square foot) (0.004 L/s x sq. m of surface area at 75-Pa) when tested in accordance with ASTM E 2357.
  4. UV Exposure Limit: Not more than 180 calendar days; per ASTM D412 and ASTM E96-Method B.
1. Available Alternate Products: Subject to compliance with requirements, approved equal products that may be incorporated into the Work include:
    - a. Elastomeric Modified Bituminous Membrane:
      - 1) Carlisle Coatings & Waterproofing; Barriseal.
      - 2) Henry Company; Air-Bloc 06.
      - 3) Meadows, W. R., Inc.; Air-Shield LM.
      - 4) NEI; AC AVS1.
      - 5) Tremco Incorporated; ExoAir.
    - b. Synthetic Polymer Membrane:
      - 1) Henry Company; Air-Bloc 21 or 21S.
      - 2) Rubber Polymer Corporation; Rub-R-Wall Airtight.

## 2.2 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Liquid Membrane for Details and Terminations: Provide Bituthene Liquid Membrane as manufactured by Grace Construction Products, 62 Whittemore Avenue, Cambridge, MA., or approved equal.
- C. Wall Primer (for Use with Throughwall Flashing and Tapes Applied to Substrate): Liquid waterborne primer recommended for substrate by manufacturer of air barrier material.
  1. Flash Point: No flash to boiling point.
  2. Solvent Type: Water.
  3. VOC Content: Not to exceed 10 g/l.
  4. Application Temperature: -4°C (25°F) and above.
  5. Freezing point (as packaged): -7°C (21°F).
- D. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

1. Product: Perm-A-Barrier WB Primer manufactured by Grace Construction Products, or approved equal.
- E. Flexible Membrane Wall Flashing: 0.8 mm (32 mils) of self-adhesive rubberized asphalt integrally bonded to 0.2 mm (8 mil) of cross-laminated, high-density polyethylene film to provide a min. 1.0 mm (40 mil) thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed, conforming with the following:
1. Water Vapor Transmission: ASTM E96, Method B: 2.9 ng/m<sup>2</sup>sPa (0.05 perms) max.
  2. Water Absorption: ASTM D570: max. 0.1% by weight.
  3. Puncture Resistance: ASTM E154: 356 N (80 lbs.) min.
  4. Tear Resistance.
    - a. Initiation ASTM D1004: min. 58 N (13.0 lbs.) M.D.
    - b. Propagation ASTM D1938: min. 40 N (9.0 lbs.) M.D.
    - c. Lap Adhesion at -4°C (25°F): ASTM D1876: 880 N/m (5.0 lbs./in.) of width
    - d. Low Temperature Flexibility ASTM D1970: Unaffected to -43°C (-45°F)
    - e. Tensile Strength: ASTM D412, Die C Modified: min. 5.5 MPa (800 psi)
    - f. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D412, Die C: min. 200%.
    - g. Product: Perm-A-Barrier Wall Flashing manufactured by Grace Construction Products, or approved equal.
- F. Joint Reinforcing Strip: Air barrier manufacturer's approved tape.
- G. Transition Membrane: 0.8 mm (32 mils) of self-adhesive rubberized asphalt integrally bonded to 0.2 mm (8 mil) of cross-laminated, high-density polyethylene film to provide a min. 1.0 mm (40 mil) thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed, conforming with the following:
1. Water Vapor Transmission: ASTM E96, Method B: 2.9 ng/m<sup>2</sup>sPa (0.05 perms) max.
  2. Water Absorption: ASTM D570: max. 0.1% by weight
  3. Puncture Resistance: ASTM E154: 356 N (80 lbs.) min.
  4. Tear Resistance
    - a. Initiation ASTM D1004: min. 58 N (13.0 lbs.) M.D.
    - b. Propagation ASTM D1938: min. 40 N (9.0 lbs.) M.D.
  5. Lap Adhesion at -4°C (25°F): ASTM D1876: 880 N/m (5.0 lbs./in.) of width
  6. Low Temperature Flexibility ASTM D1970: Unaffected to -43°C (-45°F)
  7. Tensile Strength: ASTM D412, Die C Modified: min. 5.5 MPa (800 psi)
  8. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D412, Die C: min. 200%.
  9. Product: Perm-A-Barrier Wall Flashing manufactured by Grace Construction Products, or approved equal.
- H. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
1. Product: Bituthene Liquid Membrane, manufactured by Grace Construction Products, or approved equal.
- I. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft (24 to 32 kg/cu. m) density; flame spread

index of 25 or less according to ASTM E162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

- J. Joint Sealant: ASTM C920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
  2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
  3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
  4. Verify that masonry joints are flush and completely filled with mortar.
  5. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

### 3.3 JOINT TREATMENT

- A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
1. Prime substrate and apply a single thickness of preparation coat strip extending a minimum of 3 inches (75 mm) along each side of joints and cracks. Apply a double thickness of air barrier membrane and embed a joint reinforcing strip in preparation coat.
- B. Gypsum Sheathing: Fill joints greater than 1/4 inch (6 mm) with sealant according to ASTM C 1193 and with air barrier manufacturer's written instructions. Apply first layer of fluid air barrier membrane at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.

### 3.4 TRANSITION STRIP INSTALLATION

- A. Install strips, transition strips, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
  2. Install butyl or modified bituminous strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over both substrates.
- B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply manufacturer's standard transition strip so that a minimum

of 3 inches (75 mm) of coverage is achieved over both substrates. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames with not less than 1 inch (25 mm) of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
  2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches (150 mm) o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
  3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and membrane.
- G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.
- H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- I. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, counterflashing strip.
- J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

### 3.5 AIR BARRIER MEMBRANE INSTALLATION

- A. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.
- B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.
- C. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- D. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.
1. Vapor-Permeable Membrane Air Barrier: 90-mil (2.4-mm) wet film thickness, 45-mil (1.2-mm).
- E. Apply strip and transition strip over cured air membrane overlapping 3 inches (75 mm) onto each surface according to air barrier manufacturer's written instructions.

- F. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
  - 1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
  - 2. Continuous structural support of air barrier system has been provided.
  - 3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
  - 4. Site conditions for application temperature and dryness of substrates have been maintained.
  - 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
  - 6. Surfaces have been primed, if applicable.
  - 7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
  - 8. Termination mastic has been applied on cut edges.
  - 9. Strips and transition strips have been firmly adhered to substrate.
  - 10. Compatible materials have been used.
  - 11. Transitions at changes in direction and structural support at gaps have been provided.
  - 12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
  - 13. All penetrations have been sealed.
- C. Tests: Testing to be performed will be determined by Owner's testing agency from among the following tests:
  - 1. Qualitative Testing: Air barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, smoke pencil with pressurization or depressurization.
- D. Remove and replace deficient air barrier components and retest as specified above.

### 3.7 CLEANING AND PROTECTION

- A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

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1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 60 days.
  2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION 072726



SECTION 074213 – METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Manufacturer's published Recommendations and Installation Instructions

1.2 SUMMARY

- A. This Section includes the following sheet metal wall systems:
  - 1. Factory Formed and Field Assembled VM ZINC Corrugated wall system.
- B. Related Sections include the following:
  - 1. Division 5 Section "Cold-Formed Metal Framing" for secondary support framing supporting sheet metal wall panel assemblies
  - 2. Division 7 Section "Building Insulation" for wall insulation.
  - 3. Division 7 Section "Sheet Metal Flashing and Trim" for fascia, copings, flashings and other sheet metal work not part of sheet metal wall panel assemblies.
  - 4. Division 7 Section "Joint Sealants" for field-applied sheet metal wall panel assemblies sealants.

1.3 DEFINITION

- A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weather tight system

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide complete zinc alloy sheet metal wall panel assembly, including, but not limited to factory formed metal wall panels, cleats, clips, anchors and fasteners, sheet metal flashing and drainage components related to sheet metal wall panel assembly, fascia panels, trim, wood battens, skip sheathing, underlayment, and accessories as indicated and as required for a weather tight installation.
- B. Installation: All zinc sheet metal wall panel assembly and materials shall be installed using the best available industry standards and the means and methods recommended in the manufacturer's published information, or whichever is more stringent.

- C. Thermal Movements: Provide sheet metal wall panel assembly that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal wall panel assembly thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.
- D. Water Infiltration: Provide sheet metal wall panel assembly that does not allow water infiltration to building interior, with metal flashing and connections of sheet metal wall panel assembly lapped to allow moisture to run over and off the material.

## 1.5 SUBMITTALS

1.6 Product Data: For each product indicated. Include details of construction relative to materials, dimensions of individual components and profiles, and finishes.

- A. Shop Drawings: Show fabrication and installation layouts of sheet metal wall panel assembly, including plans, elevations, and keyed references to termination points. Distinguish between shop- and field-assembled work. Shop drawings to be reviewed by wall panel manufacturer prior to fabrication. Include the following:
1. Details for forming sheet metal wall panel assembly, including seams and dimensions.
  2. Details for joining and securing sheet metal wall panel assembly, including layout of fasteners, clips, and other attachments. Include pattern of seams.
  3. Details of termination points and assemblies, including fixed points.
  4. Details of expansion joints, including showing direction of expansion and contraction.
  5. Details of wall penetrations.
  6. Details of special conditions.
  7. Details of connections to adjoining work.
  8. Details of the required accessory items.
  9. Sheet metal wall panel assembly and attachments.
- B. Samples for Verification: For each type of exposed component required, prepared on Samples of size indicated below:
1. Sheet Metal Wall panel assembly: 24 inches (600 mm) long by actual panel width, including finished seam. Include fasteners, cleats, clips, battens, closures, and other attachments.
  2. Trim and Closures: 24 inches (600 mm) long. Include fasteners and other exposed accessories.
  3. Accessories: 24-inch- (600-mm-) long Samples for each type of accessory.
- C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed sheet metal wall panel assembly similar in material, design, forming method and extent to that indicated for this Project and with a record of successful in-service performance. Provide evidence of installer participation in manufacturer's Training Course.
- B. Sheet Metal Wall Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate sheet metal wall similar to that required for this Project and whose products have a record of successful in-service performance. Provide evidence of installer participation in manufacturer's Training Course.
- C. Sheet Metal Wall panel assembly Standard: Comply with manufacturer's published Architectural Binder, Installation Manual, or best industry standards, whichever is more stringent. Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. Mockups: Before installing sheet metal wall panel assembly, construct mockups for each form of construction required to verify selection made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using exposed and concealed materials and forming methods indicated for completed work.
  - 1. Locate mockups in the location and of the size indicated or, if not indicated, as directed by the Architect.
  - 2. Approval of mockups is for other material and construction qualities specifically approved by Architect in writing.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
  - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preliminary Sheet Metal Wall Panel Conference: Before starting wall framing and sheathing construction, conduct conference at Project site. Review methods and procedures related to wall framing and sheathing construction and metal wall panels including, but not limited to, the following:
  - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal wall panel Installer, structural-support Installer, and installers whose work interfaces with or affects metal wall panels.
  - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 3. Review methods and procedures related to metal wall panel installation, including manufacturer's written instructions.
  - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
  - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.

7. Review temporary protection requirements for metal wall panel assembly during and after installation.
  8. Review wall panel observation and repair procedures after metal wall panel installation.
- F. Pre-installation Conference: Conduct conference at Project site. Review methods and procedures related to sheet metal wall panel assembly including, but not limited to, the following:
1. Meet with Owner, Architect, Building Envelope Consultant, Owner's insurer if applicable, sheet metal wall panel assembly installer, and installers whose work interfaces with or affects sheet metal wall panel assembly including installers of wall accessories and wall-mounted equipment.
  2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  3. Review methods and procedures related to sheet metal wall panel assembly installation.
  4. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
  5. Review flashings, special wall panel assembly details, wall penetrations, equipment curbs, and condition of other construction that will affect sheet metal wall panel assembly.
  6. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
  7. Review temporary protection requirements for sheet metal wall panel assembly during and after installation.
  8. Review wall observation and repair procedures after sheet metal wall panel assembly installation.
  9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.
- B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weather tight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect strippable protective covering on metal wall panels from exposure to sunlight and high humidity, except to extent necessary for period of metal wall panel installation.
- E. Protect foam-plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

#### 1.9 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.

#### 1.10 EXPRESS LIMITED COMMERCIAL PRODUCT WARRANTY Available upon request.

### PART 2 - PRODUCTS

#### 2.1 PANEL MATERIALS

- A. VM ZINC® sheet: Electrolytic, 99.995 percent pure zinc with alloying additives of titanium and copper.

1. Basis of Design Manufacturer:

- a. UMICORE BUILDING PRODUCTS USA Inc., -

- 1) Phone: 919-874-7173
- 2) Fax: 919-874-7140
- 3) Email: [info@vmzinc-us.com](mailto:info@vmzinc-us.com)
- 4) Approved Equal.

2. Available thickness: 0.031 inch (0.80 mm), unless otherwise indicated.

3. Surface Aspects:

- a. VM QUARTZ ZINC® PLUS: A zinc with a dark gray aspect on the exposed side and protected on its underside by a proprietary 60 micron coating of furnace-polymerized polyester and polyurethane-polyamide liquid.
- b. VM QUARTZ ZINC® : A zinc with a dark gray aspect on both sides
- c. VM ANTHRA ZINC® PLUS: A zinc with a black aspect on the exposed side and protected on its underside by a proprietary 60 micron coating of furnace-polymerized polyester and polyurethane-polyamide liquid.
- d. VM ANTHRA ZINC®: A zinc with a black aspect on both sides

4. Alloy Properties:

Periodic table reference	Zn
Thickness tolerance	+/- 1/1000" (0.025 mm)
Density	200 lb/in <sup>3</sup> (7.2 kg/dm <sup>3</sup> )
Thermal expansion	1/64"/ft 212° F (2.2 mm/m 100° C)
Melting point	788° F (420° C)
Re-crystallization point	572° F (300° C)
Limit of elasticity: Rp 0.2	>= 14,504 PSI (100 N/mm <sup>2</sup> )
Tensile strength	>= 21,756 PSI (150 N/mm <sup>2</sup> )
Elongation at fracture	>= 40%
Elongation in creep test (50 N/mm <sup>2</sup> or 7250 PSI over a period of 60 minutes)	0.1%
Vickers hardness	>= 40
Heat conductivity	110 W/mk
Young's modulus	11,603,200 PSI (80,000 N/mm <sup>2</sup> )
Not magnetic	
UV resistant	
Non flammable	

5. VM ZINC® Premium Zinc Manufacturing Standard exceeds EN 988:

Specification	VM ZINC® Tolerance
<b>Alloy Tolerances</b>	
Copper (%)	0.08 – 0.20
Titanium (%)	0.07 – 0.12
Aluminum (%)	<=0.015
<b>Dimensional Tolerances</b>	
Thickness	+/- 0.02mm
Width	+2 / -0 mm
Length	+5 / -0 mm
Saber	<= 1.5 mm/m
Flatness	<= 2mm

6. VM ZINC® PLUS properties. Coating on backside of the zinc to have a minimum abrasion resistance of 140 liters as per ASTM D-968, method A.

## 2.2 WEATHER RESISTIVE BARRIER (WRB) MATERIALS

- A. Available Products: Subject to compliance with requirements, weather resistive barrier products that may be incorporated into the Work include, but are not limited to, the products specified.
- B. Hydrophobic Weather Resistive Barrier: WALLSHIELD® by PROCTOR for VM ZINC®. Fabric Underlayment and Slip Sheet: High permeability, spun bonded non-woven polypropylene fabric
1. Weight: 3 oz./sq.yd. (1000g/sq.m.)
  2. Thickness: 0.020 inch (0.50 mm)
  3. Water Vapour Transmission 9.79 Perms (1.96 grams/kPa\*h\*m) per ASTM E 96 Method A
- C. Flashing Membrane: Self-Adhering, High-Temperature Sheet: 30 to 40 mils (0.76 to 1.0 mm) thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by flashing membrane manufacturer.
1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
  2. Low Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
  3. Available Products:
    - a. Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start "HR" High Performance Underlayment.
    - b. Grace, W. R. & Co.; Vycor Ultra.
    - c. Henry Company; Perma-Seal PE.
    - d. Colbond, Enka Thermaflash Butyl Flashing

## 2.3 THERMAL INSULATION FOR FIELD-ASSEMBLED METAL WALL PANELS

- D. Refer to Division 7 Section "Building Insulation."

## 2.4 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating.
1. Fasteners for wall Panels: Self-drilling or self-tapping 410 stainless hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
  2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling 410 stainless screws with pancake head.
  3. Blind Fasteners: High-strength stainless-steel rivets.

## 2.5 UMICORE BUILDING PRODUCTS FACTORY FORMED ELEMENTS

A. Corrugated-Profile, Exposed-Fastener Metal wall Panels: Formed with alternating curved ribs across width of panel.

### 1. Factory Formed Corrugated Panels

- a. Corrugated Panels , a wall system based on factory formed 13 ft. (4m) long sine-wave profiled VM ZINC® elements featuring 29 1/3" coverage. Wave depth is 7/8 in.. Panels are secured with exposed fastener arrangement.
- b. System includes full range of factory formed clips, fasteners, flashings and terminations.
- c. Thickness: 0.039 inch (1.00mm)
- d. Available finishes: [VM QUARTZ-ZINC®] [VM ANTHRA-ZINC®]

## 2.6 CLIPS AND FASTENERS

### B. Exposed Fasteners for Corrugated-Profile

#### 1. Attachment from panel to plywood

- a. #12 A point, 3/8" hex head 300 Series Stainless with EPDM Gasket

#### 2. Attachment from panel to dimensional lumber

- a. #9 A Point, 1/4" hex head 300 Series Stainless with EPDM Gasket

#### 3. Lap self drilling screw

- a. #12x1-1/2" self drilling with SFS-Irius drive system type SX3-L12-12X1-1/2; ral 7037 for VM® QUARTZ-ZINC or ral 7022 for VM® ANTHRA-ZINC
- b. #12x1-1/2" self drilling, 5/16" hex head 300 Series Stainless with EPDM Gasket

#### 4. Stitch Screw

- a. #12x7/8 self drilling with SFS-Irius drive system type SXL2-L12-12x7/8 from SFS; ral 7037 for VM® QUARTZ-ZINC or ral 7022 for VM® ANTHRA-ZINC
- b. #12 x 3/4" self drilling, 1/4" hex head 300 Series Stainless with EPDM gasket

### C. Fasteners for Trim Attachments

#### 1. Fasteners for Flashing and Trim

- a. Blind fasteners or self-drilling 410 stainless screws with pancake head

#### 2. Blind Fasteners: High-strength stainless-steel rivets

- a. High-strength stainless steel

### D. Solder, Sealing

1. Solder for Zinc: ASTM B 32, 60 percent lead and 40 percent tin with low antimony, as recommended by manufacturer.

### E. Stripping

VM ZINC® Stripping Agent and Flux by Deca Quartz for removal of coating prior to soldering

## 2.7 ACCESSORIES

- F. Sheet Metal Wall Panel Assembly Accessories: Provide components required for a complete sheet metal wall assembly including trim, copings, fasciae, corner units, edges closures, clips, flashings, sealants, and similar items. Match material and finish of sheet metal wall, unless otherwise indicated.
1. Closures: Provide closures at edges, fabricated of same metal as sheet metal wall.
  2. Clips: Minimum 0.0396-inch(1.0mm) thick, 300 series stainless-steel panel clips designed to withstand negative load requirements.
  3. Cleats: Mechanically seamed cleats formed from minimum 0.0250-inch- (0.64mm) thick 300 series stainless-steel
  4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
- G. Flashing and Trim: Formed from VM ZINC® PLUS zinc Sheet. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, rakes, corners, bases, framed openings, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent sheet metal wall.

## 2.8 FABRICATION

- H. General: Factory formed sheet metal wall panel assemblies to comply with Umicore Building Products USA Inc.'s Published Recommendations and details reviewed by Umicore Building Products USA Inc., and industry best standards that apply to the design, dimensions (pan width and seam height), geometry, metal thickness, and other characteristics of installation indicated. Fabricate sheet metal wall and accessories at the shop to greatest extent possible.
- I. Fabricate sheet metal wall panels to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work. Form exposed sheet metal work to fit substrates without excessive oil canning, buckling, and tool marks, true to line and levels indicated, and with exposed edges folded back to form hems.
1. Lay out sheet metal wall panels so cross seams, when required, are made in direction of flow with higher pans overlapping lower pans. Stagger cross seams.
  2. Fold and cleat eaves and transverse seams.
  3. Form and fabricate sheets, seams, strips, cleats, edge treatments, integral flashings, and other components of metal walls to profiles, patterns, and drainage arrangements shown and as required for leak proof construction.
- J. Metal Protection: VM ZINC® Panels and Materials shall not be stored or installed so that they come in contact with or are located beneath areas with copper or copper containing components.

## PART 3 EXECUTION

### 3.1 GENERAL WALL ASSEMBLY

- K. Wall Panel substrate and framing designs can vary greatly. Designer may consult model building code, Umicore Building Products USA's published Product User Guides and Architectural manual, or I Building Envelope Consultant for additional information of appropriate wall designs. Sheathing, Insulation, Weather Resistive Barrier, and Vapor Retarder installations may specified here or separately.
- L. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, sheet metal wall supports, and other conditions affecting performance of work.
  - 1. Examine primary and secondary wall framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed.
  - 2. Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances.
  - 3. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored, and that provision has been made for wall drains, flashings, and penetrations through sheet metal wall.
  - 4. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- M. Examine roughing-in for components and systems penetrating sheet metal wall to verify actual locations of penetrations relative to seam locations of sheet metal wall before sheet metal installation.
- N. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 METAL WALL PANEL INSTALLATION, GENERAL

- O. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Field cutting of metal wall panels by torch is not permitted.
  - 2. Shim or otherwise plumb substrates receiving metal wall panels.
  - 3. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
  - 4. Flash and seal metal wall panels with weather closures edges and at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until insulation,

weather resistive barrier and flashings that will be concealed by metal wall panels are installed.

5. Install screw fasteners in predrilled holes.
6. Locate and space fastenings in uniform vertical and horizontal alignment.
7. Install flashing and trim as metal wall panel work proceeds.
8. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
9. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
10. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

P. Allowable Erection Tolerance

1. Maximum Alignment Variation: 1/8 in (3 mm)

Q. Fasteners: Use fasteners of type and size that will secure the wall components in compliance with requirements of the project. Clip fasteners shall be selected with heads that will seat flush to the deck, eliminating potential for contact and abrasion with the panel, and telegraphing.

R. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a weather tight installation.

### 3.2 UMICORE BUILDING PRODUCTS FACTORY FORMED VM ZINC® WALL PANEL

T. General: Install , Umicore Building Products factory formed VM ZINC® wall panels elements in compliance with Umicore Building Products USA's published recommendations, Designer approved Shop Drawings, and industry best standards. User Guides are available from UMICORE Building Products and should form the basis of design.

U. Corrugated Panel: Fasten Corrugated Panels to substrate with exposed fasteners at location, spacing and fastener types recommended by UMICORE Building Products.

1. Install panels with side laps and end laps secured with required fasteners. Side and end laps shall be a minimum of 6".
2. Form all panel laps and joints to shed water.

### 3.3 CLEANING AND PROTECTION

V. Clean exposed metal surfaces of dirt and debris with warm water (no high pressure) and gently rubbing the panels in the same direction as the grain of the zinc using a clean cotton cloth.

W. Clean and neutralize flux materials. Clean off excess solder.

X. Remove protective films within 60 days of installation. On completion of sheet metal wall installation, clean finished surfaces, including removing unused fasteners, metal fillings, rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

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END OF SECTION 074213

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SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Mechanically fastened PVC membrane roofing system.
  - 2. Vapor retarder.
  - 3. Roof insulation.
- B. Section includes the installation of acoustical roof deck rib insulation strips furnished under Division 05 Section "Steel Decking."
- C. Related Sections:
  - 1. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
  - 2. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.
  - 3. Division 07 Section "Manufactured Roof Expansion Joints" for proprietary manufactured roof expansion-joint assemblies.
  - 4. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
  - 5. Division 22 Section "Storm Drainage Piping Specialties" for roof drains.

1.3 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.
- D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
  - 1. Fire/Windstorm Classification: Class 1A-90.
  - 2. Hail Resistance: MH.
- E. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- F. Energy Performance: Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- G. Energy Performance: Provide roofing system with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit SS 7.2: For roof materials, indicating that roof materials comply with Solar Reflectance Index requirement.
  - 2. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
- C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Base flashings and membrane terminations.
  - 2. Tapered insulation, including slopes.
  - 3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
  - 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- D. Samples for Verification: For the following products:
  - 1. Sheet roofing, of color specified, including T-shaped side and end lap seam.

2. Roof insulation.
  3. Walkway pads or rolls.
  4. Metal termination bars.
  5. Battens.
  6. Three insulation fasteners of each type, length, and finish.
  7. Three roof cover fasteners of each type, length, and finish.
- E. Qualification Data: For qualified Installer and manufacturer.
- F. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
1. Submit evidence of compliance with performance requirements.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
- H. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.
- I. Field quality-control reports.
- J. Maintenance Data: For roofing system to include in maintenance manuals.
- K. Warranties: Sample of special warranties.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is FM Approvals approved for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Source Limitations: Obtain components including roof insulation, fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
- D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

F. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

G. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of

manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
  - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

#### 1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

#### 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, roofing accessories, and other components of membrane roofing system.
  - 2. Warranty Period: 15 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
  - 1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PVC MEMBRANE ROOFING

- A. PVC Sheet: ASTM D 4434, Type III, fabric reinforced and fabric backed.
1. Basis of Design Manufacturer and Product: Subject to compliance with requirements, provide the following, Sarnafil® S327 polyester reinforced membrane with a lacquer coating, an approved equal acceptable to Owner from one of the following:
    - a. Carlisle SynTec, Incorporated.
    - b. GenFlex Roofing Systems.
    - c. Johns Manville.
    - d. Stevens Roofing Systems.
    - e. Versico Incorporated.
  2. Thickness: 60 mils (1.5 mm), nominal.
  3. Exposed Face Color: White.

### 2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
  2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Plastic Foam Adhesives: 50 g/L.
    - b. Gypsum Board and Panel Adhesives: 50 g/L.
    - c. Multipurpose Construction Adhesives: 70 g/L.
    - d. Fiberglass Adhesives: 80 g/L.
    - e. Contact Adhesive: 80 g/L.
    - f. Other Adhesives: 250 g/L.
    - g. PVC Welding Compounds: 510 g/L.
    - h. Adhesive Primer for Plastic: 650 g/L.
    - i. Single-Ply Roof Membrane Sealants: 450 g/L.
    - j. Nonmembrane Roof Sealants: 300 g/L.
    - k. Sealant Primers for Nonporous Substrates: 250 g/L.
    - l. Sealant Primers for Porous Substrates: 775 g/L.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet membrane.
- C. Bonding Adhesive: Manufacturer's standard, water based.
- D. Slip Sheet: Manufacturer's standard, of thickness required for application.

- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch (25 mm wide by 1.3 mm) thick, prepunched.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

### 2.3 VAPOR RETARDER

- A. Polyethylene Film: ASTM D 4397, 6 mils (0.15 mm) thick, minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).
  - 1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
  - 2. Adhesive: Manufacturer's standard lap adhesive, FM Approvals approved for vapor-retarder application.

### 2.4 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by PVC membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class I, Grade 3, felt or glass-fiber mat facer on both major surfaces.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of minimum 1/4 inch per 12 inches (1:48) unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

### 2.5 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof

insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

- C. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch (13 mm) thick, factory primed.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Georgia-Pacific Corporation; Dens Deck Prime.
    - b. Approved Equal.

## 2.6 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick, and acceptable to membrane roofing system manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
  - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
  - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
  - 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
  - 5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
  - 6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.3 VAPOR-RETARDER INSTALLATION

- A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively.
  - 1. Continuously seal side and end laps with adhesive.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

### 3.4 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
  - 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
  - 1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- G. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
  - 1. Fasten insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
  - 2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

### 3.5 MECHANICALLY FASTENED MEMBRANE ROOFING INSTALLATION

- A. Mechanically fasten membrane roofing over area to receive roofing and install according to roofing system manufacturer's written instructions.
  - 1. Install sheet according to ASTM D 5082.
  - 2. For in-splice attachment, install membranes roofing with long dimension perpendicular to steel roof deck flutes.
- B. Start installation of membrane roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Mechanically fasten or adhere membrane roofing securely at terminations, penetrations, and perimeter of roofing.
- E. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- F. In-Seam Attachment: Secure one edge of PVC sheet using fastening plates or metal battens centered within membrane seam and mechanically fasten PVC sheet to roof deck.
- G. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
  - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
  - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
  - 3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

- H. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

### 3.6 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

### 3.7 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.9 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.10 SAMPLE ROOFING INSTALLER'S WARRANTY (Refer to Owner's Sample Warranty included following this Section)

- A. WHEREAS **<Insert name>** of **<Insert address>**, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
  - 1. Owner: **<Insert name of Owner>**.
  - 2. Address: **<Insert address>**.
  - 3. Building Name/Type: **<Insert information>**.
  - 4. Address: **<Insert address>**.
  - 5. Area of Work: **<Insert information>**.
  - 6. Acceptance Date: **<Insert date>**.
  - 7. Warranty Period: **<Insert time>**.
  - 8. Expiration Date: **<Insert date>**.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
  - 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
    - a. Lightning;
    - b. Peak gust wind speed exceeding **<Insert wind speed>** mph (m/sec);
    - c. Fire;
    - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    - e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    - f. Vapor condensation on bottom of roofing; and
    - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this **<Insert day>** day of **<Insert month>**, **<Insert year>**.

1. Authorized Signature: **<Insert signature>**.
2. Name: **<Insert name>**.
3. Title: **<Insert title>**.

END OF SECTION 075419



SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following sheet metal flashing and trim:
  - 1. Manufactured reglets.
  - 2. Formed low-slope roof flashing, fascia, and trim.
  - 3. Formed wall flashing and trim.
  - 4. Formed equipment support flashing, where required.
  - 5. Formed roof expansion joint and flashing.
- B. Related Sections include the following:
  - 1. Division 4 Section "Unit Masonry Assemblies" for installing flashing, reglets, copings and other sheet metal flashing and trim.
  - 2. Division 6 Section "Miscellaneous Carpentry" for wood nailers, curbs, and blocking.
  - 3. Division 7 Section "Thermoplastic Membrane Roofing" for installing sheet metal flashing and trim integral with roofing membrane.
  - 4. Division 7 Section "Metal Wall Panels" for installation of sheet metal flashing and trim integral with metal wall panels.
  - 5. Division 7 Section "Roof Accessories" for roof hatches and other manufactured roof accessory units.
  - 6. Division 7 Section "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
  - 1. Wind Zone 3: For velocity pressures of 46 to 104 lbf/sq. ft. (2.20 to 4.98 kPa): 208-lbf/sq. ft. (9.96-kPa) perimeter uplift force, 312-lbf/sq. ft. (14.94-kPa) corner uplift force, and 104-lbf/sq. ft. (4.98-kPa) outward force.
- C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure

of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

#### 1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
4. Details of expansion-joint covers, including showing direction of expansion and contraction.

C. Samples for Initial Selection: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches (300 mm) long. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim: 12 inches (300 mm) long. Include fasteners and other exposed accessories.
3. Accessories: Full-size Sample.

#### 1.5 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof coping, approximately 48 inches (1200 mm) long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
2. Approval of mockups is for other material and construction qualities specifically approved by Architect in writing.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

#### 1.7 COORDINATION

- A. Coordinate installation of sheet metal fascia, flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

## 2.2 SHEET METALS

- A. Aluminum Sheet, where indicated: ASTM B 209 (ASTM B 209M), Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14, finished as follows:
  1. Siliconized-Polyester Coating: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.
    - a. Color: As selected by Architect from manufacturer's full range.
  2. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2604.
      - 1) Color: As selected by Architect from manufacturer's full range.
- B. Prepainted, Metallic-Coated Steel Sheet, where indicated: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
  1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
  2. Exposed Finishes: Apply the following coil coating:
    - a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      - 1) Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements of AAMA 2604, except as modified below:
        - a) Humidity Resistance: 1000 hours.
        - b) Salt-Spray Resistance: 1000 hours.

### 2.3 UNDERLAYMENT MATERIALS

- A. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.

### 2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
  - 1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
  - 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
  - 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

### 2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory- mitered and -welded corners and junctions.
  - 1. Available Manufacturers:
    - a. Cheney Flashing Company, Inc.
    - b. Fry Reglet Corporation.

- c. Heckmann Building Products Inc.
  - d. Hickman, W. P. Company.
  - e. Keystone Flashing Company, Inc.
  - f. Sandell Manufacturing Company, Inc.
2. Material: Prefinished Aluminum, where exposed, 0.024 inch (0.6 mm) thick, Galvanized steel, where not exposed, 0.0217 inch (0.55 mm) thick].
  3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
  4. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
  5. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
  6. Flexible Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
  7. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

## 2.6 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal fascia, flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal fascia, flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal fascia, flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
  1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with elastomeric butyl sealant concealed within joints.
- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured.

## 2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing and Fascia Caps, where indicated: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Furnish with 6-inch- (150-mm-) wide joint cover plates.
  1. Joint Style: Lap, 4 inches (100 mm) wide.
  2. Fabricate with scuppers spaced as indicated, of dimensions required with 4-inch- (100-mm-) wide flanges and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
  3. Fabricate scuppers from the following material:
    - a. Aluminum: 0.050 inch (1.2 mm) thick.
    - b. Prepainted, Metallic-Coated Steel: 0.0276 inch (0.7 mm) thick.
- B. Copings and Fascia, where indicated: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
  1. Joint Style Butt, with 12-inch- (300-mm-) wide concealed backup plate and 6-inch- (150-mm-) wide exposed cover plates.
  2. Fabricate copings from the following material:
    - a. Prepainted, Metallic-Coated Steel: 0.0396 inch (1.0 mm) thick.
- C. Base Flashing, where not furnished by roofing manufacturer or installer: Fabricate from one of the following material as required by roofing membrane manufacturer:
  1. Galvanized Steel: 0.0276 inch (0.7 mm) thick.
  2. Aluminum-Zinc Alloy-Coated Steel: 0.0276 inch (0.7 mm) thick.
  3. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0276 inch (0.7 mm) thick.
- D. Counterflashing: Fabricate from one of the following material as required by roofing membrane manufacturer:
  1. Galvanized Steel: 0.0217 inch (0.55 mm) thick.
  2. Aluminum-Zinc Alloy-Coated Steel: 0.0217 inch (0.55 mm) thick.
  3. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0217 inch (0.55 mm) thick.
- E. Flashing Receivers: Fabricate from one of the following material:
  1. Galvanized Steel: 0.0217 inch (0.55 mm) thick.
  2. Aluminum-Zinc Alloy-Coated Steel: 0.0217 inch (0.55 mm) thick.

3. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0217 inch (0.55 mm) thick.

F. Roof-Penetration Flashing: Fabricate from one of the following material, as required by roofing manufacturer:

1. Lead-Coated Copper: 17.2 oz./sq. ft. (0.60 mm thick).
2. Galvanized Steel: 0.0276 inch (0.7 mm) thick.
3. Aluminum-Zinc Alloy-Coated Steel: 0.0276 inch (0.7 mm) thick.
4. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0276 inch (0.7 mm) thick.
5. Zinc: 0.031 inch (0.80 mm) thick.

G. Splash Pans, where indicated: Fabricate from one of the following material:

1. Aluminum: 0.040 inch (1.0 mm) thick.
2. Stainless Steel: 0.0187 inch (0.5 mm) thick.
3. Zinc-Tin Alloy-Coated Stainless Steel: 0.018 inch (0.5 mm) thick.

H. Roof-Drain Flashing: Fabricate from one of the following material:

1. Lead: 4.0 lb/sq. ft. (1.6 mm thick), hard tempered.
2. Copper: 13.2 oz./sq. ft. (0.45 mm thick).
3. Lead-Coated Copper: [12 oz./sq. ft. (0.4 mm thick).
4. Zinc-Tin Alloy-Coated Stainless Steel: 0.015 inch (0.4 mm) thick.

## 2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing, not provided by Division 15: Fabricate from one of the following material:

1. Galvanized Steel: 0.0276 inch (0.7 mm) thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.0276 inch (0.7 mm) thick.
3. Prepainted, Metallic-Coated Steel, where exposed to public view: 0.0276 inch (0.7 mm) thick.

## 2.9 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
  - 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
  - 1. Coat side of uncoated aluminum, stainless-steel and lead sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
  - 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
  - 3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.
- C. Install exposed sheet metal flashing and trim without oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric butyl sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  - 1. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked

flanges, not less than 1 inch (25 mm) deep, filled with elastomeric butyl sealant concealed within joints.

- G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
  - 1. Galvanized or Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.
  - 2. Aluminum: Use aluminum or stainless-steel fasteners.
  - 3. Copper Use copper or stainless-steel fasteners.
  - 4. Stainless Steel: Use stainless-steel fasteners.
  
- H. Seal joints with elastomeric butyl sealant as required for watertight construction.
  - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
  - 2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."
  
- I. Soldered Joints, where required: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm) except where pre-tinned surface would show in finished Work.
  - 1. Do not solder prepainted, metallic-coated steel and aluminum sheet.
  - 2. Pre-tinning is not required for lead-coated copper, zinc-tin alloy-coated stainless steel and lead.
  - 3. Stainless-Steel Soldering: Pre-tin edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.
  - 4. Copper Soldering: Tin uncoated copper surfaces at edges of sheets using solder recommended for copper work.
  - 5. Where surfaces to be soldered are lead coated, do not tin edges, but wire brush lead coating before soldering.
  - 6. Lead-Coated Copper Soldering: Wire brush edges of sheets before soldering.
  - 7. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.
  
- J. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

### 3.3 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

- B. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches (100 mm) in direction of water flow.
- C. Splash Pans: Install where downspouts discharge on low-sloped roofs. Set in elastomeric sealant compatible with roofing membrane.

### 3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
  - 1. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 24-inch (600-mm) centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
  - 1. Interlock exterior bottom edge of coping with continuous cleats anchored to substrate at 24-inch (600-mm) centers.
  - 2. Anchor interior leg of coping with screw fasteners and washers at 24-inch (600-mm) centers.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for butyl sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant.
  - 1. Secure in a waterproof manner by means of snap-in installation and sealant or interlocking folded seam or blind rivets and sealant or anchor and washer at 36-inch (900-mm) centers.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
  - 1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
  - 2. Seal with butyl sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

### 3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Reglets: Installation of reglets is specified in Division 4 Section "Unit Masonry Assemblies."

### 3.6 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with butyl sealant to equipment support member.

### 3.7 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

## SECTION 077200 - ROOF ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Roof hatches.
  - 2. Roof supports, where not supplied by other divisions.
- B. Related Sections include the following:
  - 1. Division 5 Section "Metal Fabrications" for metal vertical ladders for access to roof hatches.
  - 2. Division 7 low-slope roofing Sections for roofing accessories.
  - 3. Division 7 Section "Sheet Metal Flashing and Trim" for shop- and field-fabricated metal flashing and counterflashing, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.
- C. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
  - 1. Size and location of roof accessories specified in this Section.
  - 2. Method of attaching roof accessories to roof or building structure.
  - 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
- D. Samples: For each type of exposed factory-applied color finish required and for each type of roof accessory indicated, prepared on Samples of size to adequately show color.

- E. Warranty: Special warranty specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.7 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
  - 1. With Architect's approval, adjust location of roof accessories that would interrupt roof drainage routes.

#### 1.8 WARRANTY

- A. Manufacturer's standard warranty: Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers listed in other Part 2 articles.

## 2.2 METAL MATERIALS

- A. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coated and mill phosphatized for field painting.
- B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 (AZM150) coated.
- C. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by manufacturer for type of use and finish. Coil-coat finish as follows:
  - 1. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Conversion coating; Organic Coating: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 and with coating and resin manufacturer's written instructions.
    - a. Color and Gloss: As selected by Architect from manufacturer's full range.
- D. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use, mill finished.
- E. Stainless-Steel Shapes or Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304 or Type 316, No. 2D finish.
- F. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized to comply with ASTM A 123/A 123M, unless otherwise indicated.
- G. Steel Tube: ASTM A 500, round tube, baked-enamel finished.
- H. Galvanized Steel Tube: ASTM A 500, round tube, hot-dip galvanized to comply with ASTM A 123/A 123M.
- I. Galvanized Steel Pipe: ASTM A 53/A 53M.

## 2.3 MISCELLANEOUS MATERIALS

- A. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- C. Polyethylene Sheet: 6-mil- (0.15-mm-) thick, polyethylene sheet complying with ASTM D 4397.
- D. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

1. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).
- E. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.
- F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.
- G. Elastomeric Sealant: ASTM C 920, polysulfide or silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- H. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, and heavy bodied for hooked-type expansion joints with limited movement.
- I. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

## 2.4 EQUIPMENT SUPPORTS

- A. Equipment Supports, where indicated: Provide metal equipment supports, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Fabricate with welded or sealed mechanical corner joints, with stepped integral metal cant raised the thickness of roof insulation and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
  1. Available Manufacturers:
    - a. Colony Custom Curbs.
    - b. Commodity Products Company, Inc.
    - c. Conn-Fab Sales, Inc.
    - d. Curbs Plus Inc.
    - e. Custom Curb, Inc.
    - f. LM Curbs.
    - g. Loren Cook Company.
    - h. Metallic Products Corporation.
    - i. Roof Products & Systems Corporation.
    - j. Roof Products, Inc.
    - k. Thaler Metal Industries Ltd.
    - l. ThyCurb; Div. of Thybar Corporation.
    - m. Uni-Curb, Inc.
    - n. Vent Products Company, Inc.
  2. Load Requirements: As indicated or required by equipment.

3. Material: Aluminum-zinc alloy-coated steel sheet, 0.079 inch (2.0 mm) thick.
4. Material: Aluminum sheet, 0.090 inch (2.28 mm) thick.
5. Material: Stainless-steel sheet, 0.078 inch (1.98 mm) thick.

a. Finish: High-performance organic coating.

6. Factory-install continuous wood nailers 5-1/2 inches (140 mm) wide at tops of equipment supports.
7. Metal Counterflashing: Manufacturer's standard removable counterflashing, fabricated of same metal and finish as equipment support.
8. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
9. Fabricate units to minimum height of 12 inches (300 mm), unless otherwise indicated.
10. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

## 2.5 ROOF HATCHES

- A. Roof Hatches: Fabricate roof hatches with insulated double-wall lids and insulated double-wall curb frame with integral deck mounting flange and lid frame counterflashing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weathertight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.

1. Available Manufacturers:

- a. Babcock-Davis; a Cierra Products Inc. Company.
- b. Bilco Company (The).
- c. Dur-Red Products.
- d. J. L. Industries, Inc.
- e. Milcor Inc.; a Gibraltar Company.
- f. Nystrom, Inc.
- g. O'Keeffe's Inc.
- h. Roof Products & Systems Corporation.
- i. ThyCurb; Div of Thybar Corporation.
- j. Wasco Products, Inc.

2. Loads: Fabricate roof hatches to withstand 40-lbf/sq. ft. (1.9-kPa) external and 20-lbf/sq. ft. (0.95-kPa) internal loads.
3. Type and Size: Double-leaf lid, (size indicated on drawings).
4. Curb and Lid Material: 14 gauge paint bond G-90 galvanized steel.

a. Finish: High-performance organic coating.

5. Insulation: Polyisocyanurate board.
6. Interior Lid Liner: Manufacturer's standard metal liner of same material and finish as outer metal lid.

7. Exterior Curb Liner: Manufacturer's standard metal liner of same material and finish as metal curb.
8. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
9. Fabricate units to minimum height of 12 inches (300 mm), unless otherwise indicated.
10. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate hatch curbs with height tapered to match slope to level tops of units.
11. Hardware
  - a. Heavy pintle hinges shall be provided
  - b. Covers shall be equipped with an enclosed two point spring latch with interior and exterior turn handles
  - c. Roof scuttle shall be equipped with interior and exterior padlock hasps.
  - d. The latch strike shall be a stamped component bolted to the curb assembly.
  - e. Covers shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25.4mm) diameter red vinyl grip handle to permit easy release for closing.
  - f. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed. Springs shall have an electrocoated acrylic finish for corrosion resistance.
  - g. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

## 2.6 ROOF SUPPORTS

- A. Pipe Roof Supports, where not furnished by another Division: Adjustable height, extruded-aluminum tube, urethane insulation filled, 2 inches (50 mm) in diameter, with aluminum base plates and manufacturer's recommended hardware for mounting to structure, and extruded-aluminum carrier assemblies, suitable for quantity of pipe runs and sizes, with EPDM end caps. Include manufacturer's standard hardware for mounting to structure or structural roof deck.
  1. Available Manufacturers:
    - a. Thaler Metal Industries Ltd.
  2. Pipe Support Height: As indicated.
  3. Pipe Roller Assembly: Stainless-steel roller assembly sized for supported pipes with extruded aluminum.
  4. Pipe Support Flashing: Uninsulated sleeve flashings with integral base flange, and EPDM grommetted top seal and base seals.
    - a. Metal: Aluminum sheet, 0.064 inch (1.6 mm) thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.
1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
  2. Verify dimensions of roof openings for roof accessories.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Install roof accessories to fit substrates and to result in watertight performance.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of uncoated aluminum or stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
  3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.
- D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
- E. Roof Curb Installation:
1. Set roof curb so top surface of roof curb is level.
- F. Equipment Support Installation:
1. Set equipment support so top surface of equipment support is level.
- G. Roof Hatch Installation:

USTAR Building #2  
Utah State University  
Life Sciences Research Center  
Logan, Utah

1. Check roof hatch for proper operation. Adjust operating mechanism as required. Clean and lubricate joints and hardware.
  2. Attach safety railing system to roof hatch curb.
  3. Attach ladder safety post according to manufacturer's written instructions.
- 

### 3.3 TOUCH UP

- A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Division 9 painting Sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

### 3.4 CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION 077200

## SECTION 078413 - PENETRATION FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Penetrations in fire-resistance-rated walls.
- 2. Penetrations in horizontal assemblies.
- 3. Penetrations in smoke barriers.

- B. Related Sections:

- 1. Division 07 Section "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. LEED Submittal:

- 1. Product Data for Credit EQ 4.1: For penetration firestopping, including printed statement of VOC content and chemical components.

- C. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

- 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

- D. Qualification Data: For qualified Installer.

- E. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
  - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
    - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
    - b. Classification markings on penetration firestopping correspond to designations listed by the following:
      - 1) UL in its "Fire Resistance Directory."
      - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."
      - 3) FM Global in its "Building Materials Approval Guide."
- D. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

## 1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Grace Construction Products.
  - 2. Hilti, Inc.
  - 3. Johns Manville.
  - 4. 3M Fire Protection Products.
  - 5. Tremco, Inc.; Tremco Fire Protection Systems Group.
  - 6. USG Corporation.

### 2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  - 1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls, and fire partitions.
  - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  - 1. Horizontal assemblies include floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.

2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
  3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.
- E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.
- F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- G. VOC Content: Provide penetration firestopping that complies with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.
  2. Sealant Primers for Nonporous Substrates: 250 g/L.
  3. Sealant Primers for Porous Substrates: 775 g/L.
- H. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-wool-fiber or rock-wool-fiber insulation.
    - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    - c. Fire-rated form board.
    - d. Fillers for sealants.
  2. Temporary forming materials.
  3. Substrate primers.
  4. Collars.
  5. Steel sleeves.
- 2.3 FILL MATERIALS (Select from the following as indicated by UL Design Assemblies)
- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
  - B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

## 2.4 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

### 3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge

so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

### 3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

### 3.7 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Firestopping for Metallic Pipes, Conduit, or Tubing:
  1. UL-Classified Systems: Basis of Design, W-J-1028.
  2. F-Rating: 2 hours.
  3. T-Rating: 0 hours.
  4. Type of Fill Materials: As required to achieve rating.
- C. Firestopping for Nonmetallic Pipe, Conduit, or Tubing:

1. UL-Classified Systems: Basis of Design, W-J-2019.
  2. F-Rating: 2 hours.
  3. T-Rating: 2 hours.
  4. Type of Fill Materials: As required to achieve rating.
- D. Firestopping for Electrical Cables:
1. UL-Classified Systems: Basis of Design, W-J-3061.
  2. F-Rating: 2 hours.
  3. T-Rating: 0 hours.
  4. Type of Fill Materials: As required to achieve rating.
- E. Firestopping for Cable Trays with Electric Cables:
1. UL-Classified Systems: Basis of Design, W-J-4016.
  2. F-Rating: 2 hours.
  3. T-Rating: 0 hours.
  4. Type of Fill Materials: As required to achieve rating.
- F. Firestopping for Insulated Pipes:
1. UL-Classified Systems: Basis of Design, W-J-5042.
  2. F-Rating: 2 hours.
  3. T-Rating: 1 hour.
  4. L-Rating at Ambient: Less than 4 cfm/sq. ft. (cu. m/s per sq. m).
  5. L-Rating at 400 deg F (204 deg C): Less than 1 cfm/sq. ft. (cu. m/s per sq. m).
  6. Type of Fill Materials: As required to achieve rating.
- G. Firestopping for Miscellaneous Mechanical Penetrants:
1. UL-Classified Systems: Basis of Design, W-J-7021, W-J-7022.
  2. F-Rating: 2 hours.
  3. T-Rating: 0 hours.
  4. Type of Fill Materials: As required to achieve rating.
- H. Firestopping for Groupings of Penetrants:
1. UL-Classified Systems: Basis of Design, W-J-8004.
  2. F-Rating: 2 hours.
  3. T-Rating: 1/4 hour.
  4. L-Rating at Ambient: Less than 1 cfm/sq. ft. (cu. m/s per sq. m).
  5. L-Rating at 400 deg F (204 deg C): Less than 4 cfm/sq. ft. (cu. m/s per sq. m).
  6. Type of Fill Materials: As required to achieve rating.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Polysulfide joint sealants.
4. Latex joint sealants.
5. Solvent-release-curing joint sealants.
6. Preformed joint sealants.
7. Acoustical joint sealants.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Division 07 Section "Expansion Control" for building expansion joints.
3. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
4. Division 08 Section "Glazed Aluminum Curtain Walls" for structural and other glazing sealants.
5. Division 08 Section "Glazing" for glazing sealants.
6. Division 09 Section "Gypsum Board" for sealing perimeter joints.
7. Division 09 Section "Tiling" for sealing tile joints.
8. Division 09 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.
9. Division 32 Section "Concrete Paving Joint Sealants" for sealing joints in pavements, walkways, and curbing.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For sealants and sealant primers used inside the weatherproofing system, including printed statement of VOC content.

- C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- E. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.
- F. Qualification Data: For qualified Installer.
- G. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- I. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- J. Warranties: Sample of special warranties.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
  - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

- E. Preinstallation Conference: Conduct conference at Project site.

## 1.5 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## 1.6 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Ten years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and

application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

- B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
  - 1. Architectural Sealants: 250 g/L.
  - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
  - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
  - 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

## 2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.
- B. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.
- C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified in the Elastomeric Joint-Sealant Schedule to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

- D. Available Products: Subject to compliance with requirements, joint sealant schedule, and manufacturer's recommendations, provide one of the products specified in each category below where needed:

1. Elastomeric Joint Sealant Designation: ES1

- a. Base Polymer: Urethane.
- b. Type: M (multicomponent).
- c. Grade: P (pourable).
- d. Class: 25.
- e. Additional Movement Capability: 25 percent movement in extension and 25 percent in compression for a total of 50 percent movement.
- f. Use(s) Related to Exposure: T (traffic).
- g. Uses Related to Joint Substrates: M (mortar) and, as applicable to joint substrates indicated, O (other).
- h. Products:
  - 1) Sikaflax - 2c SL
  - 2) Tremco - THC-900
  - 3) Approved equal

2. Elastomeric Joint Sealant Designation: ES2

- a. Base Polymer: Neutral-curing silicone.
- b. Type: S (single component).
- c. Grade: NS (nonsag).
- d. Class: 25.
- e. Additional Movement Capability: 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement.
- f. Use(s) Related to Exposure: NT (nontraffic).
- g. Uses Related to Joint Substrates: M (mortar), A (aluminum) and, as applicable to joint substrates indicated, O (other).
- h. Products:
  - 1) Dow Corning 795
  - 2) GE Silpruf
  - 3) Tremco Spectrem 2
  - 4) Approved equal

3. Elastomeric Joint Sealant Designation: ES3

- a. Base Polymer: Urethane.
- b. Type: M (multi-component).
- c. Grade: NS (nonsag).
- d. Class: 25.
- e. Additional Movement Capability: 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement.
- f. Use(s) Related to Exposure: NT (nontraffic).
- g. Uses Related to Joint Substrates: M (mortar), A (aluminum) and, as applicable to joint substrates indicated, O (other).
- h. Products:

- 1) Mameco Vulkem 922
- 2) Sikaflex 2C
- 3) Tremco Dymeric 511
- 4) Approved equal

4. Elastomeric Joint Sealant Designation: ES4

- a. Base Polymer: Acid-curing silicone.
- b. Type: S (single component).
- c. Grade: NS (nonsag).
- d. Class: 25.
- e. Additional Movement Capability: 25 percent movement in extension and 25 percent in compression for a total of 50 percent movement.
- f. Use(s) Related to Exposure: NT (nontraffic).
- g. Uses Related to Joint Substrates: G (glass), A (aluminum) and, as applicable to joint substrates indicated, O (other).
- h. Products:

- 1) Dow Corning 999-A
- 2) GE Contractors 1200
- 3) Pecora 863
- 4) Tremco Tremsil 300
- 5) Approved equal

5. Elastomeric Joint Sealant Designation: ES5

- a. Base Polymer: Acid-curing, mildew-resistant silicone.
- b. Type: S (single component).
- c. Grade: NS (nonsag).
- d. Class: 25.
- e. Additional Movement Capability: 25 percent movement in extension and 25 percent in compression for a total of 50 percent movement.
- f. Use(s) Related to Exposure: NT (nontraffic).
- g. Uses Related to Joint Substrates: G (glass), A (aluminum) and, as applicable to joint substrates indicated, O (other).
- h. Products:

- 1) Dow Corning - Trademate Tile and Ceramic
- 2) GE - Sanitary 1700
- 3) Tremco - Tremsil 600
- 4) Approved equal

6. Elastomeric Joint Sealant Designation: ES6

- a. Base Polymer: Acid-curing silicone.
- b. Type: S (single component).
- c. Grade: NS (nonsag).
- d. Class: 25.
- e. Additional Movement Capability: 25 percent movement in extension and 25 percent in compression for a total of 50 percent movement.
- f. Use(s) Related to Exposure: NT (nontraffic).

- g. Uses Related to Joint Substrates: G (glass), A (aluminum) and, as applicable to joint substrates indicated, O (other).
- h. Products:

- 1) Dow Corning 999-A
- 2) GE Contractors 1200
- 3) Pecora 863
- 4) Tremco Tremsil 300
- 5) Approved equal

7. Elastomeric Joint Sealant Designation: ES7

- a. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
- b. Products: Subject to compliance with requirements, (provide the following) (provide one of the following) (available products that may be incorporated into the Work include, but are not limited to, the following):
  - 1) Sika Corporation, Construction Products Division; Sikaflex - 15LM.
  - 2) Tremco Incorporated; (Vulkem 921) (Dymonic FC).
  - 3) <Insert manufacturer's name; product>.

2.3 LATEX JOINT SEALANTS

- A. General: For interior locations only and where movement capacity and weathering characteristics are not critical, provide manufacturer's standard one-part, nonsag, mildew-resistant, paintable latex sealant of either acrylic or silicone emulsion formulation indicated that is recommended for exposed applications on interior locations and that accommodates indicated percentage change in joint width existing at time of installation without failing either adhesively or cohesively.
- B. Latex Sealant Standard: Comply with ASTM C 834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.
- C. Available Products: Subject to compliance with requirements, latex joint sealants that may be incorporated in the Work include, but are not limited to, the following:

1. Latex Joint Sealant Designation: LS1

- a. Acrylic-Emulsion Sealant: Provide product complying with ASTM C 834 that accommodates joint movement of not more than 5 percent in both extension and compression for a total of 10 percent.
- b. Products:
  - 1) "AC-20," Pecora Corp.
  - 2) "Sonolac," Sonneborn Building Products Div., ChemRex, Inc.
  - 3) "Tremco Acrylic Latex 834," Tremco, Inc.
  - 4) Approved equal

2. Latex Joint Sealant Designation: LS2

- a. Silicone Emulsion Sealant: Provide product complying with ASTM C 834 and, except for weight loss measured per ASTM C 792, with ASTM C 920 that accommodates joint movement of not more than 25 percent in both extension and compression for a total of 50 percent.
- b. Products:
  - 1) "Trade Mate Paintable Glazing Sealant," Dow Corning Corp.
  - 2) Approved equal

## 2.4 ACOUSTICAL JOINT SEALANTS

- A. General: Use only at interior locations as indicated on drawings.
- B. Acoustical Sealant for Exposed and Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:
  1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- C. Acoustical Sealant for Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
- D. Available Products: Subject to compliance with requirements, provide one of the following:
  1. Acoustical Joint Sealant Designation: AS1
    - a. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:
      - 1) Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E 90.
      - 2) Product has flame spread and smoke developed rating of less than 25 per ASTM E 84.
    - b. Products:
      - 1) "Sheetrock Acoustical Sealant," United States Gypsum Co.
      - 2) "AC-20 FTR Acoustical and Insulation Sealant," Pecora Corp.
      - 3) Approved equal
  2. Acoustical Joint Sealant Designation: AS2

- a. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.
- b. Products:
  - 1) "BA-98," Pecora Corp.
  - 2) "Tremco Acoustical Sealant," Tremco, Inc.
  - 3) Approved equal

## 2.5 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
  - 1. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## 2.6 JOINT FILLERS FOR CONCRETE PAVING (Refer to Division 32)

- A. General: Provide joint fillers of thicknesses and widths indicated.
- B. Bituminous Fiber Joint Filler: Preformed strips of composition below, complying with ASTM D 1751:
  - 1. Asphalt saturated fiberboard.
  - 2. Sealants specified by Division 32.

## 2.7 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates. Confirm compatibility of cleaners with adjacent surfaces prior to application.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable

of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

- a. Concrete.
  - b. Masonry.
  - c. Unglazed surfaces of ceramic tile.
  - d. Exterior insulation and finish systems.
3. Remove laitance and form-release agents from concrete.
  4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  1. Do not leave gaps between ends of sealant backings.
  2. Do not stretch, twist, puncture, or tear sealant backings.
  3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
  2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
  2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
  4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
  5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
  2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch (10 mm). Hold edge of sealant bead 1/4 inch (6 mm) inside masking tape.
  3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
  4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.
- I. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT SEALANT SCHEDULE (Select from the following where indicated or required)

<b>JOINT SEALANT SCHEDULE</b>		
<b>DESIGNATION ON DATA SHEETS</b>	<b>JOINT SEALERS</b>	<b>DESCRIPTION OF JOINT CONSTRUCTION AND LOCATION WHERE SEALANT IS TYPICALLY APPLIED</b>
ES-1	Multi-part Pourable Urethane Sealant	Exterior and interior horizontal joints subject to traffic such as expansion joints in tile, pavers and sidewalks.
ES-2	One-Part Neutral Cure Silicone Sealant	Exterior and interior joints in vertical surfaces of concrete and masonry; between concrete masonry and stone; between metal and concrete, mortar, or stone; interior and exterior perimeter joints of metal frames in exterior walls; exterior overhead joints. Joints which are bordered by glass.
ES-3	Multi-component Urethane Sealant	Exterior and interior joints in vertical surfaces of concrete masonry; between concrete masonry and stone; between metal and concrete, mortar, or stone; interior and exterior perimeter joints of metal frames in exterior walls; exterior overhead joints.
ES-4	One-Part Acid Curing Silicon	Exterior and interior joints in vertical surfaces of non-porous surfaces. To be used on exterior and interior perimeter frames of walls and control and expansion and window joints. Between metal to metal, glass to glass, metal to glass, travertine to travertine, cap beads on glass.
ES-5	One-Part Mildew Resistant Silicone	Interior joints in vertical surfaces of ceramic tile in toilet rooms.

	Sealant	
ES-6	One-Part Acid Curing Silicon	Vivarium and Bio-Containment areas, vertical surfaces of non-porous surfaces.
ES-7	Single-Component, Non-sag, Urethane Joint Sealant	Vivarium and Bio-Containment areas, between Arcoplast and Stainless-steel Frames.
LS1/LS2	Latex Sealant	Exposed interior applications.
AS1	Acoustical Sealant	Exposed interior applications.
AS2	Acoustical Sealant	Unexposed interior applications.
Notes:	<ol style="list-style-type: none"> <li>1. Install sealant in joints fitting descriptions and locations listed.</li> <li>2. "LS1 and LS2" are for interior use only and are to be applied only if an "ES" designation is not otherwise indicated and where movement capacity and weathering characteristics are not critical.</li> <li>3. Either ES2 or ES3 may be used at contractors option where recommended by manufacturer.</li> <li>4. If locations are encountered that are not described above, sealant manufacturer's recommendations are to be followed. The issue is to be brought to the attention of the Architect and General Contractor in writing. The appropriate sealant shall be submitted as part of the submittal process.</li> </ol>	

END OF SECTION 079200

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Standard hollow metal doors and frames.

- B. Related Sections:

- 1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
  - 2. Division 08 Section "Stainless-Steel Doors and Frames" for hollow metal doors and frames manufactured from stainless steel.
  - 3. Division 08 Section "Detention Doors and Frames" for hollow metal doors and frames for detention facilities.
  - 4. Division 08 Section "Sound Control Door Assemblies" for packaged, acoustical hollow metal door and frame assemblies with STC ratings of 35 or more.
  - 5. Division 08 Section "Door Hardware" for door hardware for hollow metal doors.
  - 6. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.
  - 7. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

#### 1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.
- C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).

E. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

F. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

## 1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10B.

1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed life.

- D. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.
- E. Preinstallation Conference: Conduct conference at Project site.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  - 1. Provide additional protection to prevent damage to finish of factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.
  - 1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

#### 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

#### 1.8 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amweld Building Products, LLC.
  - 2. Ceco Door Products; an Assa Abloy Group company.
  - 3. Curries Company; an Assa Abloy Group company.
  - 4. Firedoor Corporation.
  - 5. Kewanee Corporation (The).
  - 6. Pioneer Industries, Inc.

7. Security Metal Products Corp.
8. Steelcraft; an Ingersoll-Rand company.
9. Windsor Republic Doors.

## 2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
  1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- H. Glazing: Comply with requirements in Division 08 Section "Glazing."
- I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
  1. Design: Flush panel.
  2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.

- a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
  - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W) when tested according to ASTM C 1363.
    - 1) Locations: Exterior doors and interior doors where indicated.
3. Vertical Edges for Single-Acting Doors: Beveled edge.
    - a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
  4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
  5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick end closures or channels of same material as face sheets.
  6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level, as indicated:
1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
  2. Level 4 and Physical Performance Level A (Maximum Duty), Model 2 (Seamless).
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level, as indicated:
1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
  2. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush).
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.
- ## 2.4 STANDARD HOLLOW METAL FRAMES
- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
1. Fabricate frames as full profile welded unless otherwise indicated.
  2. Frames for Level 3 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
  3. Frames for Level 4 Steel Doors: 0.067-inch- (1.7-mm-) thick steel sheet.

- C. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.
  - 1. Fabricate frames as full profile welded unless otherwise indicated.
  - 2. Frames for Level 2 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
  - 3. Frames for Level 3 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
  - 4. Frames for Wood Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
  - 5. Frames for Borrowed Lights: 0.053-inch- (1.3-mm-) thick steel sheet.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

## 2.5 CUSTOM HOLLOW METAL DOORS

- A. General: Provide doors not less than 1-3/4 inches (44.5 mm) thick, of seamless hollow construction unless otherwise indicated. Construct doors with smooth surfaces without visible joints or seams on exposed faces. Comply with ANSI/NAAMM-HMMA 861.
- B. Exterior Door Face Sheets: Fabricated from metallic-coated steel sheet, minimum 0.053 inch (1.3 mm) thick.
- C. Interior Door Face Sheets: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated, minimum 0.042 inch (1.0 mm) thick.
- D. Core Construction: Provide thermal-resistance-rated cores for exterior doors and interior doors where indicated.
  - 1. Steel-Stiffened Core: 0.026-inch- (0.7-mm-) thick, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart, spot welded to face sheets a maximum of 5 inches (127 mm) o.c. Spaces filled between stiffeners with glass- or mineral-fiber insulation.
    - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
    - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W) when tested according to ASTM C 1363.
- E. Vertical Edges for Single-Acting Doors: Beveled 1/8 inch in 2 inches (3 mm in 50 mm).
- F. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
- G. Top and Bottom Channels: Closed with continuous channels, minimum 0.053 inch (1.3 mm) thick, of same material as face sheets and spot welded to both face sheets.
- H. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 861 with reinforcing plates from same material as door face sheets.

## 2.6 FRAME ANCHORS

### A. Jamb Anchors:

1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

### B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

## 2.7 LOUVERS

### A. Provide louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch- ((0.5-mm-)) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted V-shaped or Y-shaped blades.
2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other, any angle.
3. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same testing and inspecting agency that established fire-resistance rating of door assembly.

## 2.8 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- (6.4-mm-thick by 25.4-mm-) wide steel.
- C. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

## 2.9 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/NAAMM-HMMA 861.
- C. Hollow Metal Doors:
1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
  2. Glazed Lites: Factory cut openings in doors.
  3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
  2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  6. Jamb Anchors: Provide number and spacing of anchors as follows:
    - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
    - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
    - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
    - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
- b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
- 1) Three anchors per jamb up to 60 inches (1524 mm) high.
  - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
  - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.

- 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
  - 5) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.
- c. Compression Type: Not less than two anchors in each jamb.
  - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
- a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
  - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
  2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
  3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
  4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
  2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  4. Provide loose stops and moldings on inside of hollow metal work.
  5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

## 2.10 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
  - B. Factory-Applied Paint Finish: Manufacturer's standard, complying with ANSI/SDI A250.3 for performance and acceptance criteria.
- 2.11 Color and Gloss: As selected by Architect from manufacturer's full range.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
  1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
  3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
  - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-protection-rated openings, install frames according to NFPA 80.
    - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - c. Install frames with removable glazing stops located on secure side of opening.
    - d. Install door silencers in frames before grouting.
    - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
  - 4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
  - 5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
    - a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
    - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
    - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
    - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
  2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
  3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.

### 3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

## SECTION 081416 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

- B. Related Sections:

1. Division 08 Section "Glazing" for glass view panels in flush wood doors.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.

- B. LEED Submittals:

1. Certificates for Credit MR 7: Chain-of-custody certificates certifying that flush wood doors comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

- a. Include statement indicating costs for each certified wood product.

2. Product Data for Credit EQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.

3. Additional LEED credits: MR 4.1; MR 4.2; MR 5.1; MR5.2; MR 6.

- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.

4. Indicate doors to be factory finished and finish requirements.
  5. Indicate fire-protection ratings for fire-rated doors.
- D. Samples for Initial Selection: For factory-finished doors.
- E. Samples for Verification:
1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
  2. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.
- F. Warranty: Sample of special warranty.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Source Limitations: Obtain flush wood doors and wood paneling from single manufacturer.
- C. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
- D. Forest Certification: Provide doors made with not less than 70 percent of wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- E. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.
1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
  2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- F. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.

- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 17 and 50 percent during the remainder of the construction period.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
    - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.
  - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
  - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Algoma Hardwoods, Inc.
  - 2. Buell Door Company Inc.
  - 3. Chappell Door Co.
  - 4. Eagle Plywood & Door Manufacturing, Inc.
  - 5. Eggers Industries.
  - 6. Graham; an Assa Abloy Group company.
  - 7. Marlite.
  - 8. Marshfield Door Systems, Inc.
  - 9. Mohawk Flush Doors, Inc.; a Masonite company.
  - 10. Oshkosh Architectural Door Company.
  - 11. Poncraft Door Company.
  - 12. VT Industries Inc.

## 2.2 DOOR CONSTRUCTION, GENERAL

- A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.
- B. WDMA I.S.1-A Performance Grade:
  - 1. Heavy Duty unless otherwise indicated.
  - 2. Extra Heavy Duty: Classrooms, public toilets, janitor's closets, assembly spaces, and exits.
- A. Particleboard-Core Doors:
  - 1. Particleboard: Straw-based or Agrifiber particleboard complying with ANSI A208.1, Grade LD-2 or M-2, except for density.
  - 2. Blocking: Provide wood blocking in particleboard-core doors as follows:
    - a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
    - b. 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
    - c. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.
  - 3. Provide doors with glued-wood-stave FSC Certified cores instead of particleboard cores for doors indicated to receive exit devices.
- B. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
  - 1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
  - 2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- C. Mineral-Core Doors:
  - 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
  - 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware as follows:
    - a. 5-inch (125-mm) top-rail blocking.
    - b. 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
    - c. 5-inch (125-mm) midrail blocking, in doors indicated to have armor plates.
    - d. 4-1/2-by-10-inch (114-by-250-mm) lock blocks, 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

## 2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

### A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade AA faces.
2. Species: Cherry.
3. Cut: Plain sliced (flat sliced).
4. Match between Veneer Leaves: Book match.
5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions).
7. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
8. Exposed Vertical and Top Edges: Same species as faces.
1. Core: Particleboard - Agrafiber.
2. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.
3. WDMA I.S.1-A Performance Grade: Extra Heavy Duty and Heavy Duty, as indicated.

## 2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
  1. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
  1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
  2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Cut and trim openings through doors in factory.
  1. Light Openings: Trim openings with moldings of material and profile indicated.
  2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."
  3. Louvers: Factory install louvers in prepared openings.

## 2.5 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Finish doors at factory.
- C. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.
- D. Finish doors at factory where indicated in schedules or on Drawings as factory finished.
- E. Transparent Finish:
  - 1. Grade: Premium.
  - 2. Finish: WDMA TR-6 catalyzed polyurethane.
  - 3. Staining: As selected by Architect from manufacturer's full range.
  - 4. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
  - 5. Sheen: Satin.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
  - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Hardware: For installation, see Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
  - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or

permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
    - a. Comply with NFPA 80 for fire-rated doors.
  2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
  3. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- 3.3 ADJUSTING
- A. Operation: Rehang or replace doors that do not swing or operate freely.
  - B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416



SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Access doors and frames for walls and ceilings.
2. Floor access doors and frames.

- B. Related Sections include the following:

1. Division 07 Section "Roof Accessories" for roof hatches.
2. Division 08 Section "Door Hardware" for mortise or rim cylinder locks and master keying.
3. Division 09 Section "Acoustical Tile Ceilings" for suspended acoustical tile ceilings.
4. Division 22 Section "Facility Storm Drainage Piping" for connection of floor door drainage couplings to drains.
5. Division 23 Section "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.3 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
- C. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.
- D. Ceiling Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of access door(s) and frame(s) through one source from a single manufacturer.
- B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. NFPA 252 or UL 10B for vertical access doors and frames.
  - 2. ASTM E 119 or UL 263 for horizontal access doors and frames.
- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

#### 1.5 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

### PART 2 - PRODUCTS

#### 2.1 STEEL MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
  - 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
  - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
  - 1. ASTM A 123/A 123M, for galvanizing steel and iron products
  - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS) with A60 (ZF180) zinc-iron-alloy (galvannealed) coating or G60 (Z180) mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.
- D. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel,

- complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Surface Preparation for Metallic-Coated Steel Sheet: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
    - a. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
  3. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.
  4. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
- E. Drywall Beads: Edge trim formed from 0.0299-inch (0.76-mm) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

## 2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acudor Products, Inc.
  2. Babcock-Davis; A Cierra Products Co.
  3. Bar-Co, Inc. Div.; Alfab, Inc.
  4. Cendrex Inc.
  5. Dur-Red Products.
  6. Elmdor/Stoneman; Div. of Acorn Engineering Co.
  7. Jensen Industries.
  8. J. L. Industries, Inc.
  9. Karp Associates, Inc.
  10. Larsen's Manufacturing Company.
  11. MIFAB, Inc.
  12. Milcor Inc.
  13. Nystrom, Inc.
  14. Williams Bros. Corporation of America (The).
- B. Flush Access Doors and Trimless Frames: Fabricated from metallic-coated steel sheet.
1. Locations: Wall and ceiling surfaces.
  2. Door: Minimum 0.060-inch- (1.5-mm-) thick sheet metal, set flush with surrounding finish surfaces.
  3. Frame: Minimum 0.060-inch- (1.5-mm-) thick sheet metal with drywall bead flange.
  4. Hinges: Continuous piano.
  5. Latch: Cam latch operated by screwdriver with interior release.

6. Lock: Cylinder.

a. Lock Preparation: Prepare door panel to accept cylinder specified in Division 08 Section "Door Hardware."

C. Fire-Rated, Insulated, Flush Access Doors and Trimless Frames: Fabricated from metallic-coated steel sheet.

1. Locations: Wall and ceiling surfaces.
2. Fire-Resistance Rating: Not less than that of adjacent construction.
3. Temperature Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.
4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch (0.9 mm).
5. Frame: Minimum 0.060-inch- (1.5-mm-) thick sheet metal with drywall bead.
6. Hinges: Continuous piano.
7. Automatic Closer: Spring type.
8. Latch: Self-latching device operated by flush key with interior release.
9. Lock: Self-latching device with cylinder lock.

a. Lock Preparation: Prepare door panel to accept cylinder specified in Division 08 Section "Door Hardware."

### 2.3 FLOOR ACCESS DOORS AND FRAMES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acudor Products, Inc. (aluminum only).
2. Babcock-Davis, A Cierra Products Co.
3. Bilco Company (The).
4. Cendrex Inc.
5. Dur-Red Products.
6. Halliday Products (aluminum only).
7. J. L. Industries, Inc.
8. Karp Associates, Inc.
9. Milcor Inc.
10. Nystrom, Inc.
11. U.S.F. Fabrication.

C. Floor Doors, General: Equip each door with adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with red vinyl grip that allows for one-handed closure, and recessed lift handle.

D. Aluminum Floor Door: Single-leaf opening. Extruded-aluminum angle frame with 1/4-inch- (6.4-mm-) thick, diamond-pattern, aluminum tread plate door; nonwatertight; loading capacity to support 300-lbf/sq. ft. (14.4-kN/sq. m) pedestrian live load.

- E. Hardware: Provide the following:
  - 1. Hinges: Heavy-duty, stainless steel butt hinges with stainless-steel pins.
  - 2. Latch: Stainless-steel slam latch.
  - 3. Lock: Keyed deadlock bolt.
  - 4. Hardware Material: Stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and all brackets, hinges, pins, and fasteners.
- F. Insulation: Urethane with liner pan.
- G. Safety Accessories: Safety chains.

## 2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
  - 1. Exposed Flanges: Nominal 1 to 1-1/2 inches (25 to 38 mm) wide around perimeter of frame.
  - 2. Provide mounting holes in frames for attachment of units to metal or wood framing.
  - 3. Provide mounting holes in frame for attachment of masonry anchors. Furnish adjustable metal masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
  - 1. For cylinder lock, furnish two keys per lock and key all locks alike.
  - 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.
- E. Extruded Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

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- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

### 3.2 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

## SECTION 083323 - OVERHEAD COILING DOORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Insulated service doors.

- B. Related Sections:

- 1. Division 05 Section "Metal Fabrications" for miscellaneous steel supports.
  - 2. Division 26 Sections for electrical service and connections for powered operators and accessories.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.
  - 1. Wind Loads: Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward.
    - a. Basic Wind Speed: 90 mph (40 m/s).
    - b. Importance Factor: II.
    - c. Exposure Category: **C**.
  - 2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
- C. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa) wind load, acting inward and outward.

- D. Windborne-Debris-Impact-Resistance Performance: Provide impact-protective overhead coiling doors that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and ASTM E 1996.
- E. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the emergency-egress-door component will be fully operational after the seismic event."
  - 2. Seismic Component Importance Factor: 1.5, unless otherwise indicated.
- F. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

#### 1.4 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:
  - 1. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
  - 2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
  - 3. For fire-rated doors, description of fire-release system including testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Show locations of replaceable fusible links.
  - 3. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
  - 1. Include similar Samples of accessories involving color selection.
- D. Delegated-Design Submittal: For overhead coiling doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail fabrication and assembly of seismic restraints.
  - 2. Summary of forces and loads on walls and jambs.

- E. Qualification Data: For qualified Installer.
- F. Seismic Qualification Certificates: For overhead coiling doors, accessories, and components, from manufacturer.
- G. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.
- H. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
  - 1. Obtain operators and controls from overhead coiling door manufacturer.
- C. Fire-Rated Door Assemblies, where indicated: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.
  - 1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
  - 2. Smoke Control: In corridors and smoke barriers, provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. (0.01524 cu. m/s x sq. m) of door opening at 0.10 inch wg (24.9 Pa) for both ambient and elevated temperature tests.
- D. Sound-Control Doors, where indicated: Assemblies that have been fabricated and tested to control the passage of sound and have minimum certified STC rating according to ASTM E 413.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

## PART 2 - PRODUCTS

### 2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm) and as required to meet requirements.
  2. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet or fire-protection rated glass as required for type of door; set in glazing channel secured to curtain slats.
  3. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.
  4. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
  5. Gasket Seal: Provide insulated slats with manufacturer's standard interior-to-exterior thermal break or with continuous gaskets between slats.
- B. Endlocks and Windlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
- C. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.
- D. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- E. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks at exterior doors.

### 2.2 HOOD

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached.

Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
3. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

### 2.3 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
  1. Lock Cylinders: Provide cylinders specified in Division 08 Section "Door Hardware" and keyed to building keying system.
  2. Keys: Provide Three for each cylinder.
- C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

### 2.4 CURTAIN ACCESSORIES

- A. Smoke Seals: Equip each fire-rated door with smoke-seal perimeter gaskets for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.
  1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous sheet secured to inside of hood.
  2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.
- C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
  1. Provide pull-down straps or pole hooks for doors more than 84 inches (2130 mm) high.
- D. Automatic-Closing Device for Fire-Rated Doors: Equip each fire-rated door with an automatic-closing device that is inoperative during normal door operations and that

has a governor unit complying with NFPA 80 and an easily tested and reset release mechanism designed to be activated by the following:

1. Building fire-detection and -alarm systems and manufacturer's standard door-holder-release devices.

## 2.5 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.6 MANUAL DOOR OPERATORS

- A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.
- B. Push-up Door Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed 25 lbf (111 N).

## 2.7 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
  1. Comply with NFPA 70.
  2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.

- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
  - 1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
  - 2. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
  - 3. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
- D. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 11 Section "Common Motor Requirements for Equipment" unless otherwise indicated.
  - 1. Electrical Characteristics:
    - a. Phase: Polyphase.
    - b. Volts: 230 V, unless otherwise indicated.
    - c. Hertz: 60.
  - 2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
  - 3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
  - 4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
  - 5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. For fire-rated doors, activation delays closing.
  - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

- a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.
- 
- 2. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    - a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
  - G. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
    - 1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
  - H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).
  - I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
  - J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
  - K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

## 2.8 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cookson Company.
    - b. Cornell Iron Works, Inc.
    - c. McKeon Rolling Steel Door Company, Inc.
    - d. Overhead Door Corporation.
    - e. Raynor.
    - f. Southwestern Steel Rolling Door Co.
    - g. Wayne-Dalton Corp.

- h. Windsor Door.
  - i. Approved Equal.
- B. Operation Cycles: Not less than 20,000.
- 1. Include tamperproof cycle counter.
- C. STC Rating: 26, where indicated.
- D. Curtain R-Value: 5.0 deg F x h x sq. ft./Btu (0.881 K x sq. m/W).
- E. Door Curtain Material: Galvanized steel.
- F. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.
- 1. Vision Panels, where indicated: Approximately 10- by 1-5/8-inch (254- by 41-mm) openings spaced approximately 2 inches (51 mm) apart and beginning 12 inches (305 mm) from end guides; in three rows of slats at height indicated on Drawings; installed with insulated vision-panel glazing.
  - 2. Insulated-Slat Interior Facing: Metal.
- G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- H. Hood: Match curtain material and finish.
- 1. Shape: Round.
  - 2. Mounting: Face of wall.
- I. Integral Frame, Hood, and Fascia for Counter Door: Galvanized steel.
- 1. Mounting: Face of wall.
- J. Sill Configuration for Counter Door: No sill.
- K. Locking Devices: Equip door with locking device assembly.
- 1. Locking Device Assembly: locking bars, operable from inside with thumb turn, outside with cylinder.
- L. Electric Door Operator:
- 1. Usage Classification: Standard duty, up to 60 cycles per hour.
  - 2. Operator Location: Top of Hood, Front of hood, or Wall, as shown on Drawings.
  - 3. Motor Exposure: Interior.
  - 4. Emergency Manual Operation: Push-up type.
  - 5. Obstruction-Detection Device: Automatic photoelectric sensor, electric sensor edge on bottom bar.
    - a. Sensor Edge Bulb Color: Black.
  - 6. Remote-Control Station: Interior.

- M. Door Finish:
  - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
  - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

## 2.9 FIRE-RATED DOOR ASSEMBLY

- A. Fire-Rated Service Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cookson Company.
    - b. Cornell Iron Works, Inc.
    - c. McKeon Rolling Steel Door Company, Inc.
    - d. Overhead Door Corporation.
    - e. Raynor.
    - f. Southwestern Steel Rolling Door Co.
    - g. Wayne-Dalton Corp.
    - h. Windsor Door.
    - i. Approved Equal.
- B. Operation Cycles: Not less than 20,000.
  - 1. Include tamperproof cycle counter.
- C. Fire Rating: As indicated.
- D. Curtain R-Value: 5.0 deg F x h x sq. ft./Btu (0.881 K x sq. m/W).
- E. Door Curtain Material: Galvanized steel.
- F. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.
- G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- H. Hood: Match curtain material and finish.
  - 1. Shape: Round.
  - 2. Mounting: Face of wall.
- I. Locking Devices: Equip door with locking device assembly.
  - 1. Locking Device Assembly: inside with thumbturn, outside with cylinder.
- J. Manual Door Operator: Push-up operation.
- K. Electric Door Operator:
  - 1. Usage Classification: Standard duty, up to 60 cycles per hour.

2. Operator Location: Wall or as shown on Drawings.
3. Motor Exposure: Interior
4. Emergency Manual Operation: Push-up type.
5. Obstruction Detection Device: Automatic photoelectric sensor, and electric sensor edge on bottom bar.
  - a. Sensor Edge Bulb Color: Black.
6. Remote-Control Station: Interior.

L. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Fire-Rated Doors: Install according to NFPA 80.
- E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

### 3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Perform installation and startup checks according to manufacturer's written instructions.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

### 3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide weathertight fit around entire perimeter.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

## SECTION 083401 – FIBERGLASS REINFORCED PLASTIC DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Fiberglass Reinforced Plastic (FRP) Doors.
2. Fiberglass Reinforced Plastic (FRP) Frames.
3. Fire Rated Fiberglass Reinforced Plastic (FRP) Doors.
4. Fire Rated Fiberglass Reinforced Plastic (FRP) Frames.

#### 1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections:

1. Division 08 Section "Door Hardware" for door hardware for hollow metal doors.
2. Division 09 Sections "Interior Painting" for field painting hollow metal doors and frames.
3. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

#### 1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).

E. Other Action Submittals:

1. Schedule: Provide a schedule of work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

F. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

#### 1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with fire-rated door and frame construction will conform to tested products under ASTM E152, NFPA 252 & UL10C Retain first subparagraph below if applicable and acceptable to authorities having jurisdiction. Install door and frame assembly in conformance with NFPA 80 for fire-rated class, ANSI A117.1 specifications for ADA requirements, handicap accessibility.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

C. A flame spread classification of 25 or less per ASTM E84 will apply to all FRP component parts and shall be self extinguishing per ASTM D635.

D. If the application dictates, resin formulation will conform to USDA and FDA standards for incidental food contact.

E. Retain first two paragraphs below if applicable.

F. Swinging Door Test, Doors and Frames, AAMA 920-03, ANSI A250.4-2001 (supercedes ANSI A-151.1), NWWDA TM-7: In excess of 1,000,000 cycles.

G. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

H. Preinstallation Conference: Conduct conference at Project site.

I. Warranty

1. Fiberglass doors and frames shall carry a lifetime warranty against failure due to corrosion from the specific environment named at the time of purchase. Manufacturer's written warranty and conditions will apply to all products contained in this section.

J.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  1. Provide additional protection to prevent damage to finish of factory-finished units.
- B. Store doors and frames under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.
  1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate installation of anchorages for frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, provide products from one of the following:
  1. Ceco Door Products; an Assa Abloy Group company.
  2. CMI Architectural Products.
  3. Corguard, Inc.
  4. Dor-Tech Fiberglass Door Systems.

5. EPI Extrutech Plastics.
6. Fib-R-Door, Division of Advance Fiberglass, Inc.
7. Special-Lite.

## 2.2 MATERIALS

- A. **Fiberglass Reinforced Plastic Doors: Face Panels:** Standard face panels shall be chemical resistant, using a fiberglass- reinforced polyester resin system with light stabilizing additives. Thickness of panels shall be 0.090 to 0.125, with a standard of 0.120".
1. Door thickness: 1 3/4".
  2. Finish: All surfaces shall have a textured, semi-gloss, seamless, gel coat finish. Gel coat coverage shall be 15 mils thick, plus or minus 3 mils.
  3. First option in first paragraph below is default for standard hollow metal work. Retain second option for custom hollow metal work or for increased protection of standard hollow metal work.
  4. Color: As selected by Architect from manufacturer's standard, optional or custom colors.
- B. **Internal Construction:**
1. Stiles and Rails shall be constructed of rectangular and square high modulus pultruded fiberglass tubes.
  2. Core material as application dictates.
    - a. Honeycomb Core, Phenolic impregnated resin honeycomb.
    - b. Polyurethane Foam Core, 1 1/2" thick rigid block of polyurethane with an "R" factor of 11-12 shall be laminated to the interior of the face panels.
    - c. Mineral Core, fire rated up to 90 minutes.
  3. Internal reinforcements for full mortise hinges to be solid FRP blocking and for thru-bolted hardware to be high modulus pultrusions.
- C. **Door Accessories:**
1. Windows: Glazing support structures and window lite retainers shall be fabricated from high modulus pultrusions and/or fiberglass composition common to the door construction. The opening itself shall be sealed in such a manner as to prevent moisture or contaminants from penetrating the interior of the door. Polyvinyl window retainers will not be acceptable.
  2. Louvers: Door louvers shall be constructed using FRP material in an inverted "v" type design and will adhere to the same guidelines as window openings above.
  3. Transoms: All transom panels will be identical to the doors in materials, construction, thickness, finish and color.
  4. Astragals: Astragals for pairs of doors will be fabricated of FRP material in the manufacturer's standard design.
  5. Fire rated door accessories will be manufactured or supplied in compliance with the labeling agency and in accordance with UL10C.
- D. **Powder-Actuated Fasteners in Concrete:** Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

- E. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- G. Glazing: Comply with requirements in Division 08 Section "Glazing."

### 2.3 FIRE RATED AND NON-RATED FRP FRAMES

- A. General: Fabricate frames of fiberglass reinforced plastic.
  - 1. Head and Jamb: Pultruded fiberglass reinforced plastic, minimum ¼" wall thickness, conforming to SDI requirements.
  - 2. Frame Profile: Double rabbeted with 5/8" stop. Face will be 2" with a standard jamb depth of 5 3/4".
  - 3. Joint Connection: Jamb to Head joints will be neatly mitered at 45 degrees.
  - 4. Finish: 15 mil +/- 3 mil gel coat finish. Color to match door unless otherwise indicated.
- B. Fire rated frames will be FRP, similar to non-rated frames in manufacture and appearance and shall be in compliance with the labeling agency and in accordance with UL10C. Fire rated frames manufactured in a material other than fiberglass will not be accepted.
- C. Reinforcements
  - 1. Corner: Reinforcement at frame corner will be pultruded fiberglass angle, 4" x 4" x 5 3/8" x 1/4".
  - 2. Hardware: Frames will incorporate non-woven polyester fabric at mortise hinge, closer and strike locations for unparallelled screw-holding strength.
- D. Anchoring Systems
  - 1. Wire anchors are recommended for masonry construction.
  - 2. New Masonry
    - a. Wire Type
    - b. FRP Base Anchor
  - 3. Existing Masonry
    - a. #14-10x3-3/4" Crete Flex Masonry Screw
  - 4. FRP Base Anchor
    - a. Stud Wall (Metal or Wood)
    - b. 1/4-20x2-3/4" SS Phillips Head Machine Screw
  - 5. FRP Base Anchor

## 2.4 FABRICATION

- A. Fabricate FRP doors and frames rigid, neat in appearance and free from defects.
- B. Form to sizes and profiles as indicated on drawings.
- C. In compliance with the hardware manufacturer's instructions and templates, doors and frames shall be mortised and reinforced for hardware, including hinges, locks, strikes, closers, etc.
- D. Bottom of frames will terminate at the indicated finished floor level.
- E. Clearances will be as follows:
  - 1. Jambs and Head: 1/8 inch plus or minus 1/16 inch
  - 2. Between Edges and Pairs of Doors: 1/8 inch plus or minus 1/16 inch
  - 3. Between Bottom of Door and Threshold: Maximum 3/8 inch
  - 4. Between Bottom of Door and Top of Finish Floor: Maximum 3/4 inch

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Installer shall meet local building standards requirements and shall examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of fiberglass doors and frames and shall submit a written report if the conditions are unacceptable. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Install doors and frames plumb, rigid, properly aligned and securely fastened in place. Install in accordance with manufacturer's instructions and NFPA 80 standards at fire rated openings.
- C. Where applicable, set frames in place prior to construction of enclosing walls and ceilings. Space between wall and frame may be solidly filled with mortar and anchors built into the joints as the walls are constructed.

- D. A flame spread classification of 25 or less per ASTM E84 will apply to all FRP component parts and shall be self extinguishing per ASTM D635.
- E. Check plumb, squareness and twist of frames as walls are constructed. Brace securely until permanently anchored. Shim as necessary to comply with installation tolerances.
- F. Remove temporary braces and spreaders necessary for installation only after frames have been properly set and secured.
- G. Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows: 1) Three anchors per jamb from 60 to 90 inches in height, 2) Four anchors per jamb from 90 to 96 inches in height.
- H. Protect frames during construction.
- I. Align doors in frames for uniform clearances at each edge.

### 3.3 ADJUSTING

- A. Adjust doors in accordance with door manufacturer's maintenance instructions to swing open and shut without binding and to remain in place at any angle without being moved by gravitational influence.
- B. Adjust door hardware to operate correctly in accordance with hardware manufacturer's maintenance instructions Contact Simon Door Co. if help is required with hardware installation instructions; do not alter doors to fit hardware without prior approval.

### 3.4 CLEANING

- A. Clean all exposed surfaces, removing dirt and excess sealant from all exposed surfaces. Follow the manufacturer's maintenance instructions for proper techniques and products to clean all surfaces.
- B. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- C. Remove grout and other bonding material from hollow metal work immediately after installation.

END OF SECTION 083401



SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Exterior and interior storefront framing.

- B. Related Sections:

- 1. Division 08 Section "Glazed Aluminum Curtain Walls" for curtain-wall systems that mechanically retain glazing on four sides.

1.3 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

- 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
  - 2. Dimensional tolerances of building frame and other adjacent construction.
  - 3. Failure includes the following:

- a. Deflection exceeding specified limits.
    - b. Thermal stresses transferring to building structure.
    - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
    - d. Glazing-to-glazing contact.
    - e. Noise or vibration created by wind and by thermal and structural movements.
    - f. Loosening or weakening of fasteners, attachments, and other components.

- g. Sealant failure.
  - h. Failure of operating units.
- B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:
  - 1. Wind Loads: As indicated on Drawings.
    - a. Basic Wind Speed: 90 mph (40 m/s).
    - b. Importance Factor: II.
    - c. Exposure Category: C.
  - 2. Seismic Loads: As indicated on Drawings.
  - 3. Blast Loads: As indicated on Drawings.
- D. Deflection of Framing Members:
  - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed  $L/175$  of the glass edge length for each individual glazing lite,  $1/175$  of clear span for spans up to 13 feet 6 inches (4.1 m) and to  $1/240$  of clear span plus  $1/4$  inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to  $3/4$  inch (19 mm), whichever is less.
  - 2. Deflection Parallel to Glazing Plane: Limited to  $L/360$  of clear span or  $1/8$  inch (3.2 mm), whichever is smaller, amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below them to less than  $1/8$  inch (3.2 mm) and clearance between members and operable units directly below them to less than  $1/16$  inch (1.5 mm).
- E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
  - 1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
  - 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
  - 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- F. Windborne-Debris-Impact-Resistance Performance: Provide aluminum-framed systems that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 or AAMA 506.
  - 1. Large-Missile Impact: For aluminum-framed systems located within 30 feet (9.1 m) of grade.

2. Small-Missile Impact: For aluminum-framed systems located more than 30 feet (9.1 m) above grade.
- G. Story Drift: Provide aluminum-framed systems that accommodate design displacement of adjacent stories indicated.
1. Design Displacement: As indicated on Drawings.
  2. Test Performance: Meet criteria for passing, based on building occupancy type, when tested according to AAMA 501.4 at design displacement and 1.5 times design displacement.
- H. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
- I. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- J. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
  2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
    - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
    - b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
  3. Interior Ambient-Air Temperature: 75 deg F (24 deg C).
- K. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.
- L. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) when tested according to AAMA 1503.
- M. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:
1. Sound Transmission Class (STC): Minimum 30 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

- N. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by aluminum-framed systems without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

- O. Structural-Sealant Joints: Designed to produce tensile or shear stress of less than 20 psi (138 kPa).

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
- B. LEED Submittal:
1. Product Data for Credit EQ 4.1: For adhesives and sealants used inside of the weatherproofing system, including printed statement of VOC content.
- C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
  2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- F. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
1. Joinery, including concealed welds.
  2. Anchorage.
  3. Expansion provisions.
  4. Glazing.
  5. Flashing and drainage.
- G. Other Action Submittals:

1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
  - H. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
    1. Detail fabrication and assembly of aluminum-framed systems.
    2. Include design calculations.
  - I. Qualification Data: For qualified Installer.
  - J. Seismic Qualification Certificates: For aluminum-framed systems, accessories, and components, from manufacturer.
    1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - K. Welding certificates.
  - L. Preconstruction Test Reports: For sealant.
  - M. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.
  - N. Source quality-control reports.
  - O. Quality-Control Program for Structural-Sealant-Glazed System: Include reports.
  - P. Field quality-control reports.
  - Q. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
  - R. Warranties: Sample of special warranties.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
  - B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
  - C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

- D. Quality-Control Program for Structural-Sealant-Glazed System: Develop quality control program specifically for Project. Document quality-control procedures and verify results for aluminum-framed systems. Comply with ASTM C 1401 recommendations including, but not limited to, system material-qualification procedures, preconstruction sealant-testing program, procedures for system fabrication and installation, and intervals of reviews and checks.
- E. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
  - 1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- F. Preconstruction Sealant Testing: For structural-sealant-glazed systems, perform sealant manufacturer's standard tests for compatibility with and adhesion of each material that will come in contact with sealants and each condition required by aluminum-framed systems.
  - 1. Test a minimum five samples each of metal, glazing, and other material.
  - 2. Prepare samples using techniques and primers required for installed systems.
  - 3. For materials that fail tests, determine corrective measures necessary to prepare each material to ensure compatibility with and adhesion of sealants including, but not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.
- G. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- H. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- I. Structural-Sealant Glazing: Comply with ASTM C 1401, "Guide for Structural Sealant Glazing" for design and installation of structural-sealant-glazed systems.
- J. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.
- K. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."
- L. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical wall area as shown on Drawings.

2. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

M. Preinstallation Conference: Conduct conference at **(Project site) <Insert location>**.

#### 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Structural failures including, but not limited to, excessive deflection.
- b. Noise or vibration caused by thermal movements.
- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- d. Adhesive or cohesive sealant failures.
- e. Water leakage through fixed glazing and framing areas.
- f. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 20 years from date of Substantial Completion.

#### 1.9 MAINTENANCE SERVICE

- A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. Arcadia, Inc.
  2. Arch Aluminum & Glass Co., Inc.
  3. CMI Architectural
  4. Commercial Architectural Products, Inc.
  5. EFCO Corporation.
  6. Leed Himmel Industries, Inc.
  7. Pittco Architectural Metals, Inc.
  8. TRACO.
  9. Tubelite.
  10. United States Aluminum.
  11. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
  12. YKK AP America Inc.

### 2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
  2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
  3. Extruded Structural Pipe and Tubes: ASTM B 429.
  4. Structural Profiles: ASTM B 308/B 308M.
  5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
  1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

## 2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  - 1. Construction: Thermally broken.
  - 2. Glazing System: Retained mechanically with gaskets on four sides.
  - 3. Glazing Plane: As indicated.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  - 2. Reinforce members as required to receive fastener threads.
  - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system, fabricated from stainless steel).
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
  - 1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
- E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:
  - 1. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in

contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.

- a. Provide sealants for use inside of the weatherproofing system that have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - b. Color: Black.
2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.
    - a. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - b. Color: Matching structural sealant.

## 2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
  1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
    - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
  2. Door Design: Medium stile; 3-1/2-inch (88.9-mm) nominal width.
    - a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.
  3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
    - a. Provide nonremovable glazing stops on outside of door.
- B. Entrance Door Hardware: As specified in Division 08 Section "Door Hardware."

## 2.6 ENTRANCE DOOR HARDWARE

- A. General: Provide entrance door hardware and entrance door hardware sets indicated for each entrance door to comply with requirements in this Section.
1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products complying with BHMA standard referenced.
  2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
  3. Opening-Force Requirements:
    - a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf ((133 N))to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
    - b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
  2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- C. Opening-Force Requirements:
1. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force of not more than 15 lbf (67 N) for not more than 3 seconds.
  2. Latches and Exit Devices: Not more than 15 lbf (67 N) required to release latch.
- D. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.
- E. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- F. Manual Flush Bolts: BHMA A156.16, Grade 1.
- G. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- H. Cylinders: As specified in Division 08 Section "Door Hardware." BHMA A156.5, Grade 1.
1. Keying: to be furnished by Owner.
- I. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

- J. Operating Trim: BHMA A156.6.
- K. Removable Mullions: BHMA A156.3, extruded aluminum.
  - 1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.
- L. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet field conditions and requirements for opening force.
- M. Concealed Overhead Holders: BHMA A156.8, Grade 1.
- N. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- O. Weather Stripping: Manufacturer's standard replaceable components.
  - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
  - 2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- P. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- Q. Silencers: BHMA A156.16, Grade 1.
- R. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

## 2.7 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."
  - 1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762-mm) thickness per coat.

## 2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.

- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
  - 4. Physical and thermal isolation of glazing from framing members.
  - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
  - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
- F. Storefront Framing: Fabricate components for assembly using shear-block system screw-spline system.
- G. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
  - 1. At exterior doors, provide compression weather stripping at fixed stops.
  - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- H. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
  - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
  - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- I. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- J. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 08 Section "Glazing."

1. Structural-Sealant Glazing:

- a. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

- b. Install weatherseal sealant according to Division 07 Section "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

### 3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
2. Alignment:
  - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
  - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

### 3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Structural-Sealant Compatibility and Adhesion: Structural sealant shall be tested according to recommendations in ASTM C 1401.
  - a. Destructive Test Method A, "Hand Pull Tab (Destructive)," in ASTM C 1401, Appendix X2, shall be used.

- 1) A minimum of two areas on each building face shall be tested.
  - 2) Repair installation areas damaged by testing.
2. Structural-Sealant Glazing Inspection: After installation of aluminum-framed systems is complete, structural-sealant glazing shall be inspected and evaluated according to recommendations in ASTM C 1401.
  3. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. (0.03 L/s per sq. m), of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
  4. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing under "Performance Requirements" Article, but not less than 4.18 lbf/sq. ft. (200 Pa), and shall not evidence water penetration.
  5. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 75 feet (23 m) by 1 story of aluminum-framed systems designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
- C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.
  - D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  - E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.
  - F. Prepare test and inspection reports.
- 3.5 ADJUSTING
- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
    1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION 084113

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes conventionally glazed aluminum curtain walls installed as stick assemblies.
- B. Related Sections:
1. Division 07 Section "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
  2. Division 08 Section "Louvers and Vents" for units installed with glazed aluminum curtain walls.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of manufacturer's standard glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Glazed aluminum curtain walls shall withstand movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- B. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:

1. Wind Loads:
    - a. Basic Wind Speed: 90 mph (40 m/s).
    - b. Importance Factor: II.
    - c. Exposure Category: C.
  2. Blast Loads: As indicated on Drawings.
  3. Periodic Maintenance-Equipment Loads: As indicated on Drawings.
- D. Structural-Test Performance: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
  2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
  3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.
- F. Windborne-Debris-Impact-Resistance Performance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone 4.
1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.
  2. Small-Missile Test: For glazed openings located more than 30 feet (9.1 m) above grade.
- G. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
1. Component Importance Factor is 1.5.
- H. Story Drift: Accommodate design displacement of adjacent stories indicated.
1. Design Displacement: As indicated on Drawings.
  2. Test Performance: Meeting criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement (and 1.5 times the design displacement).

- I. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- J. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:
  - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
  - 2. Test Interior Ambient-Air Temperature: 75 deg F (24 deg C).
  - 3. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
- K. Energy Performance: Glazed aluminum curtain walls shall have certified and labeled energy performance ratings in accordance with NFRC.
  - 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) as determined according to NFRC 100.
  - 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.
  - 3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. (1.50 L/s per sq. m) of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
  - 4. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 35 as determined according to NFRC 500.
- L. Sound Transmission: Provide glazed aluminum curtain walls with fixed glazing and framing areas having the following sound-transmission characteristics:
  - 1. Outdoor-Indoor Transmission Class: Minimum 30 when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

#### 1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Provide glazed aluminum curtain walls that comply with test-performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard assemblies by a qualified testing agency.
  - a. Structural-performance preloading at 50 percent of the specified wind-load design pressure when tested according to ASTM E 330.
  - b. Air infiltration when tested according to ASTM E 283.
  - c. Water penetration under static pressure when tested according to ASTM E 331.
  - d. Water penetration under dynamic pressure when tested according to AAMA 501.1.

- e. Structural performance at design load when tested according to ASTM E 330.
- f. Repeat air filtration when tested according to ASTM E 283.
- g. Repeat water penetration under static pressure when tested according to ASTM E 331.
- h. Structural performance at maximum 150 percent of positive and negative wind-load design pressures when tested according to ASTM E 330.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. LEED Submittal:
  - 1. Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.
- C. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
  - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  - 2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing.
    - e. Flashing and drainage.
  - 3. Include laboratory mockup Shop Drawings, prepared by a qualified preconstruction testing agency, showing details of laboratory mockup.
    - a. Resubmit Shop Drawings with changes made to glazed aluminum curtain walls to successfully complete preconstruction testing.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- F. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
  - 1. Joinery, including concealed welds.
  - 2. Anchorage.
  - 3. Expansion provisions.
  - 4. Glazing.

5. Flashing and drainage.

- G. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- H. Qualification Data: For qualified Installer.
- I. Seismic Qualification Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
- J. Welding certificates.
- K. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.
  - 1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
- L. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency, for glazed aluminum curtain walls, indicating compliance with performance requirements.
- M. Field quality-control reports.
- N. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.
- O. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating glazed aluminum curtain walls that meet or exceed energy performance requirements indicated and of documenting this performance by certification, labeling, and inclusion in lists.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- C. Preconstruction Testing Agency Qualifications: Qualified according to ISO/IEC 17025 and accredited by ICC-ES for preconstruction testing indicated.
- D. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- E. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of

components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

F. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

G. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.

1. Provide NFRC-certified glazed aluminum curtain walls with an attached label.

H. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Preinstallation Conference: Conduct conference at Project site.

## 1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication and indicate measurements on Shop Drawings.

## 1.8 WARRANTY

A. Special Assembly Warranty: Standard form in which Installer agrees to repair or replace components of glazed aluminum curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
  - a. Structural failures including, but not limited to, excessive deflection.
  - b. Noise or vibration created by wind and thermal and structural movements.
  - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

- d. Water penetration through fixed glazing and framing areas.
  - e. Failure of operating components.
2. Warranty Period: Five years from date of Substantial Completion.
- 
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  2. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Arcadia, Inc.
  2. Arch Aluminum & Glass Co., Inc.
  3. Bruce Wall Systems Corporation.
  4. CMI Architectural.
  5. EFCO Corporation.
  6. Glassalum International Corporation.
  7. Pittco Architectural Metals, Inc.
  8. Tingwall Inc.
  9. TRACO.
  10. Tubelite.
  11. United States Aluminum.
  12. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
  13. Waltek & Company Limited.
  14. Wausau Window and Wall Systems.
  15. YKK AP America Inc.

### 2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
  2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).

3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

## 2.3 FRAMING

- A. Framing Members: Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Thermally broken.
  2. Glazing System: Retained mechanically with gaskets on four sides.
  3. Glazing Plane: Front.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.
  3. Use exposed fasteners with countersunk Phillips screw heads, fabricated from 300 series stainless steel.
- D. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- F. Framing Sealants: Manufacturer's standard sealants.

## 2.4 GLAZING

- A. Glazing: Comply with Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers."
- C. Glazing Sealants: As recommended by manufacturer."
  - 1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.5 INSULATED SPANDREL PANELS

- A. Insulated Spandrel Panels: Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.
  - 1. Overall Panel Thickness: 1 inch (25.4 mm).
  - 2. Exterior Skin: Aluminum or glass, as indicated .
    - a. Thickness: Manufacturer's standard for finish and texture indicated.
    - b. Finish: As indicated.
    - c. Texture: Smooth.
    - d. Backing Sheet: 0.125-inch- (3.2-mm-) thick, corrugated, high-density polyethylene.
  - 3. Interior Skin: Aluminum.
    - a. Thickness: Manufacturer's standard for finish and texture indicated.
    - b. Finish: Low-gloss, white baked enamel.
    - c. Texture: Smooth.
    - d. Backing Sheet: 1/2-inch- (12.7-mm-) thick, gypsum board with proprietary fire-resistance-rated core.
  - 4. Thermal Insulation Core: Manufacturer's standard rigid, closed-cell, polyisocyanurate board.
  - 5. Surface-Burning Characteristics: For exposed interior surfaces of panels, when tested according to ASTM E 84 as follows:
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.

## 2.6 ACCESSORY MATERIALS

- A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

## 2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Physical and thermal isolation of glazing from framing members.
  - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 5. Provisions for field replacement of glazing from interior.
  - 6. Provisions for safety railings mounted between mullions at interior.
  - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
  - 8. Components curved to indicated radii.
- D. Fabricate components that, when assembled, have the following characteristics:
  - 1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
  - 2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
- E. Curtain-Wall Framing: Fabricate components for assembly using shear-block system.
- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

#### A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

#### B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

#### C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

#### D. Install components plumb and true in alignment with established lines and grades.

#### E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

#### F. Install glazing as specified in Division 08 Section "Glazing."

### 3.3 ERECTION TOLERANCES

#### A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6 mm in 12 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6 mm in 12 m).
3. Alignment:
  - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
  - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
  - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.7 m); 1/2 inch (12.7 mm) over total length.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of representative areas of glazed aluminum curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.
  1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article, but not more than 0.50 cfm/sq. ft. (2.25 L/s per sq. m), of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
    - a. Test Area: One bay wide, but not less than 30 feet (9.1 m), by one story of glazed aluminum curtain wall.
    - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 35, and 70 percent completion.
  2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.
    - a. Test Area: One bay wide, but not less than 30 feet (9.1 m), by one story of glazed aluminum curtain wall.
    - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 35, and 70 percent completion.
  3. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
    - a. Test Area: A minimum area of 75 feet (23 m) by one story of glazed aluminum curtain wall.
- C. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 084413

SECTION 08710 – DOOR HARDWARE

PART I – GENERAL

1.01 SUMMARY

A. SECTION INCLUDES

1. The work in this section includes furnishing all items of finish hardware as hereinafter specified or obviously necessary for all swinging, sliding, folding and other doors. Except items, which are specifically excluded from this section of the specification or of unique hardware, specified in the same sections as the doors and frames on which they are installed.

B. RELATED DOCUMENTS

1. Related documents, drawings and general provisions of contract, including General and Supplementary Conditions and Division 1 specification sections apply to this section.

C. RELATED SECTIONS

1. 062000 – Finish Carpentry
2. 081100 – Metal Doors and Frames
3. 082100 – Wood Doors
4. 084100 – Entrances and Storefronts
5. Division 26 – Access Control

1.02 REFERENCES

A. STANDARDS

1. ANSI A156.1 – Butts and Hinges
2. ANSI A156.2 – Bored Locks and Latches
3. ANSI A156.3 – Exit Devices
4. ANSI A156.4 – Door Controls – Door Closers
5. ANSI A156.5 – Auxiliary Locks and Associated Products
6. ANSI A156.6 – Architectural Door Trim
7. ANSI A156.7 – Template Hinge Dimensions
8. ANSI A156.8 – Door Controls – Overhead Holders
9. ANSI A156.13 – Mortise Locks and Latches
10. ANSI A156.15 – Closer Holder Release Devices
11. ANSI A156.16 – Auxiliary Hardware
12. ANSI A156.18 – Material and Finishes
13. NFPA 80 – Fire Doors and Windows
14. UL10C – Positive Pressure Fire Tests of Door Assemblies
15. AIA A201 1997 – General Conditions of the Contract

B. CODES

1. NFPA 101 – Life Safety Code
2. IBC 2003 – International Building Code
3. ANSI A117.1 – Accessible and Usable Buildings and Facilities

4. ADA – Americans with Disabilities Act

1.03 SUBMITTALS

A. GENERAL REQUIREMENTS

1. Submit copies of finish hardware schedule in accordance with Division 1, General Requirements.

B. SCHEDULES AND PRODUCT DATA

1. Schedules to be in vertical format, listing each door opening, and organized into "hardware sets" indicating complete designations of every item required for each door opening to function as intended. Hardware schedule shall be submitted within two (2) weeks from date the purchase order is received by the finish hardware supplier. Furnish four (4) copies of revised schedules after approval for field and file use. Note any special mounting instructions or requirements with the hardware schedule. Schedules to include the following information:
  - a. Location of each hardware set cross-referenced to indications on drawings, both on floor plans and in door and frame schedule.
  - b. Handing and degree of swing of each door.
  - c. Door and frame sizes and materials.
  - d. Keying information.
  - e. Type, style, function, size, and finish of each hardware item.
  - f. Elevation drawings and operational descriptions for all electronic openings.
  - g. Name and manufacturer of each hardware item.
  - h. Fastenings and other pertinent information.
  - i. Explanation of all abbreviations, symbols and codes contained in schedule
  - j. Mounting locations for hardware when varies from standard.
2. Submit catalog cuts and/or product data sheets for all scheduled finish hardware.
3. Submit separate detailed keying schedule for approval indicating clearly how the owner's final instructions on keying of locks has been fulfilled.

C. SAMPLES

1. Upon request, samples of each type of hardware in finish indicated shall be submitted. Samples are to remain undamaged and in working condition through submittal and review process. Items will be returned to the supplier or incorporated into the work within limitations of keying coordination requirements.

D. TEMPLATES

1. Furnish a complete list and suitable templates, together with finish hardware schedule to contractor, for distribution to necessary trades supplying materials to be prepped for finish hardware.

E. ELECTRONIC HARDWARE SYSTEMS

1. Provide complete wiring diagrams prepared by an authorized factory employee for each opening requiring electronic hardware, except openings where only magnetic hold-open devices are specified. Provide a copy with each hardware schedule submitted after approval.
2. Provide complete operational descriptions of electronic components listed by opening in the hardware submittals. Operational descriptions to detail how each electrical component functions within the opening incorporating all conditions of ingress and egress. Provide a copy with each hardware schedule submitted for approval.
3. Provide elevation drawings of electronic hardware and systems identifying locations of the system components with respect to their placement in the door opening. Provide a copy with each hardware schedule submitted for approval.
4. Prior to installation of electronic hardware, arrange conference between supplier, installers and related trades to review materials, procedures and coordinating related work.
5. The electrical products contained within this specification represent a complete engineered system. If alternate electrical products are submitted, it is the responsibility of the distributor to bear the cost of providing a complete and working system including re-engineering of electrical diagrams and system layout, as well as power supplies, power transfers and all required electrical components. Coordinate with electrical engineer and electrician to ensure that line voltage and low voltage wiring is coordinated to provide a complete and working system.

F. OPERATIONS AND MAINTENANCE MANUALS

1. Upon completion of construction and building turnover, furnish two (2) complete maintenance manuals to the owner. Manuals to include the following items:
  - a. Approved hardware schedule, catalog cuts and keying schedule.
  - b. Hardware installation and adjustment instructions.
  - c. Manufacturer's written warranty information.
  - d. Wiring diagrams, elevation drawings and operational descriptions for all electronic openings.

1.04 QUALITY ASSURANCE

A. SUBSTITUTIONS

1. All substitution requests must be submitted during bidding and within the procedures and time frame as outlined in Division 1, General Requirements. Approval of products is at the discretion of the Owner, architect and his hardware consultant.

B. SUPPLIER QUALIFICATIONS

1. A recognized architectural door hardware supplier who has maintained an office and has been furnishing hardware in the project's vicinity for a period of at least two (2) years.
2. Hardware supplier shall have office and warehouse facilities to accommodate this project.

3. Hardware supplier shall have in his employment at least one (1) Architectural Hardware Consultant (AHC) who is available at reasonable times during business hours for consultation about the project's hardware and requirements to the owner, architect and contractor.
4. Hardware supplier must be an authorized factory distributor of all products specified herein.

#### 1.05 FIRE-RATED OPENINGS

1. Provide door hardware for fire-rated openings that comply with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed by Underwriter's Laboratories (UL) or Warnock Hersey (WH) for use on types and sizes of doors indicated.
2. Project requires door assemblies and components that are compliant with positive pressure and S-label requirements. Specifications must be cross-referenced and coordinated with door manufacturers to ensure that total opening engineering is compatible with UL10C Standard for Positive Pressure Fire Tests of Door Assemblies.
  - a. Hardware required for fire doors shall be listed with Underwriters Laboratories for ratings specified.
  - b. Certification(s) of compliance shall be made available upon request by the Authority Having Jurisdiction.

#### 1.06 DELIVERY, STORAGE AND HANDLING

##### A. MARKING AND PACKAGING

1. Properly package and mark items according to the approved hardware schedule, complete with necessary screws and accessories, instructions and installation templates for spotting mortising tools. Contractor shall check deliveries against accepted list and provide receipt for them, after which he is responsible for storage and care. Any shortage or damaged good shall be made without cost to the owner.
2. Packaging of door hardware is the responsibility of the supplier. As hardware supplier receives material from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set and door numbers to match the approved hardware schedule. Two or more identical sets may be packed in same container.

##### B. DELIVERY

1. The supplier shall deliver all hardware to the project site; direct factory shipments are not allowed unless agreed upon beforehand. Hardware supplier shall coordinate delivery times and schedules with the contractor. Inventory door hardware jointly with representatives of hardware supplier and hardware installer/contractor until each is satisfied that count is correct.
2. No keys, other than construction master keys and/or temporary keys are to be packed in boxes with the locks.
3. At time of hardware delivery, door openings supplier in conjunction with the contractor shall check in all hardware and set up a hardware storage room.

## C. STORAGE

1. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of work will not be delayed by hardware losses both before and after installation.

### 1.07 WARRANTY

- A. All items, except as noted below, shall be warranted in writing by the manufacturer against failure due to defective materials and workmanship for a minimum period of one (1) year commencing on the date of final completion and acceptance. In the event of product failure, promptly repair or replace item with no additional cost to the owner.
  1. Cylindrical locksets – Heavy Duty: Seven (7) years
  2. Mortise locksets: Ten (10) years
  3. Exit Devices: Five (5) years
  4. Door closers: Ten (10) years
  5. Securifron (and approved equals) electrified hardware: Unlimited Lifetime

## PART II – PRODUCTS

### 2.01 MANUFACTURERS

- A. Only manufacturers as listed below shall be accepted, unless pre-approved by Owner, by substitution request during bidding. Obtain each type of finish hardware (hinges, latch and locksets, exit devices, door closers, etc.) from a single manufacturer.

### 2.02 MATERIALS

#### A. SCREWS AND FASTENERS

1. All required screws shall be supplied as necessary for securing finish hardware in the appropriate manner. Thru-bolts shall be supplied for exit devices and door closers where required by code and the appropriate blocking or reinforcing is not present in the door to preclude their use.

#### B. HANGING DEVICES

##### 1. HINGES

- a. Hinges shall conform to ANSI A156.1 and have the number of knuckles as specified, oil-impregnated bearings as specified with NRP (non-removable pin) feature, at all exterior reverse bevel doors. Unless otherwise scheduled, supply one (1) hinge for every 30" of door height. Hinges shall be a minimum of 4 1/2" high and 4" wide; heavy weight hinges (.180) shall be supplied at all doors where specified.

- 1) Specified Manufacturer: McKinney
- 2) Approved Substitutes: Hager

## 2. ELECTRIC HINGES

- a. Electric hinges shall be provided with connectors to accommodate up to twelve (12) wires. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Provide a mortar guard for each electric hinge specified.

- 1) Specified Manufacturer: McKinney QC Series
- 2) Approved Substitutes: Hager

## 3. MONITORING SWITCH HINGES

- a. Monitoring switch hinges to be magnetic reed, concealed, adjustable switch type with extra heavy magnet.

- 1) Specified Manufacturer: McKinney MM Series
- 2) Approved Substitutes: Hager EMN Series

## 4. CONTINUOUS GEARED HINGES

- a. All hinges to be non-handed and completely reversible. Hinge line to be available in concealed flush mount with or without inset, full surface and half surface types as specified in the hardware sets. All concealed hinges to be fire-rated for 20, 45 and 90 minutes when incorporated into proper door and frame labeled installations, without necessitating the use of fusible-link pins. All concealed hinges to be available in standard, heavy, and extra heavy duty weights; all full surface and half surface hinges in standard and heavy duty weights as specified in the hardware sets. All hinges to be factory cut for door size.

- b. Continuous hinges must be used at all exterior storefront openings.

- 1) Specified Manufacturers: McKinney
- 2) Approved Manufacturers: Markar, Roton, Select

## 5. FLOOR CLOSERS

- a. Floor closer shall be of offset hung type and available for labeled, lead lined and regular doors. Floor closer shall have independent and adjustable valves for closing speed, latch speed, and backcheck. Floor closers shall have a built in dead stop to prevent the door from swinging beyond the opening degree and all shall be of non-hold open type unless specified otherwise. Include top and intermediate pivots per the manufacturer's recommendations.

- 1) Specified Manufacturer: Rixson
- 2) Approved Substitutes: Dorma

## C. FLUSH BOLTS AND ACCESSORIES

1. All manual and automatic flush bolts to be furnished as specified and as permitted by the Utah State Fire Marshal.

- a. Specified Manufacturer: McKinney
- b. Approved Substitutes: Rockwood, Trimco

D. CYLINDERS AND KEYING

1. CYLINDERS

- a. Rim and Mortise cylinders for exit devices, mullions and mortise locks shall be prepared to receive an ASSA interchangeable core and shall be provided and installed by the general contractor.
- b. Cylindrical locks shall be prepared to receive an ASSA conventional cylinder.
- c. All permanent interchangeable cores and conventional cores will be supplied by the owner.
- d. Contact the USU lock shop 435-797-0659 (Kirk Lukenbill or Curtis Leishman) for temporary interchangeable and conventional cores.
  - 1) Specified Manufacturer: Assa
  - 2) Approved Substitutes: NONE

2. KEYING

- a. All locks and cylinders shall be keyed by the owner.

E. LOCKING DEVICES

1. MORTISE LOCKSETS

- a. All locksets shall be ANSI 156.13 Series 1000, Grade 1 Certified. All functions shall be manufactured in a single sized case formed from 12 gauge steel minimum, or manufacturer's standard materials acceptable to Owner. The lockset shall have a field-adjustable, beveled armored front, with a .125" minimum thickness and shall be reversible without opening the lock body. The lockset shall be 2 3/4" backset with a one-piece 3/4" anti-friction stainless steel latchbolt. The deadbolt shall be a full 1" throw made of stainless steel and have 2 hardened steel roller inserts. All strikes shall be non-handed with a curved lip. To insure proper alignment, all trim, shall be thru-bolted and fully interchangeable between rose and escutcheon designs.
- b. Mortise locksets shall only be supplied when specifically requested. Contact Kirk Lukenbill or Curtis Leishman 435-797-0659 for details.
  - 1) Specified Manufacturer: Sargent 8200 Series
  - 2) Approved Substitutes: Schlage L Series

2. CYLINDRICAL LOCKSETS – HEAVY DUTY

- a. All locksets shall be ANSI 156.2 Series 4000, Grade 1 Certified. Furnish with standard 2 3/4" backset. Lock housing shall be fabricated of steel zinc dichromate and stainless steel, or manufacturer's standard materials acceptable to Owner. Latchbolt shall be brass or stainless steel with a minimum 1/2" throw. Locks shall be non-handed and fully field reversible.

- 1) Specified Manufacturer: Sargent 10 Line (LL)
- 2) Approved Substitutes: Schlage ND Series (RHO)

### 3. ELECTRIFIED LOCKSETS

- a. Mechanical features of locksets shall conform to standards as specified above. Locksets shall be fail-secure unless otherwise specified. Where specified electrified locksets shall be provided with a switch to monitor inside or outside lever handle or signal remote location. Provide an in-line power controller with all electrified locksets.

- 1) Specified Manufacturers: Sargent QC
- 2) Approved Manufacturers: Schlage

### 4. LOCKSET STRIKES

- a. Strikes shall be non-handed and available with curved lip, full lip or ASA type strikes as required. Provide strikes with lip-length required to accommodate jamb and/or trim detail and projection.

## F. ELECTRIC STRIKES

### 1. STANDARD STRIKES

- a. All standard electric strikes shall meet BHMA standard 501, grade 1 and be UL Listed for Burglary Resistance, category 1034. Strikes shall be all stainless steel construction for corrosion resistance, strength and durability. Strikes shall have been tested to withstand a forcing strength of a minimum 2400 lbs. before releasing and perform with a minimum of one million cycles of operation. Strikes shall be 24VDC fail-secure unless otherwise specified. Provide an in-line power controller with all electric strikes.

- 1) Specified Manufacturers: HES 1006 Series
- 2) Approved Substitutes: Folger Adam 712 Series

### 2. SURFACE MOUNTED STRIKES

- a. All surface mounted electric strikes shall meet BHMA standard 501, grade 1 and be UL Listed for Burglary Resistance, category 1034. Strikes shall have two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Optional latchbolt and latchbolt strike monitoring that indicates position of the latchbolt and locked condition of the strike shall be available. Strikes shall have been tested for a minimum of 500,000 operating cycles. Provide an in-line power controller with all electric strikes.

- 1) Specified Manufacturers: HES 9500 Genesis
- 2) Approved Substitutes: NONE

## G. ELECTROMAGNETIC LOCKS

### 1. MAGNALOCKS

- a. Magnalocks shall operate on 24VDC input and shall not consume more than three (3) watts of power (125mA @ 24VDC). The magnalock shall be capable of providing a pull-

apart or tensile holding force of at least 1200 pounds. The strike plate shall be mounted using a steel sex bolt and roll pin to provide a "floating" movement to assure automatic self-alignment with the lock. Anti-tamper caps shall be provided for the exposed holes. The lock and strike shall be plated to provide corrosion proofing. The lock shall be full sealed in resin to make it tamper and weather proof. The lock shall contain a suppression circuit to prevent residual magnetism and inductive kickback. The circuit also shall provide accelerated field collapse and radiation suppression. Ten feet of jacketed stranded conductor shall be provided for electrical connection.

- 1) Specified Manufacturers: Securitron Model 62
- 2) Approved Manufacturers: Folger Adams

## 2. SHEAR LOCKS

- a. Shear locks shall be produced by an ISO 9001 certified manufacturer. The lock shall be of the self-aligning magnetic shear type suitable for mortise mounting and shall not exceed 15 cubic inches. The lock shall be "dual voltage" accepting 12 or 24VDC without the alteration of any settings at the time of the installation. The power requirements of the lock shall not exceed four Watts (160mA @ 24VDC). The lock shall be self-contained with no external circuit board and will self align into the locked position when the door closes without the need for door position sensing or timers. The lock shall not be position sensitive; it may be mounted at the top or side of the door and will operate on single or double acting doors. The lock shall be fully sealed in resin to make it tamper proof.

- 1) Specified Manufacturer: Securitron SAM
- 2) Approved Substitutes: Folger Adams

## H. EXIT DEVICES

### 1. CONVENTIONAL DEVICES – PUSH RAIL

- a. All exit devices shall be ANSI A156.3, Grade 1 Certified and shall be listed by Underwriters Laboratories and bear the UL label for life safety in full compliance with NFPA 80 and NFPA 101. Mounting rails shall be formed from a solid single piece of stainless steel, brass or bronze no less than 0.072" thick, or manufacturers standard materials acceptable to Owner. Push rails shall be constructed of 0.062" thick material. Lever trim shall be available in finishes and designs to match that of the specified locksets.
- b. Where ever possible, on pairs of doors rim exit devices with removable mullions are to be used.
- c. When vertical rod exit devices must be used, use surface vertical rod devices less bottom rods, acceptable to Utah State Fire Marshal.

- 1) Specified Manufacturer: Von Duprin 99 Series (990 series)
- 2) Approved Substitutes: Sargent 80 Series (ETL)

### 2. ELECTRIFIED DEVICES

- a. Electrified exit devices shall conform to all traditional exit device standards as specified above. All power requirements for exit devices used must utilize a continuous circuit electric hinge for clean design and no visible means of interrupting power to device.
- b. Options for delayed egress exit devices to be specified in the hardware sets. Devices to conform to NFPA 101 - Special Locking Arrangements for delayed egress. Nuisance delay to be available as standard for either zero (0) or two (2) seconds. Internal latchbolt monitoring, and a standard 10-second delay for "Authorized Entry" to be standard features on every device. Delayed egress feature to be available throughout all styles and sizes of exit devices including: Panic and Fire rated Rim, Wide and Narrow Stile, Mortise, Surface Vertical Rod, and Concealed Vertical Rod.
- c. All exit devices, both fire labeled and non-labeled devices, requiring electric dogging shall be held in the "dogged" or retracted position. All exit devices with electric latch retraction shall provide for a remote means of unlocking for momentary or maintained periods of time.
- d. Exit devices with electrified trim shall be fail-secure unless otherwise specified.
- e. Where specified exit devices shall be provided with a switch to monitor push rail or signal remote location and latchbolt monitoring.
- f. Provide an in-line power controller with all electrified exit devices.
  - 1) Specified Manufacturers: Von Duprin
  - 2) Approved Manufacturers: Sargent

## I. DOOR CLOSERS

### 1. SURFACE MOUNTED CLOSERS – HEAVY DUTY

- a. All door closers shall be ANSI 156.4, Grade 1 Certified. Closers shall be furnished with parallel arms mounting on all doors opening into corridors or other public spaces and shall be mounted to permit 180 degrees door swing wherever wall conditions permit. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
  - 1) Specified Manufacturer: LCN 4040 Series
  - 2) Approved Substitutes: Dorma 8916 Series, Norton 7500 Series

### 2. HOLD OPEN CLOSERS

#### a. SINGLE-POINT HOLD OPEN

- 1) Closers to have adjustable hold-open range of 85 to 110 degrees. Mountings for regular and double egress arm applications to be supplied where necessary. When a detector is required, use integral photo-electric type with LED indicator. Voltage to be 24VDC unless otherwise specified.

- a) Specified Manufacturers: 4040 SE Sentronic
- b) Approved Manufacturers: Sargent EHT

b. MULTI-POINT HOLD OPEN

- 1) Closers to have multi position hold-open range of 10 to 170 degrees, with trim permitting. When called for swing free application to be supplied for pull side mounting. When detector is required, use integral photo electric type with LED indicator. Voltage to be 24VDC unless otherwise specified.

- a) Specified Manufacturers: 4040 SEL Sentronic
- b) Approved Manufacturers: Sargent EHT

3. AUTOMATIC DOOR OPERATORS – HEAVY DUTY

- a. All door closers shall be ANSI 156.19, Grade 1 Certified. Units shall have adjustments for door closing force and backcheck, motor assist from 0 to 30 seconds, motor start up delay, vestibule interface delay, electric lock delay, and door hold open delay up to 30 seconds. Operator units shall provide conventional door closer opening and closing forces unless the power operator motor is activated by an initiating device with door closer assembly having adjustable spring size, backcheck valve, sweep valve, latch valve, speed control valve, and pressure adjustment valve to control door closing. Operators shall have push and go function to activate power operator or power assist functions. Units shall have a presence detector input to prevent a closed door from opening or a door that is fully opened from closing and shall have a hold open toggle input to allow remote activation for indefinite hold open; door shall close the second time the input is activated. Operators shall have a SPDT relay for interfacing with latching or locking devices. All controlling operator switches shall be of radio-frequency design and not hard-wired.

- 1) Specified Manufacturer: Gyro Tech 710
- 2) Approved Substitutes: 4600 Series LCN

J. DOOR TRIM AND PROTECTIVE PLATES

- 1. Kick plates shall be .050 gauges and two (2) inches less full width of door, or as specified. Push plates, pull plates, door pulls and miscellaneous door trim shall be as shown in the hardware schedule.

- a. Specified Manufacturer: McKinney
- b. Approved Substitutes: Hager, Rockwood

K. DOOR STOPS AND HOLDERS

1. WALL MOUNTED DOOR STOPS

- a. Where a door is indicated on the plans to strike flush against a wall, wall bumpers shall be provided. Provide convex or concave design as indicated.

- 1) Specified Manufacturers: McKinney
- 2) Approved Substitutes: Hager, Rockwood

2. OVERHEAD STOPS/HOLDERS

- a. Where specified, overhead stops/holders as shown in the hardware sets are to be provided. Track, slide, arm and jamb bracket shall be constructed of extruded bronze and shock absorber spring shall be of heavy tempered steel. Overhead stops shall be of non-handed design.

- 1) Specified Manufacturers: Rixson 1/2/9/10 Series
- 2) Approved Substitutes: Sargent 690/1530/590/1540 Series

3. MAGNETIC HOLD-OPENS

- a. Magnetic door holders shall meet or exceed ANSI A156.15 and be UL listed 228 for Door Closer and Holders, with or without integral smoke detectors. Holding force shall be 25 to 40 pounds and shall be fail-safe. Pushpin release that eliminates residual magnetism shall be standard. Provide magnetic hold-opens with triple-voltage coil that can receive 12 VDC, 24 VAC/DC, or 120VAC; or coordinate required voltage with electrical.

- 1) Specified Manufacturers: Notifer
- 2) Approved Substitutes: None

L. GASKETING AND THRESHOLDS

1. Provide continuous weatherseal on exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide intumescent seals as required to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies. Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.
2. Provide threshold units not less than 4" wide, formed to accommodate change in floor elevation where indicated, fabricated to accommodate door hardware and to fit door frames. All threshold units shall comply with the Americans with Disabilities Act (ADA).

- a. Specified Manufacturers: McKinney
- b. Approved Substitutes: Pemko, Reese

M. SILENCERS

1. Furnish rubber door silencers all hollow metal frames; two (2) per pair and three (3) per single door frame.

N. ELECTRONIC PRODUCTS AND ACCESSORIES

1. INTEGRATED KEYPAD/PROXIMITY CARD PRODUCTS

- a. Provide access control products in type and functions as specified in the hardware groups with nonvolatile memory. Provide keypad operated products with a minimum of 100 user codes or 2,000 user codes as specified. Where specified provide keypad/proximity and proximity only products with a minimum of 2,000 user codes and the ability to audit the last 2,000 transactions. In addition to user codes, provide a Master Code as standard, the Master Code assigns emergency, supervisory, and user codes. Provide the ability to print the last fifteen entries via infrared printer.

- b. Wall mounted products shall be supplied for all openings as specified. Each unit shall use HID based proximity cards or fobs and/or a keypad and have the capabilities to integrate into facilities with existing HID based technology. Units shall have a main relay capable of switching up to 2 amps and a separate auxiliary 2 amp relay to signal alarm shunt, propped or forced door in conjunction with a door status switch or other means on door monitoring.
- c. Where specified, locksets and exit devices shall have the option to be remotely controlled via hand-held radio frequency (RF) transmitter, allowing lock/unlock capabilities from up to 75 feet away from the lock. Units shall have LEDs to indicate status – unlocked and programming mode.
  - 1) Specified Manufacturers: Sargent Profile Series
  - 2) Approved Manufacturers: Schlage

## 2. PROXIMITY READERS

- a. Proximity readers shall feature a beeper and multi-colored LED's and shall be capable of reading HID cards with formats up to 85 bits with a minimum of 137 billion codes. Readers shall be compatible with all standard access control systems. Readers shall be fully sealed for either indoor or outdoor installation.
  - 1) Specified Manufacturer: HID ProxPoint I Class
  - 2) Approved Substitutes: None

## 3. EXIT DELAY SYSTEMS

- a. All exit delay systems shall be fully integrated to include a minimum 1200 pound holding force magnetic lock. The module shall allow for up to 1 inch in movement before going into alarm. The required initiating device, logic timer and key reset shall be integrated into a single unit.
  - 1) Specified Manufacturer: Securitron IMXD
  - 2) Approved Substitutes: Folger Adams

## 4. KEYSWITCHES

- a. Keyswitches shall be furnished on a stainless steel single gang face plate with a 12/24VDC bi-color LED and an integral backing bracket that shall permit integration with any 1.25" or 1.125" mortise cylinder. Keyswitches shall be available for momentary or maintained action and in narrow stile designs.
  - 1) Specified Manufacturers: Securitron MK Series
  - 2) Approved Manufacturers: Folger Adams

## 5. MOTION SENSORS

- a. Motion sensors shall employ passive infrared detection to initiate door release. The device shall have an adjustable detector face to allow for precise pattern configurations and easy pattern adjustment. The device shall have a SPDT relay output for shunting the alarm or access control system and field effect transistor for direct

control of an electromagnetic lock. The relay shall operate 50 milliseconds before the transistor to suppress false alarms.

- 1) Specified Manufacturers: Securitron XMS
- 2) Approved Manufacturers: Folger Adams

#### 6. IN-LINE POWER CONTROLLER

- a. Where specified, electrified products shall be supplied with an in-line power controller that enables the hardware to operate from 12 to 32 volts. On board safety features shall include an in-line fuse to protect the hardware and host system from any possible reverse current surges. The controller shall regulate current to provide continuous duty operation without the typical heat build up.

- 1) Specified Manufacturers: HES 2005 Smart-Pac II
- 2) Approved Manufacturers: NONE

#### 7. POWER SUPPLIES

- a. Power supplies shall furnish regulated 24VDC and shall be UL class 2 listed. LED's shall monitor zone status (voltage/no voltage) and slide switches shall be provided to connect or disconnect the load from power; 1, 4 or 8 separate output circuit breakers shall be provided to divide the load. Power supplies shall have the internal capability of charging optional 24VDC sealed lead acid batteries in addition to operating the DC load. Power supplies shall be supplied complete requiring only 120VAC to the fused input and shall be supplied in an enclosure. Power supplies shall be provided with emergency release terminals that allow the release of all devices upon activation of the fire alarm system.

- 1) Specified Manufacturer: Securitron BPS
- 2) Approved Substitutes: Folger Adams

#### 2.03 FINISHES

- A. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 or traditional U.S. finishes shown by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

### PART III – EXECUTION

#### 3.01 EXAMINATION

- A. Contractor shall ensure that the building is secured and free from weather elements prior to installing interior door hardware. Examine hardware before installation to ensure it is free of defects.

### 3.02 INSTALLATION

- A. Mount hardware units at heights indicated in the following applicable publications, except as specifically indicated or required to comply with the governing regulations.
  - 1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute (DHI.)
  - 2. NWWDA Industry Standard I.S.1.7, "Hardware Locations for Wood Flush Doors."
- B. All hardware shall be applied and installed in accordance with best trade practice by an experienced hardware installer. Care shall be exercised not to mar or damage adjacent work.
- C. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.
- D. Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

### 3.03 FIELD QUALITY CONTROL

- A. The Contractor shall comply with AIA A201 1997 section 3.3.1 which reads as follows: "The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the contract Documents give other specific instructions concerning these matters."
- B. Prior to the installation of hardware, manufacturer's representatives for locksets, closers, and exit devices shall arrange and hold a jobsite meeting to instruct the installing contractor's personnel on the proper installation of their respective products. A letter of compliance, indicating when this meeting is held and who is in attendance, shall be sent to the Architect and Owner.
- C. The hardware supplier shall do a final inspection prior to building completion to ensure that all hardware was correctly installed and is in proper working order.
- D. The manufacturer's representative shall do a final inspection prior to building completion to ensure that all hardware was correctly installed and is in proper working order.

### 3.04 ADJUSTING, CLEANING, AND DEMONSTRATING

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
- B. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating

items as necessary to restore to proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

- C. Instruct owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes and usage of any electronic devices.

3.05 PROTECTION

- A. Contractor shall protect all hardware, as it is stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

3.06 HARDWARE SCHEDULE

- A. The following schedule is furnished for whatever assistance it may afford the Contractor; do not consider it as entirely inclusive. Should any particular door or item be omitted in any scheduled hardware heading, provide door or item with hardware same as required for similar purposes. Hardware supplier is responsible for handing and sizing all products as listed in the hardware heading. Quantities listed are for each pair of doors, or for each single door.

- B. Manufacturer's Abbreviations:

1. MC – McKinney
2. NO – Norton
3. RO – Rockwood
4. RX – Rixson
5. SA – Sargent
6. SN – Securitron

Heading 01

Doors: 144, 145, 157, 154, 155, 156, 139, 140, 141, 142, 143, 160CA, 205CA, 205CB, 205G, 205H, 205I, 205J, 205K, 205L, 205M, 205N, 213A, 213B, 213C, 305G, 305H, 305I, 305J, 305K, 305L, 305M, 305N, 305C.A, 305C.B, 108, 152B

3	Hinges	TA2714 4 1/2 X 4 1/2	26D	MC
1	Passage Set	8215 LL	26D	SA
1	Wall Bumper	409	US32D	RO
3	Door Silencers	608	GREY	RO

Heading 02

Doors: 100A.B

2	Hinges	T4A3386 4 1/2 X 4 1/2 NRP	32D	MC
1	Electric Hinge	T4A3386 4 1/2 X 4 1/2 QC MM NRP	32D	MC
1	Exit Device	11 12 55 56 8804 ETL	32D	SA
1	Closer	CLP-7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO

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1	Power Supply	BPS-24-2		SN
1	Raindrip	346C		PE
1	Smoke Seal	PK 55 D		PE
1	Door Bottom	315 CN		PE
1	Threshold	272 A		PE
1	Hardware	Card Reader By Others		

Heading 03

Doors: 146, 149, 103B, 205A, 217, 220E, 223E, 225E, 112A, 137, 160B.A, 305A, 315, 316

3	Hinges	TA2714 4 1/2 X 4 1/2	26D	MC
1	Classroom Lockset	11 63 8237 LL	26D	SA
1	Closer	PR7500 H	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
3	Door Silencers	608	GREY	RO

Heading 04

Doors: 101, 102.B, 109A.B, 109B.B, 110A.C, 110B, 110C.B, 110C.C, 110C.D, 133, 302

1	Hardware	Hardware By Door Manufacturer		
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Heading 05

Doors: 100A.A, 100Y.A, 100Q, 200A, 200C, 200K, 300A, 300L, 300Q

3	Hinges	T4A3386 4 1/2 X 4 1/2 NRP	32D	MC
1	Exit Device	11 12 8813 ETL	32D	SA
1	Closer	PR7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Smoke Seal	PK 55 D		PE

Heading 06

Doors: 109A.A, 109B.A

2	Hinges	T4A3386 4 1/2 X 4 1/2 NRP	32D	MC
1	Electric Hinge	T4A3386 4 1/2 X 4 1/2 QC MM NRP	32D	MC
1	Exit Device	11 55 56 63 8804 ETL	32D	SA
1	Closer	CLP-7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Power Supply	BPS-24-2		SN
1	Hardware	Card Reader By Others		
1	Raindrip	346 C 40"		PE
1	Smoke Seal	PK 55 D		PE
1	Door Bottom	315 CN		PE
1	Threshold	272 A		PE

Heading 07

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Doors: 102.A, 111, 153, 209, 308

3	Hinges	TA2714 4 1/2 X 4 1/2	26D	MC
1	Storeroom Lockset	11 63 8204 LL	26D	SA
1	Closer	7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Smoke Seal	PK 55 D		PE

Heading 08

Doors: 100C.A, 100C.B, 100R.B

3	Hinges	T4A3386 4 1/2 X 4 1/2 NRP	32D	MC
1	Exit Device	11 63 8813 ETL	32D	SA
1	Closer	PR7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Smoke Seal	PK 55 D		PE

Heading 09

Doors: 106.A, 106.B

1	Electric Hinge	TA2314 4 1/2 X 4 1/2 QC MM	26D	MC
3	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Exit Device	11 55 56 63 8804 ETL	32D	SA
1	Closer	7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Power Supply	BPS-24-2		SN
1	Hardware	Card Reader By Others		
3	Door Silencers	608	GREY	RO

Heading 10

Doors: 100Y.B

3	Hinges	T4A3386 4 1/2 X 4 1/2 NRP	32D	MC
1	Exit Device	11 63 8813 ETL	32D	SA
1	Closer	4642 REG	AL	LC
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
2	Escutcheon	8310-876		LC
2	Wall Actuator	8310-856		LC
1	Smoke Seal	PK 55 D		PE
1	Raindrip	346 C 40"		PE
1	Door Bottom	315 CN		PE
1	Threshold	272 A		PE

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Heading 11

Doors: 107, 118.B, 118A, 104A, 104B, 103A

3	Hinges	TA2714 4 1/2 X 4 1/2	26D	MC
1	Storeroom Lockset	11 63 8204 LL	26D	SA
1	Closer	7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Smoke Seal	PK 55 D		PE

Heading 12

Doors: 317.A, 317.B, 118.A, 134, 212, 312

1	Electric Hinge	TA2314 4 1/2 X 4 1/2 QC MM	26D	MC
3	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Electrified Lockset	11 63 8271 LL	26D	SA
1	Closer	7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Power Supply	BPS-24-2		SN
1	Hardware	Card Reader By Others		
1	Smoke Seal	PK 55 D		PE

Heading 13

Doors: 132, 326, 130A, 130B, 131, 110A.B, 218, 309

3	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Classroom Lockset	11 63 8237 LL	26D	SA
1	Closer	PR7500	689	NO
1	Protection Plate	K1050 36" X 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Smoke Seal	PK 55 D		PE

Heading 14

Doors: 120A, 120B.B, 112, 100M, 220B.A, 3001.A

1	Continuous Hinge	MCK-FM300 CC4 MB ES SS Bearings	32D	MC
1	Electrified Lockset	11 63 8271 LL	26D	SA
1	Closer	PR7500	689	NO
1	Protection Plate	K1050 36" X 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Power Supply	BPS-24-2		SN
1	Hardware	Card Reader By Others		
1	Smoke Seal	PK 55 D		PE
1	Door Bottom	315 CN		PE
1	Threshold	272 A		PE

Heading 15

Doors: 121, 122, 123, 124.A, 124.B, 125.A, 105, 117, 147, 204.A, 204.C, 204A, 204E, 204F, 204G, 204H, 204J, 204K, 204L, 204M.A, 204M.B, 204N, 204O, 220, 220A, 220B.B, 220C.A, 220C.B, 220D, 220F, 220G, 220H, 304.A, 304.C, 304A, 304B, 304E, 304F, 304G, 304H, 202, 318, 318A.A, 318A.B, 318B.B, 318C.A, 318C.B, 301

1	Continuous Hinge	MCK-FM300 MB SS Bearings	32D	MC
1	Classroom Lockset	11 63 8237 LL	26D	SA
1	Closer	PR7500	689	NO
1	Protection Plate	K1050 36" X 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Smoke Seal	PK 55 D		PE

Heading 16

Doors: 113, 114, 115, 116, 138, 221A, 221B, 221C, 223A, 223B, 223C, 223D, 223F, 223G, 223H, 223I, 225A, 225B, 225C, 225D, 225F, 225G, 225H, 225I, 321, 322, 333, 334, 319, 320, 335, 221, 222, 223, 224, 225

1	Continuous Hinge	MCK-FM300 MB SS Bearings	32D	MC
1	Classroom Lockset	11 63 8237 LL	26D	SA
1	Closer	7500 H DA	689	NO
1	Protection Plate	K1050 36" X 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Smoke Seal	PK 55 D		PE
1	Auto Door Bottom	4301 CNBL 48"		PE

Heading 17

Doors: 128, 129, 135, 136, 159A, 159B, 210, 211, 214.A, 214.B, 310, 311, 215.A, 215.B, 214.C, 215.C

3	Hinges	T4A3386 4 1/2 X 4 1/2	32D	MC
1	Passage Set	8215 LL	26D	SA
1	Closer	PR7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Smoke Seal	PK 55 D		PE

Heading 18

Doors: 158, 158A

3	Hinges	T4A3386 4 1/2 X 4 1/2	32D	MC
1	Exit Device	11 63 8813 ETL	32D	SA
1	Closer	PR7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Smoke Seal	PK 55 D		PE

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Heading 19

Doors: 160D.A, 148, 313, 314

3	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Privacy Set	49 8265 LL	26D	SA
1	Closer	7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Smoke Seal	PK 55 D		PE

Heading 20

Doors: 304M, 304N, 304O, 304J, 304K, 304L, 160A, 160B

1	Continuous Hinge	MCK-FM300 MB SS Bearings	32D	MC
1	Classroom Lockset	11 63 8237 LL	26D	SA
1	Closer	PR7500 H	689	NO
1	Protection Plate	K1050 36" X 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Smoke Seal	PK 55 D		PE

Heading 21

Doors: 318B

1	Continuous Hinge	MCK-FM300 CC4 MB ES SS Bearings	32D	MC
1	Electrified Lockset	11 63 8271 LL	26D	SA
1	Closer	PR7500	689	NO
1	Protection Plate	K1050 36" X 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Power Supply	BPS-24-2		SN
1	Smoke Seal	PK 55 D		PE
1	Hardware	Bioreader By Others		B/O

Heading 22

Doors: 401.A, 401.B, 401.C

3	Hinges	TA2314 4 1/2 X 4 1/2 NRP	32D	MC
1	Storeroom Lockset	11 63 8204 LL	26D	SA
1	Closer	CLP-7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Smoke Seal	PK 55 D		PE
1	Door Bottom	315 CN		PE
1	Threshold	272 A		PE

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Heading 23

Doors: 401.D, 200D.A, 200D.B, 200Q.C, 300D.A, 300D.B, 300K

6	Hinges	TA2314 4 1/2 X 4 1/2 NRP	32D	MC
2	Flush Bolts	555	US26D	RO
1	Storeroom Lockset	11 63 8204 LL	26D	SA
2	Closer	CLP-7500	689	NO
2	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Dust Proof Strike	570	US26D	RO
1	Astragal	357 SP		PE
1	Smoke Seal	PK 55 D		PE
2	Door Bottom	315 CN		PE
1	Threshold	272 A		PE

Heading 24

Doors: 205F.A, 205F.B, 305F.A, 305F.B

1	Flush Pull Set	94L X 94P	US32D	RO
1	Side Wall Track Set	280SWT		PE

Heading 25

Doors: 104C

3	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Lockset	11 63 74 (CASE) 8204 LL	26D	SA
1	Closer	PR7500 LL METAL COV	689	NO
1	Protection Plate	K1050 36" X 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Smoke Seal	PK 55 D		PE

Heading 26

Doors: 110A.A

1	Electric Hinge	TA2314 4 1/2 X 4 1/2 QC MM	26D	MC
2	Hinges	TA2314 4 1/2 X 4 1/2 NRP	32D	MC
1	Electrified Lockset	11 63 8271 LL	26D	SA
1	Closer	PR7500	689	NO
1	Protection Plate	K1050 36" X 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Power Supply	BPS-24-2		SN
1	Hardware	Card Reader By Others		
1	Smoke Seal	PK 55 D		PE

Heading 27

Doors: 100AA.A, 100BB.A

1	Continuous Hinge	MCK-FM300 CC4 MB ES SS Bearings	32D	MC
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1	Continuous Hinge	MCK-FM300 MB SS Bearings	32D	MC
1	Removable Mullion	11 63 L980A	28	SA
1	Exit Device	11 63 55 56 8504 862	32D	SA
2	Exit Device	8510 852	32D	SA
1	Closer	CLP-7500	689	NO
1	Closer	4642 REG	AL	LC
2	Wall Actuator	8310-852		LC
2	Escutcheon	8310-876		LC
1	Power Supply	BPS-24-2		SN
1	Hardware	Card Reader By Others		
1	Hardware	Hardware By Door Manufacturer		B/O

Heading 28

Doors: 100AA.B, 100BB.B, 100J.A

2	Continuous Hinge	MCK-FM300 MB SS Bearings	32D	MC
2	Inactive Push Bar	8893	32D	SA
2	Exit Device Trim	862	32D	SA
1	Closer	CLP-7500	689	NO
1	Closer	4642 REG	AL	LC
2	Wall Bumper	409	US32D	RO
1	Escutcheon	8310-876		LC
1	Wall Actuator	8310-856		LC
1	Hardware	Hardware By Door Manufacturer		B/O

Heading 29

Doors: 100J.B

1	Continuous Hinge	MCK-FM300 CC4 MB ES SS Bearings	32D	MC
1	Continuous Hinge	MCK-FM300 MB SS Bearings	32D	MC
1	Removable Mullion	11 63 L980A	28	SA
1	Exit Device	8510 852	32D	SA
1	Exit Device	11 63 55 56 8504 862	32D	SA
2	Closer	CLP-7500	689	NO
1	Power Supply	BPS-24-2		SN
1	Hardware	BioReader By Others		

Heading 30

Doors: 100P

1	Continuous Hinge	MCK-FM300 MB SS Bearings	32D	MC
1	Continuous Hinge	MCK-FM300 CC4 MB ES SS Bearings	32D	MC
1	Removable Mullion	11 63 L980A	28	SA
1	Exit Device	8810	32D	SA
1	Exit Device	11 55 56 63 8813 ETL	32D	SA
2	Closer	PR7500	689	NO
2	Protection Plate	K1050 10 x 2" LDW	US32D	RO
2	Wall Bumper	409	US32D	RO
1	Power Supply	BPS-24-2		SN

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1 Hardware Card Reader By Others

Heading 31

Doors: 100F, 100L, 100K.A, 100K.B, 100Z.A, 100Z.B, 200I.B, 200J, 300I.B

2	Continuous Hinge	MCK-FM300 MB SS Bearings	32D	MC
2	Inactive Push Bar	8893	32D	SA
2	Exit Device Trim	862	32D	SA
2	Magnetic Holder	998	689	RX
2	Closer	PR7500	689	NO
2	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Smoke Seal	PK 55 D		PE

Heading 32

Doors: 100R.A

3	Hinges	T4A3386 4 1/2 X 4 1/2 NRP	32D	MC
1	Exit Device	8810	32D	SA
1	Closer	CLP-7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Raindrip	346 C 40"		PE
1	Smoke Seal	PK 55 D		PE
1	Door Bottom	315 CN		PE
1	Threshold	272 A		PE

Heading 33

Doors: 100T.A

1	Continuous Hinge	MCK-FM300 MB SS Bearings	32D	MC
1	Inactive Push Bar	8893	32D	SA
1	Exit Device Trim	862	32D	SA
1	Closer	4642 REG	AL	LC
1	Escutcheon	8310-876		LC
1	Wall Actuator	8310-856		LC

Heading 34

Doors: 100T.B, 100U.A, 100U.B, 127

2	Continuous Hinge	MCK-FM300 MB SS Bearings	32D	MC
2	Inactive Push Bar	8893	32D	SA
2	Exit Device Trim	862	32D	SA
1	Auto Operator	9760		LCN
2	Protection Plate	K1050 36" X 2" LDW	US32D	RO
2	Smoke Seal	PK 55 D		PE

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Heading 35

Doors: 150, 151

1	Continuous Hinge	MCK-FM300 MB SS Bearings	32D	MC
1	Deadlock	MS1850S	628	AD
1	Inactive Push Bar	8893	32D	SA
1	Exit Device Trim	862	32D	SA
2	Mortise Cylinder	11 63 41	26D	SA
1	Closer	PR7500	689	NO
1	Hardware	Hardware By Door Manufacturer		B/O

Heading 36

Doors: 205B.A, 205B.B, 205E, 305B.A, 305B.B, 305E

3	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Classroom Lockset	11 63 8237 LL	26D	SA
1	Closer	PR7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Smoke Seal	PK 55 D		PE

Heading 37

Doors: 205D, 305D, 213

3	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Office Lockset	11 63 8205 LL	26D	SA
1	Closer	7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
3	Door Silencers	608	GREY	RO

Heading 38

Doors: 306.A, 306.B, 206.A

3	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Passage Set	8215 LL	26D	SA
1	Closer	PR7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
3	Door Silencers	608	GREY	RO

Heading 39

Doors: 318B.A, 2001.A, 3000

1	Continuous Hinge	MCK-FM300 MB SS Bearings	32D	MC
1	Electrified Lockset	11 63 8271 LL	26D	SA
1	Closer	PR7500	689	NO

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1	Protection Plate	K1050 36" X 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Hardware	Bioreader By Others		

Heading 40

Doors: 204B, 201, 203, 204D, 204.B, 303, 304.B, 304.D

2	Continuous Hinge	MCK-FM300 MB SS Bearings	32D	MC
2	Flush Bolts	555	US26D	RO
1	Classroom Lockset	11 63 8237 LL	26D	SA
2	Closer	PR7500	689	NO
2	Protection Plate	K1050 36" X 2" LDW	US32D	RO
2	Wall Bumper	409	US32D	RO
1	Dust Proof Strike	570	US26D	RO
1	Smoke Seal	PK 55 D		PE
1	Astragal	357 SP		PE

Heading 41

Doors: 300S.A, 300N.A, 200Q.A

1	Continuous Hinge	MCK-FM300 CC4 MB ES SS Bearings	32D	MC
1	Electrified Lockset	11 63 8271 LL	26D	SA
1	Mortise Cylinder	11 63 41	26D	SA
1	Magnalock	M82B	US32D	SN
1	Closer	PR7500	689	NO
1	Protection Plate	K1050 10 x 2" LDW	US32D	RO
1	Wall Bumper	409	US32D	RO
1	Power Supply	BPS-24-2		SN
1	Mortise Keyswitch	MK	US32D	SN
1	Hardware	Card Reader By Others		
1	Smoke Seal	PK 55 D		PE

Note: CARD READER INITIATES ENTRY FROM THE ENTRY POINT. UPON OPENING THE DOOR THE ES SWITCH IN THE HINGE SENSES THAT THE DOOR IS OPEN. THIS ENERGIZES THE MAGNETIC LOCK ON THE OPPOSITE END OF THE AIR LOCK CORRIDOR AND WILL NOT ALLOW THE DOOR TO BE OPENED UNTIL THE SWITCH SENSES THE ENTRY DOOR IS CLOSES. THE OTHER END OF THE AIR LOCK IS NOT LOCKED. THAT DOOR HAS A SWITCH IN THE HINGE AND WILL WORK LIKE THE CARD READER DOOR. KEY SWITCH CAN BE THROWN TO DEACTIVATE IN CASE OF EMERGENCY.

Heading 42

Doors: 300S.B, 300N.B, 200Q.B

1	Continuous Hinge	MCK-FM300 CC4 MB ES SS Bearings	32D	MC
1	Passage Set	8215 LL	26D	SA
1	Mortise Cylinder	11 63 41	26D	SA
1	Magnalock	M82B	US32D	SN
1	Closer	PR7500	689	NO
1	Wall Bumper	409	US32D	RO

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1 Mortise Keyswitch  
1 Power Supply

MK  
BPS-24-2

US32D SN  
SN

END OF SECTION 087100

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SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Glazed curtain walls.
4. Storefront framing.
5. Glazed entrances.
6. Interior borrowed lites.

- B. Related Sections:

1. Division 05 Section "Decorative Metal Railings" for glass panels in railings.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

- B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
    - a. Basic Wind Speed: 90 mph (40 m/s).
    - b. Importance Factor: II.
    - c. Exposure Category: C.
  2. Design Snow Loads: As indicated on Drawings.
  3. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
  4. Glass Type Factors for Wired, Patterned, and Sandblasted Glass:
    - a. Short-Duration Glass Type Factor for Wired Glass: 0.5.
    - b. Long-Duration Glass Type Factor for Wired Glass: 0.3.
    - c. Short-Duration Glass Type Factor for Patterned Glass: 1.0.
    - d. Long-Duration Glass Type Factor for Patterned Glass: 0.6.
    - e. Short-Duration Glass Type Factor for Sandblasted Glass: 0.5.
  5. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
  6. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
  7. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

#### 1.5 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. LEED Submittals:
1. Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including printed statement of VOC content.
- C. Glass Samples: For each type of the following products, where indicated; 12 inches (300 mm) square.
1. Tinted glass.
  2. Coated glass.

3. Wired glass.
  4. Fire-resistive glazing products.
  5. Insulating glass.
- D. Glazing Accessory Samples: For gaskets, sealants and colored spacers, in 12-inch (300-mm) lengths.
- E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- G. Qualification Data: For installers.
- H. Product Certificates: For glass and glazing products, from manufacturer.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for tinted glass, coated glass, insulating glass, glazing sealants and glazing gaskets.
1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- J. Preconstruction adhesion and compatibility test report.
- K. Warranties: Sample of special warranties.
- 1.6 QUALITY ASSURANCE
- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- E. Source Limitations for Glass: Obtain ultraclear float glass, tinted float glass, coated float glass, insulating glass from single source from single manufacturer for each glass type.
- F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

I. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.

J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

K. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install glazing in mockups specified in Division 08 Section "Aluminum-Framed Entrances and Storefronts, Glazed Aluminum Curtain Walls" to match glazing systems required for Project, including glazing methods.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

L. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

2. Review temporary protection requirements for glazing during and after installation.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

## 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

## 1.9 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
1. Warranty Period: 10 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
  2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes enhanced-protection testing requirements in ASTM E 1996 for Wind Zone 3 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.
1. Large-Missile Test: For all glazing, regardless of height above grade.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
  2. For laminated-glass lites, properties are based on products of construction indicated.
  3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
  5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91 percent.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. AFG Industries, Inc.; Krystal Klear.
    - b. Guardian Industries Corp.; Ultrawhite.
    - c. Pilkington North America; Optiwhite.
    - d. PPG Industries, Inc.; Starphire.
- C. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
  2. For uncoated glass, comply with requirements for Condition A.
  3. For coated vision glass, comply with requirements for Condition C (other coated glass).
- D. Reflective-Coated Vision Glass: ASTM C 1376, coated by pyrolytic process, or vacuum deposition (sputter-coating) process, and complying with other requirements specified.
1. Basis-of-Design Product: Subject to compliance with requirements, provide PPG, Solarban 80, or comparable product by one of the following:
    - a. AFG Industries, Inc.
    - b. Guardian Industries Corp.
    - c. Pilkington North America.
  2. Kind: Kind CV (coated vision glass), except that Kind CO (coated overhead glass) may be used where the lower edge of the glass is more than 6 feet (1.8 m) above the adjacent floor level or cannot be approached closer than 10 feet (3.0 m).
  3. Coating Color: Pewter.
  4. Glass: Tinted float.
  5. Tint Color: Gray.
  6. Visible Light Transmittance: 47 percent minimum.
  7. Self-Cleaning, Low-Maintenance Coating: Pyrolytic coating on first surface.
- E. Reflective-Coated Spandrel Glass: ASTM C 1376, Kind CS; coated by **(pyrolytic process) (vacuum deposition (sputter-coating) process)**, and complying with other requirements specified.
1. Products: Subject to compliance with requirements, **(provide the following) (provide one of the following) (available products that may be incorporated into the Work include, but are not limited to, the following):**
    - a. **<Insert, in separate subparagraphs, manufacturer's name; product name or designation>.**
  2. Basis-of-Design Product: Subject to compliance with requirements, provide **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
    - a. **<Insert, in separate subparagraphs, manufacturer's name>.**
  3. Coating Color: **(Gold) (Pewter) (Silver) <Insert color>.**
  4. Glass: **(Clear float) (Ultraclear float) (Tinted float).**
  5. Tint Color: **(Blue) (Blue-green) (Bronze) (Green) (Gray) <Insert color>.**

## 2.3 INSULATING GLASS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide PPG, Solarban 80, or comparable product by one of the following:
- a. AFG Industries, Inc.
  - b. Guardian Industries Corp.
  - c. Pilkington North America.
- B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
  2. Spacer: Manufacturer's standard spacer material and construction.
  3. Desiccant: Molecular sieve or silica gel, or blend of both.
- C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article and in "Insulating-Laminated-Glass Types" Article.

## 2.4 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
1. Neoprene complying with ASTM C 864.
  2. EPDM complying with ASTM C 864.
  3. Silicone complying with ASTM C 1115.
  4. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone, or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.
- C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

## 2.5 GLAZING SEALANTS

- A. General:
1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service

- and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
  4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Dow Corning Corporation; 790.
  - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
  - c. May National Associates, Inc.; Bondaflex Sil 290.
  - d. Pecora Corporation; 890.
  - e. Sika Corporation, Construction Products Division; SikaSil-C990.
  - f. Tremco Incorporated; Spectrem 1.

C. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

## 2.6 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

## 2.8 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

## 2.9 MONOLITHIC-GLASS TYPES

- A. Glass Type: Clear heat-strengthened float glass, and fully tempered float glass, where indicated.
  - 1. Thickness: 6.0 mm.
  - 2. Provide safety glazing labeling.
- B. Glass Type: Ultraclear heat-strengthened float glass, and fully tempered float glass, where indicated.

1. Thickness: 6.0 mm.
2. Provide safety glazing labeling.

C. Glass Type: Polished wired glass.

1. Thickness: 6.0 mm.

D. Glass Type: Reflective-coated vision glass, heat-strengthened float glass, and fully tempered float glass, where indicated.

1. Thickness: 6.0 mm.
2. Coating Location: Second surface.
3. Winter Nighttime U-Factor: 0.29 maximum.
4. Summer Daytime U-Factor: 0.27 maximum.
5. Solar Heat Gain Coefficient: 0.24 maximum.
6. Provide safety glazing labeling.

E. Glass Type: Reflective-coated spandrel glass, fully tempered float glass.

1. Thickness: 6.0 mm.
2. Coating Location: Second surface.
3. Winter Nighttime U-Factor: <Insert value> maximum.
4. Summer Daytime U-Factor: <Insert value> maximum.
5. Fallout Resistance: Passes fallout-resistance test in ASTM C 1048 for an assembly of glass and adhered reinforcing material.
6. Factory apply manufacturer's standard opacifier of the following material to coated second surface of lites, with resulting products complying with Specification No. 89-1-6 in GANA's Tempering Division's "Engineering Standards Manual":
  - a. Manufacturer's standard opacifier material.
  - b. Polyester film laminated to glass with solvent-based adhesive.

## 2.10 LAMINATED-GLASS TYPES

A. Glass Type: Clear laminated glass with two plies of ultraclear fully tempered float glass.

1. Thickness of Each Glass Ply: 3.0 mm.
2. Interlayer Thickness: 0.060 inch (1.52 mm).
3. Provide safety glazing labeling.

## 2.11 INSULATING-GLASS TYPES

1. Provide safety glazing labeling.

B. Glass Type: Low-e-coated, tinted insulating glass.

1. Overall Unit Thickness: 1 inch (25 mm).
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Tinted heat-strengthened float glass, or fully tempered float glass, where indicated.

4. Interspace Content: Air.
  5. Indoor Lite: Clear heat-strengthened float glass, or fully tempered float glass, where indicated.
  6. Low-E Coating: Pyrolytic or sputtered on third surface.
  7. Visible Light Transmittance: 47 percent minimum.
  8. Winter Nighttime U-Factor: 0.29 maximum.
  9. Summer Daytime U-Factor: 0.27 maximum.
  10. Solar Heat Gain Coefficient: 0.24 maximum.
  11. Provide safety glazing labeling.
- C. Glass Type: Reflective-coated, insulating spandrel glass.
1. Overall Unit Thickness: 1 inch (25 mm).
  2. Thickness of Each Glass Lite: 6.0 mm.
  3. Outdoor Lite: Fully tempered float glass.
  4. Interspace Content: Air.
  5. Indoor Lite: Fully tempered float glass.
  6. Coating Location: Fourth surface.
  7. Winter Nighttime U-Factor: <Insert value> maximum.
  8. Summer Daytime U-Factor: <Insert value> maximum.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  2. Presence and functioning of weep systems.
  3. Minimum required face and edge clearances.
  4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

### 3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.8 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000



SECTION 092116 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes gypsum board shaft-wall assemblies for the following:
  - 1. Shaft-wall enclosures.
  - 2. Chase enclosures.
  - 3. Stair enclosures.
  - 4. Horizontal enclosures.
- B. Related Sections include the following:
  - 1. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall assemblies that incorporate gypsum board shaft-wall assemblies.

1.3 SUBMITTALS

- A. Product Data: For each gypsum board shaft-wall assembly indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
  - 2. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.

1.4 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Provide materials and construction identical to those of assemblies with fire-resistance ratings determined according to ASTM E 119 by a testing and inspecting agency.

- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures for installing gypsum board shaft-wall assemblies including, but not limited to, the following:
  - 1. Fasteners proposed for anchoring nonstructural steel framing to building structure.
  - 2. Sprayed fire-resistive materials applied to structural steel framing.
  - 3. Elevator equipment, including hoistway doors, elevator call buttons, and elevator floor indicators.
  - 4. Wiring devices in shaft-wall assemblies.
  - 5. Doors and other items penetrating shaft-wall assemblies.
  - 6. Items supported by shaft-wall-assembly framing.
  - 7. Mechanical work enclosed within shaft-wall assemblies.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.
- C. Stack panels flat on leveled supports off floor or slab to prevent sagging.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or plotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Gypsum Company.
  2. BPB America Inc.
  3. G-P Gypsum.
  4. Lafarge North America Inc.
  5. National Gypsum Company.
  6. PABCO Gypsum.
  7. Temple-Inland Forest Products Corporation.
  8. USG Corporation.

### 2.2 GYPSUM BOARD SHAFT-WALL ASSEMBLIES, GENERAL

- A. Provide materials and components complying with requirements of fire-resistance-rated assemblies indicated.
1. Provide panels in maximum lengths available to eliminate or minimize end-to-end butt joints.
  2. Provide auxiliary materials complying with gypsum board shaft-wall assembly manufacturer's written recommendations.

### 2.3 PANEL PRODUCTS

- A. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
- B. Gypsum Liner Panels: Comply with ASTM C 442/C 442M.
1. Type X: Manufacturer's proprietary liner panels with moisture-resistant paper faces.
    - a. Core: 1 inch (25.4 mm) thick.
    - b. Long Edges: Double bevel.
- C. Gypsum Board: As specified in Division 09 Section "Gypsum Board."

### 2.4 NON-LOAD-BEARING STEEL FRAMING

- A. Framing Members: Comply with ASTM C 754 for conditions indicated.
- B. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.

1. Recycled Content: Provide steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
2. Protective Coating: ASTM A 653/A 653M, G60 (Z180, hot-dip galvanized, unless otherwise indicated).

## 2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced product standards and manufacturer's written recommendations.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes specified in Division 09 Section "Gypsum Board" that comply with gypsum board shaft-wall assembly manufacturer's written recommendations for application indicated.
- C. Gypsum Board Joint-Treatment Materials: As specified in Division 09 Section "Gypsum Board."
- D. Laminating Adhesive: Adhesive or joint compound recommended by manufacturer for directly adhering gypsum face-layer panels to backing-layer panels in multilayer construction.
  1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
  1. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- F. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
  1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
  2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- G. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing), produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

2. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.

H. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."

1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.6 GYPSUM BOARD SHAFT-WALL ASSEMBLIES

- A. Basis-of-Design Product: As indicated on Drawings by design designation of a qualified testing agency.
- B. Fire-Resistance Rating: 1 hour.
- C. STC Rating: 51, minimum.
- D. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
  1. Depth: As indicated.
  2. Minimum Base-Metal Thickness: 0.0220 inch (0.55 mm).
- E. Runner Tracks: Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches (51 mm) long and in depth matching studs.
  1. Minimum Base-Metal Thickness: Matching steel studs.
- F. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
  1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dietrich Metal Framing; The System by Metal-Lite, Inc.
    - b. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
- G. Jamb Struts: Manufacturer's standard J-profile strut with long-leg length of 3 inches (76 mm), in depth matching studs, and not less than 0.0329 inch (0.84 mm) thick.
- H. Room-Side Finish: Gypsum board.
- I. Shaft-Side Finish: As indicated by fire-resistance-rated assembly design designation.
- J. Insulation: Sound attenuation blankets.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates to which gypsum board shaft-wall assemblies attach or abut, with installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft-wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft-wall assemblies to comply with requirements specified in Division 07 Section "Applied Fireproofing."
  - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runner tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft-wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

### 3.3 INSTALLATION

- A. General: Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:
  - 1. ASTM C 754 for installing steel framing except comply with framing spacing indicated.
  - 2. Division 09 Section "Gypsum Board" for applying and finishing panels.
- B. Do not bridge architectural or building expansion joints with shaft-wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.

1. At elevator hoistway entrance door frames, provide jamb struts on each side of door frame.
  2. Where handrails directly attach to gypsum board shaft-wall assemblies, provide galvanized steel reinforcing strip with 0.0312-inch (0.79-mm) minimum thickness of base (uncoated) metal, accurately positioned and secured behind at least 1 gypsum board face-layer panel.
- D. Integrate stair hanger rods with gypsum board shaft-wall assemblies by locating cavity of assemblies where required to enclose rods.
- E. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- F. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- G. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- H. Control Joints: Install control joints at locations indicated on Drawings or according to ASTM C 840 and in specific locations approved by Architect, while maintaining fire-resistance rating of gypsum board shaft-wall assemblies.
- I. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with ASTM C 919 requirements or with manufacturer's written instructions, whichever are more stringent.
- J. In elevator shafts where gypsum board shaft-wall assemblies cannot be positioned within 4 inches (102 mm) of the shaft face of structural beams, floor edges, and similar projections into shaft, install 1/2- or 5/8-inch- (13- or 16-mm-) thick, gypsum board cants covering tops of projections. No recesses allowed (at steel beams especially).
1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches (610 mm) o.c. with screws fastened to shaft-wall framing.
  2. Where steel framing is required to support gypsum board cants, install framing at 24 inches (610 mm) o.c. and extend studs from the projection to shaft-wall framing.
- K. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3mm) from the plane formed by faces of adjacent framing.

### 3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

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- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092116

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes non-load-bearing steel framing members for the following applications:
1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
  2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).
- B. Related Sections include the following:
1. Division 05 Section "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.
  2. Division 07 Section "Thermal Insulation" for insulation installed with Z-shaped furring members.
  3. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall joint systems installed with non-load-bearing steel framing.
  4. Division 09 Section "Gypsum Plastering" for metal lath supported by non-load-bearing steel framing.
  5. Division 09 Section "Portland Cement Plastering" for metal lath supported by non-load-bearing steel framing.
  6. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for non-load-bearing metal shaft-wall framing, gypsum panels, and other components of shaft-wall assemblies.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittal:
1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    - a. Include statement indicating costs for each product having recycled content.

#### 1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

### PART 2 - PRODUCTS

#### 2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

- A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
  - 2. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized, unless otherwise indicated.

#### 2.2 SUSPENSION SYSTEM COMPONENTS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
  - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
    - a. Type: Postinstalled, chemical anchor.
  - 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.

- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2-inch- (12.7-mm-) wide flanges.
1. Depth: 2-1/2 inches (64 mm).
- E. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges, 3/4 inch (19.1 mm) deep.
  2. Steel Studs: ASTM C 645.
    - a. Minimum Base-Metal Thickness: 0.0312 inch (0.79 mm).
    - b. Depth: As indicated on Drawings.
  3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.
    - a. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
  4. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.
    - a. Configuration: Asymmetrical or hat shaped.
- F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
    - b. Chicago Metallic Corporation; 640-C Drywall Furring System.
    - c. USG Corporation; Drywall Suspension System.

### 2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
1. Minimum Base-Metal Thickness: As indicated on Drawings.
  2. Depth: 3-5/8 inches (92.1 mm) and 6 inches (152.4 mm).
- B. Slip-Type Head Joints: Where indicated, provide one of the following as indicated or required:
1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
  2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
  - a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - b. Products: Subject to compliance with requirements, provide one of the following:
    - 1) Steel Network Inc. (The); VertiClip SLD Series.
    - 2) Superior Metal Trim; Superior Flex Track System (SFT).
    - 3) Approved Equal.
- C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
  1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
    - b. Metal-Lite, Inc.; The System.
    - c. Approved Equal.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  1. Minimum Base-Metal Thickness: 0.027 inch (0.7 mm).
- E. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.
  1. Depth: 1-1/2 inches (38.1 mm).
  2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  1. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
  2. Depth: 7/8 inch (22.2 mm).
- G. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.
  1. Configuration: Asymmetrical or hat shaped.
- H. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.

1. Depth: 3/4 inch (19.1 mm).
  2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch (0.79 mm).
  3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.
- I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare-metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.

## 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive

- materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (600 mm) o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
  1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
  2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
  3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
  4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.4 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
  1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support

standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

- a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  5. Do not attach hangers to steel roof deck.
  6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
- ### 3.5 INSTALLING FRAMED ASSEMBLIES
- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
  - B. Install studs so flanges within framing system point in same direction.
    1. Space studs as follows:
      - a. Single-Layer Application: 16 inches (406 mm) o.c., unless otherwise indicated.
      - b. Multilayer Application: 16 inches (406 mm) o.c., unless otherwise indicated.
      - c. Tile backing panels: 16 inches (406 mm) o.c., unless otherwise indicated.
  - C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb, unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
  6. Curved Partitions:
    - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches (150 mm) o.c.
- D. Direct Furring:
1. Screw to wood framing.
  2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- E. Z-Furring Members:
1. Erect insulation (specified in Division 07 Section "Thermal Insulation") vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.
  2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (600 mm) o.c.
  3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.

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- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

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END OF SECTION 092216



## SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:

- 1. Interior gypsum board.
- 2. Exterior gypsum board for ceilings and soffits.
- 3. Tile backing panels.

- B. Related Sections include the following:

- 1. Division 05 Section "Cold-Formed Metal Framing" for load-bearing steel framing that supports gypsum board.
- 2. Division 06 Section "Rough Carpentry" for wood framing and furring that supports gypsum board.
- 3. Division 06 Section "Sheathing" for gypsum sheathing.
- 4. Division 07 Section "Thermal Insulation" for insulation and vapor retarders installed in assemblies that incorporate gypsum board.
- 5. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall assemblies that incorporate gypsum board.
- 6. Division 09 Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board.
- 7. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
- 8. Division 09 Section "Tiling" for cementitious backer units installed as substrates for ceramic tile.
- 9. Division 09 painting Sections for primers applied to gypsum board surfaces.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For the following products:
  - 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
- C. LEED Submittals:

1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
  - a. Include statement indicating costs for each product having recycled content.
2. Product Data for Credit EQ 4.1: For adhesives used to laminate gypsum board panels to substrates, including printed statement of VOC content.

#### 1.4 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Install mockups for the following:
    - a. Each level of gypsum board finish indicated for use in exposed locations.
    - b. Each texture finish indicated.
  2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
  3. Simulate finished lighting conditions for review of mockups.
  4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.5 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.

- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 PANELS, GENERAL

- A. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
- B. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

### 2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum Co.
    - b. BPB America Inc.
    - c. G-P Gypsum.
    - d. Lafarge North America Inc.
    - e. National Gypsum Company.
    - f. PABCO Gypsum.
    - g. Temple.
    - h. USG Corporation.
- B. Type X:
  - 1. Thickness: 5/8 inch (15.9 mm).
  - 2. Long Edges: **(Tapered) (Tapered and featured (rounded or beveled) for prefilling)**.
- C. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.
  - 1. Thickness: 1/2 inch (12.7 mm).

2. Long Edges: Tapered.
- D. Abuse-Resistant Type, where indicated: Manufactured to produce greater resistance to surface indentation, through-penetration (impact resistance), and abrasion than standard, regular-type and Type X gypsum board.
1. Core: 5/8 inch (15.9 mm), Type X.
  2. Long Edges: Tapered.
- E. High-Impact Type, where indicated: Manufactured with Type X core, plastic film laminated to back side for greater resistance to through-penetration (impact resistance).
1. Core: 5/8 inch (15.9 mm) thick.
  2. Plastic-Film Thickness: 0.020 inch (0.508 mm).
- F. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
1. Core: 5/8 inch (15.9 mm), Type X.
  2. Long Edges: Tapered.

## 2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
  2. Shapes, as indicated or required:
    - a. Cornerbead.
    - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - c. L-Bead: L-shaped; exposed long flange receives joint compound.
    - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - e. Expansion (control) joint.

## 2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
1. Interior Gypsum Wallboard: Paper.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, beveled panel edges, and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
  - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

## 2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
  1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
  1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
  2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
  2. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
- E. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."
  1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."
- G. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members, or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Type X: As indicated on Drawings.
  - 2. Ceiling Type: Ceiling surfaces, unless otherwise indicated.
  - 3. Abuse-Resistant Type: As indicated on Drawings.
  - 4. High-Impact Type: As indicated on Drawings.
  - 5. Moisture- and Mold-Resistant Type: As indicated on Drawings.
- B. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
  - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), or horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
  - 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
  - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
  - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing

- member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
  3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
  4. Fastening Methods: Fasten base layers and face layers separately to supports with screws, fasten face layers with adhesive and supplementary fasteners.
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

### 3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings or according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  1. Cornerbead: Use at outside corners, unless otherwise indicated.
  2. LC-Bead: Use at exposed panel edges.
  3. L-Bead: Use where indicated.
  4. U-Bead: Use at exposed panel edges and where indicated.

### 3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile, and panels that are substrate for acoustical tile or wood paneling.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
  - a. Primer and its application to surfaces are specified in other Division 09 Sections.
5. Level 5: Where indicated on Drawings and surfaces for high gloss finishes.
  - a. Primer and its application to surfaces are specified in other Division 09 Sections.

### 3.6 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900



## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

#### 1.3 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For components with factory-applied color finishes.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
  - 1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
  - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
- D. LEED Submittals:
  - 1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

- a. Include statement indicating costs for each product having recycled content.
  2. Product Data for Credit EQ 4.1: For sealants, including printed statement of VOC content.
- E. Qualification Data: For testing agency.
  - F. Field quality-control test reports.
  - G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
  - H. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.
  - I. Maintenance Data: For finishes to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- B. Source Limitations:
  1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
  2. Suspension System: Obtain each type through one source from a single manufacturer.
- C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.
- D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
  1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
    - a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
    - b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

- a. Smoke-Developed Index: 450 or less.

- E. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
  1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
  2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."
  3. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."
  4. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."
  5. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
- F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

## 1.8 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

## 1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
  2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
  3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

## PART 2 - PRODUCTS

### 2.1 ACOUSTICAL PANELS, GENERAL

- A. Recycled Content: Provide acoustical panels with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
  1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
- C. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
  1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- D. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that

inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

- E. Antimicrobial Fungicide Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

## 2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Armstrong World Industries, Inc..
  2. BPB USA.
  3. Chicago Metallic Corporation.
  4. Ecophon CertainTeed, Inc.
  5. Tectum Inc.
  6. USG Interiors, Inc.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable approved equal product.
- C. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
  2. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 1, nodular; with washable vinyl-film overlay.
  3. Type and Form: Type XX, other types; described as high-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
  4. Pattern: E (lightly textured); G (smooth); K (surface scored); Z (other patterns as described) or as indicated by manufacturer's designation.
- D. Color: White, unless otherwise indicated in a schedule.
- E. LR: Not less than 0.80.
- F. NRC: Not less than 0.85.
- G. CAC: Not less than 25.
- H. AC: Not less than 190.
- I. Edge/Joint Detail: Square; or Beveled, where indicated.
- J. Thickness: 3/4 inch (19 mm), unless otherwise indicated on Drawings or in a schedule.

- K. Modular Size: 24 by 24 inches (610 by 610 mm) and 24 by 48 inches (610 by 1220 mm), as indicated on Drawings or in a schedule.
- L. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.

### 2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than **25** percent.
- B. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
  - 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- D. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
  - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Type: Postinstalled bonded anchors.
    - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
    - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
  - 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
- E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
  3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
  4. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- (3.5-mm-) diameter wire.
- F. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- I. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.
- J. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.
- K. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.
- L. Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including manufacturer's standard antimicrobial gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.

## 2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Armstrong World Industries, Inc..
  2. BPB USA.
  3. Chicago Metallic Corporation.
  4. Ecophon CertainTeed, Inc.
  5. USG Interiors, Inc.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
1. Structural Classification: Heavy-duty system.
  2. End Condition of Cross Runners: Override (stepped) or butt type.
  3. Face Design: Flat, flush.

4. Cap Material: Steel cold-rolled sheet.
  5. Cap Finish: Painted white.
- C. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 9/16-inch- (15-mm-) wide metal caps on flanges.
1. Structural Classification: Heavy-duty system.
  2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
  3. Face Design: Flat, flush.
  4. Cap Material: Steel cold-rolled sheet.
  5. Cap Finish: Painted white.

## 2.5 METAL EDGE MOLDINGS AND TRIM

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Armstrong World Industries, Inc.
  2. BPB USA.
  3. Chicago Metallic Corporation.
  4. Fry Reglet Corporation.
  5. Gordon, Inc.
  6. USG Interiors, Inc.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
  2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

## 2.6 ACOUSTICAL SEALANT

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Products: Subject to compliance with requirements, provide one of the following:
1. Acoustical Sealant for Exposed and Concealed Joints:
    - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
    - b. USG Corporation; SHEETROCK Acoustical Sealant.
  2. Acoustical Sealant for Concealed Joints:

- a. OSI Sealants, Inc.; Pro-Series SC-175 Rubber Base Sound Sealant.
- b. Pecora Corporation; BA-98.
- c. Tremco, Inc.; Tremco Acoustical Sealant.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
  1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

### 3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with UBC Standard 25-2 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
  1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
  1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  8. Do not attach hangers to steel deck tabs.
  9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
  11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.
    - b. Install panels with pattern running in one direction parallel to **(long)** **(short)** axis of space.
    - c. Install panels in a basket-weave pattern.
  2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
7. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
8. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:
  1. Suspended ceiling system.
  2. Hangers, anchors and fasteners.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Tests and Inspections: Testing and inspecting of completed installations of acoustical panel ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
  1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
    - a. Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every 2 postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
    - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Remove and replace acoustical panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.

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3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096530 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Resilient wall base and accessories.
- B. Related Sections include:
  - 1. Division 1 Section "Summary" for coordination with hazardous material abatement contractor for removal of existing asbestos bearing Resilient Floor Tile and adhesive.
  - 2. Division 09 Section "Resilient Tile Flooring" for resilient floor tile.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
- C. Samples for Verification:
  - 1. Resilient Wall Base and Accessories: Manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long, of each resilient product color and pattern required.
- D. Maintenance Data: For resilient products to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store tiles on flat surfaces.

1.6 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Resilient Wall Base and Accessories: Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 RESILIENT WALL BASE

- A. Wall Base, Basis of Design: ROPPE, P 193, Black Brown, ASTM F 1861, or Approved Equal.

- B. Type (Material Requirement): TS (rubber, vulcanized thermoset).
- C. Group (Manufacturing Method): I (solid).
- D. Style: Cove (with top-set toe).
- E. Minimum Thickness: 0.125 inch (3.2 mm).
- F. Height: 4 inches (102 mm).
- G. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.
- H. Outside Corners: Job formed.
- I. Inside Corners: Job formed.
- J. Surface: Smooth.

### 2.3 RESILIENT MOLDING ACCESSORY

- A. Description: Carpet edge for glue-down applications, Nosing for resilient floor covering, Reducer strip for resilient floor covering, Joiner for tile and carpet.
  - 1. Roppe Corporation, to match base, or Approved Equal.
- B. Material: Rubber.
- C. Profile and Dimensions: As indicated.

### 2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
  - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. VCT and Asphalt Tile Adhesives: 50 g/L.
    - b. Cove Base Adhesives: 50 g/L.
    - c. Rubber Floor Adhesives: 60 g/L.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
  - 3. Moisture Testing:
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    - b. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
  - 1. Do not install resilient products until they are same temperature as space where they are to be installed.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 RESILIENT WALL BASE INSTALLATION

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
- F. Job-Formed Corners:
  - 1. Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

### 3.5 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
    - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 096530



SECTION 096550 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Linoleum floor tile.

- B. Related Sections:

- 1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.
  - 2. Division 09 Section "Resilient Sheet Flooring".

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. LEED Submittals:

- 1. Product Data for Credit EQ 4.1: For adhesives, sealants and chemical-bonding compounds, including printed statement of VOC content.

- C. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

- 1. Show details of special patterns.

- D. Samples for Initial Selection: For each type of floor tile indicated.

- E. Samples for Verification: Full-size units of each color and pattern of floor tile required.

- F. Qualification Data: For qualified Installer.

- G. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

## PART 2 - PRODUCTS

### 2.1 LINOLEUM TILE

- A. Basis of Design Product: Subject to compliance with requirements, provide the following product: Tarket Linoleum Tile, #LT25 6602, or Approved Equal.
- B. Tile Standard: ASTM F 2034, Type 1, EN 548.
- C. Wearing Surface: Smooth, ASTM D 2047.
- D. Thickness: 2.5 mm, EN 428.
- E. Size: 19.68 by 19.68 inches (50 by 50 cm).

### 2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
  - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Linoleum Floor Tile Adhesives: Not more than 50 g/L.
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
  - 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Wood Substrates: Install according to manufacturer's written instructions.
- E. Do not install floor tiles until they are same temperature as space where they are to be installed.
  - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

### 3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction, unless otherwise directed.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

#### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
  1. Remove adhesive and other blemishes from exposed surfaces.
  2. Sweep and vacuum surfaces thoroughly.
  3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
  1. Apply two coats, according to manufacturer's written instructions.
- E. Cover floor tile until Substantial Completion.

END OF SECTION 096550



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## SECTION 096723 – ELASTOMERIC RESINOUS FLOORING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes resinous flooring systems with elastomeric urethane body coats.

1. Application Method: Troweled.

B. Related Sections include the following:

1. Division 7 Section "Joint Sealants" for sealants installed at joints in resinous flooring systems.

#### 1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.

C. Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in product schedule.

D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

E. Material Test Reports: For each resinous flooring component.

F. Maintenance Data: For resinous flooring to include in maintenance manuals.

#### 1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.

1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated. Resinous flooring manufacturer must be a partner to the warranty covering the installation of the resinous floor by signing a Joint and Several warranty.

B. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Apply full-thickness mockups on 48-inch- square floor area selected by Architect.

a. Include 48-inch length of integral cove base.

2. Simulate finished lighting conditions for Architect's review of mockups.

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3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

#### 1.5 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

#### 1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under the other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Manufacturer to provide a single, written warranty covering both materials and workmanship for a period of one (1) full year from date of substantial completion. Warranty does not include deterioration or failure of flooring system due to unusual weather phenomena, failure of prepared and treated substrate cracks exceeding 1/32 inch in width, fire vandalism, or abuse by snowplow, maintenance equipment and truck traffic.

1. Deterioration of resinous flooring system includes, but is not limited to, the following:

Adhesive or cohesive failures.

Abrasion or tearing failures due to de-lamination or breakdown of coating.

Surface crazing or spalling.

Intrusion of water, oils, gasoline, grease, salt. Deicer chemicals, or acids into deck substrate.

## PART 2 - PRODUCTS

### 2.1 RESINOUS FLOORING

#### A. Products:

1. Stonhard, Inc., Maple Shade, NJ – Local Stonhard contact: Shane Coles, (801) 623-3040. StonRes.

2. Sherwin Williams Company – (303)-475-4258. Trafficote #105 Self Leveling Slurry coated with GP 3744 Epoxy.

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B. System Characteristics:

1. Color and Pattern: As selected by architect from manufacturers at standard colors.
2. Wearing Surface: Provide smooth or textured surface where indicated.
3. Integral Cove Base: 4 inches high, where designated on drawings.
4. Overall System Thickness: 1/8 inch to 3/16 inch.

C. System Components: Manufacturer's standard components that are compatible with each other and as follows:

a. Resin: Elastomeric Urethane.

b. Formulation Description: 100 percent solids

c. Application Method: Troweled.

Thickness of Coats: 1/8" - 3/16 inch.

Number of Coats: One.

d. Aggregates: Graded aggregates blended with inorganic pigments.

2. Primer: Type recommended by manufacturer for substrate and body coat(s) indicated.

a. Formulation Description: 100 percent solids, Standard Primer

3. Topcoat: Chemical-resistant finish coats.

a. Resin: Urethane

b. Formulation Description: 100 percent solids

c. Type: Pigmented

d. Finish: Gloss

e. Number of Coats: One

4. Sealcoat: UV-resistant seal coat: Stonhard "Stonseal GS6" or Sherwin Williams "GP 4618".

a. Resin: Urethane

b. Formulation Description: UV-resistant

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Type: Pigmented. Finish: Gloss, Number of Coats: One.

D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: 10,000 psi per ASTM C 579.
2. Tensile Strength: 1,750 psi per ASTM C 307.
3. Flexural Modulus of Elasticity:  $2.0 \times 10^6$  psi per ASTM C 580.
4. Water Absorption: 0.2% per ASTM C 413.
5. Coefficient of Thermal Expansion:  $3.5 \times 10^{-5}$  in/in/C per ASTM C 531.
6. Impact Resistance: > 160 in./lbs per ASTM D 4226
7. Abrasion Resistance: 0.08 gm maximum weight loss per ASTM D 4060, C-17 wheel
8. Flammability: Self-extinguishing per ASTM D 635.
9. Hardness: 85-90, Shore D per ASTM D 2240.
10. Bond Strength: 100 percent concrete failure per ASTM D-4541

#### PART 1 - 2.2 MISCELLANEOUS MATERIAL

PART 2 - A. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

PART 3 - B. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

#### PART 3 - EXECUTION

##### 3.1 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:

Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.

3. Verify that concrete substrates are dry.

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- a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 5 lb of water/1000 sq. ft. in 24 hours.
  - b. Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
  - c. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
  - d. Verify that surface temperature of concrete substrate is not warming or cooling prior to installation.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

### 3.2 APPLICATION

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
  3. At substrate control, expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
    - a. Apply joint sealant to comply with manufacturer's written recommendations.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
- D. Apply self-leveling slurry body coat(s) in thickness indicated for flooring system.
- E. Apply troweled screeded body coat(s) in thickness indicated for flooring system. Hand or power trowel grout to fill voids. When cured, sand to remove trowel marks and roughness.
- F. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.
- G. Apply Sealcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

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### 3.3 FIELD QUALITY CONTROL

A. Core Sampling: At the direction of Owner and at locations designated by Owner, take 1 core sample per 1000 sq. ft. of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring and correct deficiencies.

B. Material Sampling: Owner may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.

1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.

3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

### 3.4 CLEANING AND PROTECTING

Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

SECTION 096820 – BROADLOOM CARPET AND CARPET TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes broadloom carpet and modular, tufted carpet tile.
- B. Related Sections include the following:
  - 1. Division 9 Section "Resilient Wall Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation methods.
- B. LEED Submittal:
  - 1. Product Data for Credit EQ 4.3:
    - a. For carpet tile, documentation indicating compliance with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.
    - b. For installation adhesive, including printed statement of VOC content.
- C. Shop Drawings: Show the following:
  - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
  - 2. Existing flooring materials to be removed.
  - 3. Existing flooring materials to remain.
  - 4. Carpet tile type, color, and dye lot.
  - 5. Type of subfloor.
  - 6. Type of installation.
  - 7. Pattern of installation.
  - 8. Pattern type, location, and direction.
  - 9. Pile direction.
  - 10. Type, color, and location of insets and borders.
  - 11. Type, color, and location of edge, transition, and other accessory strips.
  - 12. Transition details to other flooring materials.

- D. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
  - 1. Carpet Tile: Full-size Sample.
  - 2. Exposed Edge Stripping and Accessory: 12-inch- (300-mm-) long Samples.
- E. Maintenance Data: For carpet tile to include in maintenance manuals specified in Division 1. Include the following:
  - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Product Options: Products and manufacturers named in Part 2 establish requirements for product quality in terms of appearance, construction, and performance. Other manufacturers' products comparable in quality to named products and complying with requirements may be considered.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with CRI 104, Section 5, "Storage and Handling."

#### 1.6 PROJECT CONDITIONS

- A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."
- B. Environmental Limitations: Do not install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tile over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tile, install carpet tile before installing these items.

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Carpet Tile Warranty: Written warranty, signed by carpet tile manufacturer agreeing to replace carpet tile that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

PART 2 - PRODUCTS

2.1 BROADLOOM CARPET

- A. Basis of Design Product: As indicated on Drawings.
  - 1. Color: As selected by Architect.
- B. Fiber Content: 100 percent nylon.
- C. Fiber Type: nylon.
- D. Pile Characteristic: Tufted texture loop pile.
- E. Density: 7925/13.9.
- F. Pile Thickness: High 0.157, Low 0.079 for finished carpet tile per ASTM D 6859.
- G. Stitches: 12.0/inch.
- H. Gage: 1/10 inch (39.4/10 cm).
- I. Surface Pile Weight: 26 oz./sq. yd. (g/sq. m).

- J. Size: 12 feet (366 cm).
- K. Primary Backing/Backcoating: Manufacturer's standard composite materials.
- L. Backing System: Super-Lok.
- M. Applied Soil-Resistance Treatment: Guardian, fluorochemical soil-resistant treatment.
- N. Performance Characteristics: As follows:
  - 1. Critical Radiant Flux Classification: Rated Class 1.
  - 2. Electrostatic Propensity: Less than 3.5 kV per AATCC 134.
  - 3. Environmental Requirements: Provide carpet tile that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

## 2.2 CARPET TILE CP-3

- A. Basis of Design Product: As indicated on Drawings.
  - 1. Color: As selected by Architect.
- B. Fiber Content: 100% eco\*solution dyed premium branded sd nylon.
- C. Fiber Type: Premium branded sd nylon.
- D. Pile Characteristic: Level-loop pile.
- E. Density: 11,613 oz./cu. yd. (g/cu. cm).
- F. Pile Thickness: 0.093 inches (mm) for finished carpet tile per ASTM D 6859.
- G. Stitches: 11.5 stitches per inch (mm).
- H. Gage: 1/10 gage in ends per inch (mm).
- I. Weight Density: 348,390.
- J. Backing System: Manufacturer's standard composite materials made from thermoplastic polyolefin compound with fiberglass reinforcing layer.
- K. Size: 24 by 24 inches (610 by 610 mm).
- L. Applied Soil-Resistance Treatment: Manufacturer's standard material, S.S.P. Shaw Soil Protection.
- M. Performance Characteristics: As follows:
  - 1. Critical Radiant Flux Classification: ASTM E-648 flooring radiant panel Class 1.
  - 2. Electrostatic Propensity: Less than 3.5 kV per AATCC 134.

3. Environmental Requirements: Provide carpet tile that complies with testing and product requirements of Carpet and Rug Institute's "Green Label Plus" program.

## 2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and that is recommended by carpet tile manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Verify that substrates and conditions are satisfactory for carpet tile installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
  2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. For wood subfloors, verify the following:
  1. Underlayment over subfloor complies with requirements specified in Division 06 Section "Rough Carpentry."
  2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 13, "Carpet Modules (Tiles)."
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- D. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- F. Install pattern parallel to walls and borders,  $\frac{1}{4}$  turned.

### 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
  - 2. Remove yarns that protrude from carpet tile surface.
  - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 15, "Protection of Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096820

SECTION 099120 – INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following substrates:
  - 1. Steel doors and frames.
  - 2. Gypsum board.
  - 3. Steel.
  - 4. Galvanized metal.
- B. Related Sections include the following:
  - 1. Division 9 Section "High Performance Coatings".

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  - 2. Step coats on Samples to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
- E. LEED Submittal:

1. Product Data for Credit EQ 4.2: For paints, including printed statement of VOC content and chemical components.

#### 1.4 QUALITY ASSURANCE

##### A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

##### B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
  - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
  - b. Other Items: Architect will designate items or areas required.
2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.
  - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- ##### A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

#### 1.6 PROJECT CONDITIONS

- ##### A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- ##### B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Benjamin Moore & Co.
  2. Columbia Paint & Coatings.
  3. Coronado Paint.
  4. ICI Paints.
  5. Kelly-Moore Paints.
  6. Kwals Paint.
  7. M.A.B. Paints.
  8. Porter Paints.
  9. PPG Architectural Finishes, Inc.
  10. Sherwin-Williams Company (The).
  11. Spectra-Tone.
  12. Approved equal.

2.2 PAINT, GENERAL

- A. Material Compatibility:
1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:
1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
  2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.

3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Floor Coatings: VOC not more than 100 g/L.
5. Shellacs, Clear: VOC not more than 730 g/L.
6. Flat Topcoat Paints: VOC content of not more than 50 g/L.
7. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
8. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
9. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
10. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.
11. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
12. Restricted Components: Paints and coatings shall not contain any of the following:
  - a. Acrolein.
  - b. Acrylonitrile.
  - c. Antimony.
  - d. Benzene.
  - e. Butyl benzyl phthalate.
  - f. Cadmium.
  - g. Di (2-ethylhexyl) phthalate.
  - h. Di-n-butyl phthalate.
  - i. Di-n-octyl phthalate.
  - j. 1,2-dichlorobenzene.
  - k. Diethyl phthalate.
  - l. Dimethyl phthalate.
  - m. Ethylbenzene.
  - n. Formaldehyde.
  - o. Hexavalent chromium.
  - p. Isophorone.
  - q. Lead.
  - r. Mercury.
  - s. Methyl ethyl ketone.
  - t. Methyl isobutyl ketone.
  - u. Methylene chloride.
  - v. Naphthalene.
  - w. Toluene (methylbenzene).
  - x. 1,1,1-trichloroethane.
  - y. Vinyl chloride.

C. Colors: As indicated in a color schedule.

### 2.3 METAL PRIMERS

- A. Alkyd Anticorrosive Metal Primer: MPI #79.
  1. VOC Content: E Range of E2.
- B. Cementitious Galvanized-Metal Primer: MPI #26.

1. VOC Content: E Range of E1.

#### 2.4 ALKYD PAINTS

- A. Alkyd Enamel (Semigloss): MPI #94 (Gloss Level 5).

1. VOC Content: E Range of E2.

#### 2.5 INTERIOR PRIMERS/SEALERS

- A. Interior Latex Primer/Sealer: MPI #50.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 3.

- B. Interior Alkyd Primer/Sealer: MPI #45.

1. VOC Content: E Range of E1.

#### 2.6 INTERIOR METAL PRIMERS

- A. Waterborne Galvanized-Metal Primer: MPI #134.

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 2.

- B. Rust-Inhibitive Primer (Water Based): MPI #107.

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 2.

#### 2.7 LATEX PAINTS

- A. High-Performance Architectural Latex (Low Sheen): MPI #138 (Gloss Level 2).

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 6.

- B. High-Performance Architectural Latex (Eggshell): MPI #139 (Gloss Level 3).

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 6.

- C. High-Performance Architectural Latex (Satin): MPI #140 (Gloss Level 4).

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 6.5.

- D. High-Performance Architectural Latex (Semigloss): MPI #141 (Gloss Level 5).
  - 1. VOC Content: E Range of E2.
  - 2. Environmental Performance Rating: EPR 6.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
  - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- F. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
  - 1. Mechanical Work:
    - a. Uninsulated metal piping.
    - b. Uninsulated plastic piping.
    - c. Pipe hangers and supports.
    - d. Tanks that do not have factory-applied final finishes.
    - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
    - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
  - 2. Electrical Work:
    - a. Switchgear.
    - b. Panelboards.

- c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

### 3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
  - 1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
  - 2. Testing agency will perform tests for compliance with product requirements.
  - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.6 INTERIOR PAINTING SCHEDULE

- A. Steel Substrates:
  - 1. High-Performance Architectural Latex System: MPI INT 5.1R.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: High-performance architectural latex matching topcoat.
    - c. Topcoat: High-performance architectural latex (semigloss).
- B. Galvanized-Metal Substrates:
  - 1. High-Performance Architectural Latex System: MPI INT 5.3M.

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- a. Prime Coat: Waterborne galvanized-metal primer.
  - b. Intermediate Coat: High-performance architectural latex matching topcoat.
  - c. Topcoat: High-performance architectural latex (satin) and (semigloss), where indicated.
- 

C. Gypsum Board Substrates:

1. High-Performance Architectural Latex System: MPI INT 9.2B.
  - a. Prime Coat: Interior latex primer/sealer.
  - b. Intermediate Coat: High-performance architectural latex matching topcoat.
  - c. Topcoat: High-performance architectural latex (flat) and (satin), where indicated.

END OF SECTION 099120



SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes surface preparation and application of high-performance coating systems on the following substrates:
  - 1. Exterior Substrates:
    - a. Steel.
    - b. Galvanized Steel.
- B. Related Sections include the following:
  - 1. Division 02 Section "Asphalt and Concrete Paving" for asphalt and concrete paving paint striping requirements.
  - 2. Division 05 Sections for Structural Steel galvanizing exterior steel and preparation for primers specified in this Section.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit EQ 4.2: For coatings, including printed statement of VOC content and chemical components.
- C. Samples for Initial Selection: For each type of finish-coat product indicated.
- D. Samples for Verification: For each type of coating system and in each color and gloss of finish coat indicated.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  - 2. Step coats on Samples to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.

- E. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

#### 1.4 QUALITY ASSURANCE

- A. Master Painters Institute (MPI) Standards:
  - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
  - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and coating systems indicated.
- B. Mockups: Apply benchmark samples of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each type of coating and substrate.
  - 2. Final approval of color selections will be based on benchmark samples.
    - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### 1.6 PROJECT CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

## PART 2 - PRODUCTS

### 2.1 HIGH-PERFORMANCE COATINGS, GENERAL

#### A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Provide products of same manufacturer for each coat in a coating system.

#### B. Chemical Components of Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:

1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
2. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
3. Anticorrosive Coatings: VOC content of not more than 250 g/L.
4. Stains: VOC content of not more than 250 g/L.
5. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing 1 or more benzene rings).
6. Restricted Components: Paints and coatings shall not contain any of the following:
  - a. Acrolein.
  - b. Acrylonitrile.
  - c. Antimony.
  - d. Benzene.
  - e. Butyl benzyl phthalate.
  - f. Cadmium.
  - g. Di (2-ethylhexyl) phthalate.
  - h. Di-n-butyl phthalate.
  - i. Di-n-octyl phthalate.
  - j. 1,2-dichlorobenzene.
  - k. Diethyl phthalate.
  - l. Dimethyl phthalate.
  - m. Ethylbenzene.
  - n. Formaldehyde.
  - o. Hexavalent chromium.
  - p. Isophorone.
  - q. Lead.
  - r. Mercury.
  - s. Methyl ethyl ketone.
  - t. Methyl isobutyl ketone.
  - u. Methylene chloride.
  - v. Naphthalene.

- w. Toluene (methylbenzene).
- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

- C. Colors: As indicated in color schedule, or as selected by Architect from manufacturer's full range.

## 2.2 METAL PRIMERS

- A. Epoxy Zinc Primer: MPI #20.

- 1. Basis of Design Product: Subject to compliance with requirements, provide the following:
  - a. Tnemec; Zinc, Series 90-97.
- 2. Alternate Approved Equal Products: Subject to compliance with requirements, provide one of the following:
  - a. Columbia Paint & Coatings; Carboline, Carboline 861, 861.
  - b. Coronado Paint; Polyamide Epoxy Zinc Rich Primer, 101-152.
  - c. Dunn-Edwards Corporation; Interzinc 52, EPA 175.
  - d. ICI Paints; Devoe Coatings, Catha-Cote, 313.
  - e. Parker Paint Mfg. Co. Inc.; Ameron, Amercoat Zinc Rich Epoxy Primer, 68HS.
  - f. Porter Paints; Porterzinc 3000, Zinc Rich Epoxy Primer, 3000.
  - g. PPG Architectural Finishes, Inc.; Aquapon Epoxy Zinc Rich Primer, 97-670.
  - h. Sherwin-Williams Company (The); Industrial & Marine, Zinc Clad IV, B69A8/V8.

## 2.3 EPOXY COATINGS

- A. Epoxy, Cold-Cured, Gloss: MPI #77.

- 1. Basis of Design Product: Subject to compliance with requirements, provide one of the following:
  - a. Tnemec; Hi-Build Epoxoline II, Series N69.
- 2. Alternate Approved Equal Products: Subject to compliance with requirements, provide one of the following:
  - a. Benjamin Moore & Co.; Polyamide Epoxy Coating, M36/M37.
  - b. Columbia Paint & Coatings; Insl-x, Insl-Tile II, EP-5300.
  - c. Coronado Paint; Polyamide Epoxy Coating, 101 Line.
  - d. ICI; ICI Devoe, Devran 724, 724-KXXXX.
  - e. Porter Paints; Porterglaze 4000, Gloss Epoxy, 4000.
  - f. PPG Architectural Finishes, Inc.; Aquapon, Epoxy Cold Cured Gloss, 95-1.

## 2.4 POLYURETHANE COATINGS

### A. Polyurethane, Two-Component, Pigmented, Semi-Gloss: MPI #72.

1. Basis of Design Product: Subject to compliance with requirements, provide one of the following:
  - a. Tnemec; Endura-Shield, Series 73U.
2. Alternate Approved Equal Products: Subject to compliance with requirements, provide one of the following:
  - a. Benjamin Moore & Co.; Aliphatic Acrylic Urethane Gloss, CM74/M75.
  - b. Columbia Paint & Coatings; Insl-x, Insl-Tron, AU-0500.
  - c. Coronado Paint; Superthane, Aliphatic Acrylic Urethane, 827 Line.
  - d. Dunn-Edwards Corporation; Interthane 990HS, 99010.
  - e. ICI Paints; Devoe Coatings, Devthane Aliphatic Urethane, 379.
  - f. PPG Architectural Finishes, Inc.; Pitthane, Urethane Aliphatic Pigmented Gloss, 95-850.

### B. Two-Component, Aliphatic Polyurethane, Clear: MPI #78.

1. Basis of Design Product: Subject to compliance with requirements, provide one of the following:
  - a. Tnemec; Endura-Clear, Series 76-762.
2. Alternate Approved Equal Products: Subject to compliance with requirements, provide one of the following:
  - a. Benjamin Moore & Co.; Aliphatic Acrylic Urethane Clear, CM7400
  - b. Columbia Paint & Coatings; DuPont, Imron Polyurethane Clear Enamel, 610P.
  - c. ICI Devoe, Devthane Aliphatic Urethane, 369K-379K.
  - d. PPG Architectural Finishes, Inc.; Pitthane, Polyurethane Aliphatic 2 Comp. Clear, 95-8000.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
  1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
    - a. Wood: 15 percent.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
4. Coating application indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
  1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
- C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.
  1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.
- D. Steel Substrates: Refer to Division 05 Section, Structural Steel for exterior galvanized steel prep for field primer requirements. Prep steel for painting according to primer and paint manufacturer's written instructions. In case of conflicts, the most stringent requirement shall be followed. Contact Architect.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.
- F. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions. Do not apply traffic striping paints until 30 days after the placement of the final pavement surface.

### 3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions.
  1. Use applicators and techniques suited for coating and substrate indicated.
  2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed parts, otherwise inaccessible during painting.

- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

### 3.4 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following procedure at any time and as often as deemed necessary during the period when coatings are being applied:
  - 1. Owner may direct Contractor to stop applying coatings if materials being used do not comply with specified requirements. Contractor shall remove non-complying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Contracting Officer, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

### 3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Steel Substrates:
  - 1. Polyurethane, Pigmented, Over High-Build Epoxy Coating System:
    - a. Prime Coat: Epoxy zinc primer, MPI#20.
    - b. Intermediate Coat: High-build epoxy marine coating, low gloss, MPI #108.
    - c. First Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.

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d. Second Topcoat: Polyurethane, two-component, pigmented, gloss, MPI #72.

B. Galvanized-Metal Substrates:

1. Polyurethane, Pigmented Coating System:

- a. Prime Coat Epoxy zinc primer, MPI#20.
- b. Intermediate Coat: High-build epoxy marine coating, low gloss, MPI #108.
- c. First Topcoat: Polyurethane, two-component, pigmented, semi-gloss, MPI #72.
- d. Second Topcoat: Polyurethane, two-component, clear, gloss, MPI #72.

END OF SECTION 099600

## SECTION 102226 - OPERABLE PARTITIONS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Electrically operated, acoustical panel partitions.

- B. Related Sections:

- 1. Division 05 Section "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
  - 2. Division 08 Section "Door Hardware" for hardware to the extent not specified in this Section.
  - 3. Division 09 Section "Gypsum Board" for fire-rated assemblies and sound barrier construction above the ceiling at track.
  - 4. Divisions 26 and 27 Sections for electrical service and connections for motor operators, controls, and limit switches; and for system disconnect switches.

#### 1.3 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."
- B. Glass and Glazing Definitions: See Division 08 Section "Glazing."
- C. NIC: Noise Isolation Class.
- D. NRC: Noise Reduction Coefficient.
- E. STC: Sound Transmission Class.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design operable panel partitions, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."
- C. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
  - 1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
  - 2. Acoustical Performance Requirements: Installed operable panel partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E 336, determined by ASTM E 413, and rated for 10 dB less than STC value indicated.
- D. Fire Resistance: Provide fire-rated operable panel partition assemblies including pass doors with fire-resistance ratings indicated.
  - 1. Pass Doors: Provide doors in fire-rated operable panel partition assemblies with fire-resistance ratings indicated. Pass doors shall meet positive-pressure requirements.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
  - 1. Certificates for Credit MR 7: Chain-of-custody certificates certifying that operable panel partitions comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
  - 2. Product Data for Credit EQ 4.4: For each composite wood product used in operable panel partitions, documentation indicating that product contains no urea formaldehyde.
- C. Shop Drawings: Include plans, elevations, sections, details, numbered panel installation sequence, and attachments to other work.
  - 1. For installed products indicated to comply with design loads, include structural analysis data for attachments, signed and sealed by the qualified professional engineer responsible for their preparation.
  - 2. Indicate storage and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
  - 3. Wiring Diagrams: For power, signal, and control wiring.
- D. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing indicated.

1. Include similar Samples of accessories involving color selection.
- E. Samples for Verification: For each type of exposed material, finish, covering, or facing indicated, prepared on Samples of size indicated below:
1. Textile: Full width by not less than 36-inch- (914-mm-) long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
  2. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches (75 mm) square.
  3. Panel Edge Material: Not less than 3 inches (75 mm) long.
  4. Hardware: Manufacturer's standard exposed door-operating device.
- F. Delegated-Design Submittal: For operable panel partitions indicated to comply with performance requirements, including analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate requirements for seismic restraints.
- G. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Suspended ceiling components.
  2. Structural members to which suspension systems will be attached.
  3. Size and location of initial access modules for acoustical tile.
  4. Items penetrating finished ceiling, including the following:
    - a. Lighting fixtures.
    - b. HVAC ductwork, outlets, and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Smoke detectors.
    - f. Access panels.
  5. Plenum fire and acoustical barriers.
- H. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.
- I. Qualification Data: For qualified Installer.
- J. Seismic Qualification Certificates: For operable panel partitions, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- K. Product Certificates: For each type of operable panel partition, from manufacturer.
- L. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each operable panel partition.
- M. Field quality-control reports.
- N. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
  - 2. Seals, hardware, track, carriers, and other operating components.
  - 3. Electric operator.
- O. Warranty: Sample of special warranty.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- C. Testing Agency Qualifications: Qualified according to Division 01 Section "Quality Requirements" for testing indicated.
- D. Forest Certification: Fabricate products with wood, wood veneers, and wood-based panel products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- E. Fire-Test-Response Characteristics: Provide panels with finishes meeting one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  - 2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.
- F. Fire-Rated Door Assemblies: Comply with NFPA 80, based on testing according to UL 10B.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Preinstallation Conference: Conduct conference at Project site.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

#### 1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of operable panel partition openings by field measurements before fabrication.

#### 1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Faulty operation of operable panel partitions.
- b. Deterioration of metals, metal finishes, and other materials beyond normal wear.

2. Warranty Period: Two years from date of Substantial Completion.

#### 1.10 EXTRA MATERIALS

A. Furnish extra materials from the same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Steel Frame: Steel sheet, manufacturer's standard 0.0641-inch (1.6-mm) nominal minimum thickness for uncoated steel.
- B. Steel Face/Liner Sheets: Tension-levleed steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
- C. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B 221 (ASTM B 221M) for extrusions; manufacturer's standard strengths and thicknesses for type of use.
  - 1. Frame Reinforcement: Manufacturer's standard steel or aluminum.
- D. Gypsum Board: ASTM C 36/C 36M.
- E. Medium-Density Fiberboard: ANSI A208.2, made with binder containing no urea formaldehyde.

### 2.2 OPERABLE ACOUSTICAL PANELS

- A. Operable Acoustical Panels: Operable acoustical panel partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advanced Equipment Corporation.
    - b. Curtition, Inc.
    - c. FolDoor; Holcomb & Hoke Mfg. Co., Inc.
    - d. Hufcor.
    - e. KWIK-WALL Company.
    - f. Moderco Inc.
    - g. Modernfold, Inc.; a DORMA Group Company.
    - h. Panelfold Inc.
- B. Panel Operation: Electrically operated, continuously hinged panels.
- C. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.

1. Panel Width: Standard widths.
- E. STC: Not less than 50.
- F. Panel Weight: 10 lb/sq. ft. (50 kg/sq. m) maximum.
- G. Panel Thickness: Not less than 3 inches (75 mm).
- H. Panel Closure: Manufacturer's standard.
  1. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.
  2. Final Closure: Constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal.
- I. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
  1. Hinges: Concealed (invisible).
  2. Exit Device: Manufacturer's standard.

### 2.3 OPERABLE FIRE-RATED PANELS

- A. Operable Fire-Rated Panels: Operable fire-rated acoustical panel partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advanced Equipment Corporation.
    - b. Hufcor.
    - c. Modernfold, Inc.; a DORMA Group Company.
    - d. Panelfold Inc.
- B. Panel Operation: Manually operated, paired panels.
- C. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- D. Dimensions: Fabricate operable fire-rated panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
  1. Panel Width: Standard widths.
- E. Fire Rating: 1 hour.
- F. STC: Not less than 50.

- G. Panel Weight: 10 lb/sq. ft. (50 kg/sq. m) maximum.
- H. Panel Thickness: Not less than 3 inches (75 mm).
- I. Panel Closure: Manufacturer's standard fire-rated closure.
  - 1. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.
  - 2. Final Closure: Fire-rated, constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal.
- J. Hardware: Manufacturer's standard as required to operate fire-rated operable panel partition and accessories; with decorative, protective finish.
  - 1. Hinges: Concealed (invisible).
  - 2. Exit Device: Manufacturer's standard.

## 2.4 SEALS

- A. General: Provide types of seals indicated that produce operable panel partitions complying with acoustical and fire-resistive performance requirements and the following:
  - 1. Manufacturer's standard seals.
  - 2. Seals made from materials and in profiles that minimize sound leakage.
  - 3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.
- B. Vertical Seals: Deep-nesting, interlocking steel astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- C. Horizontal Top Seals:
  - 1. Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track.
- D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
  - 1. Automatically Operated for Acoustical Panels: Extension and retraction of bottom seal automatically operated by movement of partition, with operating range not less than 1 inch (25 mm) between retracted seal and floor finish.

## 2.5 FINISH FACING

- A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.

1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with no gaps or overlaps. Horizontal seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.

- B. Fabric Wall Covering: 100 percent polyolefin woven fabric, from same dye lot, treated to resist stains.
- C. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:
  1. Steel, Painted: Finished with manufacturer's standard As selected by Architect from manufacturer's full range.
- D. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

## 2.6 SUSPENSION SYSTEMS

- A. Suspension Tracks: Steel or aluminum mounted directly to overhead structural support, with adjustable steel hanger rods for overhead support, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch (2.54 mm) between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
  1. Panel Guide: Aluminum; finished with factory-applied, decorative, protective finish.
  2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
- C. Track Intersections, Switches, and Accessories: As required for type of operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.
  1. Curve-and-Diverter Switches: Allowing radius turns to divert panels to an auxiliary track.
  2. Center carrier stop.
- D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
- E. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

## 2.7 ELECTRIC OPERATORS

- A. General: Provide factory-assembled electric operation system of size and capacity recommended and provided by operable panel partition manufacturer for partition specified; with electric motor and factory-prewired motor controls, speed reducer, chain drive, remote-control stations, control devices, and accessories required for proper operation. Include wiring from motor control to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
- B. Comply with NFPA 70.
- C. Control Equipment: Complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.
- D. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1 and the following:
1. Voltage: 208-220 V.
  2. Horsepower: Manufacturer's standard.
  3. Efficiency: Premium.
  4. Enclosure: Totally enclosed.
  5. Duty: Continuous duty at ambient temperature of 105 deg F (40 deg C) and at altitude of 3300 feet (1005 m) above sea level.
  6. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
  7. Phase: Polyphase.
- E. Remote-Control Stations: Two single-key-operated, constant-pressure control stations located remotely from each other on opposite sides and opposite ends of partition run. Wire in series to require simultaneous activation of both key stations to operate partition. Each three-position control station labeled "Open," "Close," and "Off." Provide two keys per station.
- F. Obstruction-Detection Devices: Provide each motorized operable panel partition with automatic safety sensor indicated, that causes operator to immediately stop and reverse direction.
1. Sensor Edge: Contact-pressure-sensitive safety edge along partition's leading edge.
- G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop operable panel partition at fully extended and fully stacked positions.
- H. Emergency Release Mechanism: Quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.

## 2.8 ACCESSORIES

- A. Pass Doors, where indicated: Fabricated to comply with recommendations in ICC/ANSI A117.1, the U.S. Architectural & Transportation Barriers Compliance Board's

ADA-ABA Accessibility Guidelines. Swinging door built into and matching panel materials, construction, acoustical qualities, and fire rating finish, and thickness, complete with frames and operating hardware. Hinges finished to match other exposed hardware.

1. Single Pass Door: 36 by 84 inches (914 by 2134 mm), with the following:
  - a. Door Seals: Mechanically operated floor seal on panels containing pass doors.
  - b. Panic exit device.
  - c. Concealed door closer.
  - d. Door Viewer: Installed with view in direction of swing.
  - e. Exit Sign: Recessed, self-illuminated.
  - f. Latchset: Passage set.
  - g. Lock: Key-operated lock cylinder, keyed to master key system, operable from both sides of door. Include two keys per lock.
- B. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.
  1. Manufacturer's standard method to secure storage pocket door in closed position.
  2. Rim Lock: Key-operated lock cylinder, keyed to master key system, to secure storage pocket door in closed position. Include two keys per lock.
- C. Electric Interlock: Provide each motorized operable panel partition with electric interlocks at locations indicated, to prevent operation of operable panel partition under the following conditions:
  1. On storage pocket door, to prevent operation if door is not in fully open position.
  2. On partitions at location of convergence by another partition, to prevent operation if merging partitions are in place.
- D. Vertical Edge Trim: Manufacturer's standard trim to protect vertical edges of glass in frameless panels.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.
- B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed.
- C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

### 3.3 ADJUSTING

- A. Adjust operable panel partitions to operate smoothly, without warping or binding. Lubricate hardware, electric operator, and other moving parts.
- B. Adjust pass doors and storage pocket doors to operate smoothly and easily, without binding or warping. Check and readjust operating hardware. Confirm that latches and locks engage accurately and securely without forcing or binding.

### 3.4 FIELD QUALITY CONTROL

- A. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids; adjust partitions for acceptable fit.

### 3.5 CLEANING

- A. Clean soiled surfaces of operable panel partitions to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 102226

## SECTION 111300 - LOADING DOCK EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Dock levelers.
- 2. Dock bumpers.
- 3. Dock seals.

- B. Related Sections:

- 1. Division 03 Section "Cast-in-Place Concrete" for concrete work for recessed loading dock equipment.
- 2. Division 05 Section "Metal Fabrications" for curb angles at edges of recessed pits and loading dock platform edge channels. Division 08 Sections for coiling and other overhead doors electrically interlocked to dock levelers.
- 3. Division 22 Section "Plumbing Fixtures" for pit drains for loading dock equipment permanently installed in pits.
- 4. Division 26 Sections for electrical wiring for, and connections to, loading dock equipment.

#### 1.3 DEFINITIONS

- A. Operating Range: Maximum amount of travel above and below the loading dock level.
- B. Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for loading dock equipment. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For loading dock equipment. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

- C. Samples for Initial Selection: For each type of dock-seal fabric indicated.
- D. Qualification Data: For qualified Installer.
- E. Welding certificates.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency; indicate compliance of dock levelers with requirements in MH 30.1 for determining rated capacity, which is based on comprehensive testing within last two years of current products.
1. Submittal Form: According to MH 30.1, Appendix A.
- G. Operation and Maintenance Data: For loading dock equipment to include in operation and maintenance manuals.
- H. Warranty: Sample of special warranty.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than three hours' normal travel time from Installer's place of business to Project site.
- B. Source Limitations: Obtain loading dock equipment from single source from single manufacturer.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.3, "Structural Welding Code - Sheet Steel."
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Preinstallation Conference: Conduct conference at Project site.
1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
  2. Review sequence of operation for each type of loading dock equipment.
  3. Review coordination of interlocked equipment specified in this Section and elsewhere.
  4. Review required testing, inspecting, and certifying procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle dock seals in a manner to avoid significant or permanent damage to fabric or frame.
  - 1. Comply with manufacturer's written instructions for minimum and maximum temperature requirements for storage.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with loading dock equipment, including recessed pit dimensions, slopes of driveways and heights of loading docks, by field measurements before fabrication.

1.8 WARRANTY

- A. Special Warranty for Dock Levelers: Manufacturer's standard form in which manufacturer agrees to repair or replace dock-leveler components that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including cracked or broken structural support members, load-bearing welds, and front and rear hinges.
    - b. Faulty operation of operators, control system, or hardware.
    - c. Deck plate failures including cracked plate or permanent deformation in excess of 1/4 inch (6 mm) between deck supports.
    - d. Hydraulic system failures including failure of hydraulic seals and cylinders.
  - 2. Warranty Period for Structural Assembly: 10 years from date of Substantial Completion.
  - 3. Warranty Period for Hydraulic System: Five years from date of Substantial Completion.
  - 4. Warranty shall be for unlimited usage of leveler for the specified rated capacity over the term of the warranty.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of loading dock equipment Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper loading dock equipment operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.
- B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade 55 (380).
- C. Steel Tubing: ASTM A 500, cold formed.
- D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- E. Wood: DOC PS 20 dimension lumber, select structural grade, kiln dried.
- F. Pressure-Treated Wood: DOC PS 20 dimension lumber, select structural grade, kiln dried, and pressure treated with waterborne preservatives to comply with AWPA C2.

2.2 RECESSED DOCK LEVELERS

- A. General: Recessed, hinged-lip-type dock levelers designed for permanent installation in concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Beacon Industries, Inc.
    - b. Blue Giant Equipment Corporation.
    - c. Chalfant Dock Equipment.
    - d. DLM, Inc.
    - e. Ellis Industries, Inc.
    - f. Flexon, Inc.
    - g. McGuire, W. B. Co., Inc.; Division of Overhead Door Corporation.
    - h. Nordock Inc.
    - i. NOVA Technology International, L.L.C.
    - j. Pentlift Equipment Corporation.
    - k. Pioneer Loading Dock Equipment.
    - l. Poweramp; Division of Systems, Inc.
    - m. Rite-Hite Corporation.
    - n. Rol-Lift Corporation.
    - o. Rotary Products Inc.
    - p. SPX Dock Products - Kelley.
    - q. SPX Dock Products - Serco.
    - r. Vestil Manufacturing Company.
- B. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity.

- C. Rated Capacity: Capable of supporting total gross load indicated without permanent deflection or distortion.
- D. Platform: Not less than 1/4-inch- (6-mm-) thick, nonskid steel plate.
  - 1. Platform Size: As indicated on Drawings.
  - 2. Frame: Clean-pit type, designed to support leveler at sides of pit, with no side-to-side supports at front of pit floor.
  - 3. Toe Guards: Equip open sides of dock leveler over range indicated with metal toe guards.
    - a. Toe-Guard Range: Entire upper operating range.
- E. Hinged Lip: Not less than 5/8-inch- (16-mm-) thick, nonskid steel plate.
  - 1. Hinge: Full width, piano-type hinge with heavy-wall hinge tube and greased fittings, with gussets on lip and ramp for support.
  - 2. Safety Barrier Lip: Designed to protect material-handling equipment from an accidental fall from loading platform edge of the dock leveler when the leveler is not in use.
- F. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
  - 1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
    - a. Above Adjoining Platform: 18 inches (457 mm).
    - b. Below Adjoining Platform: 12 inches (305 mm).
  - 2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
  - 3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 inches (102 mm) over width of ramp.
  - 4. Lip Operation: Manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.
    - a. Length of Lip Extension: 18 inches (457 mm).
  - 5. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs.
  - 6. Interlock: Leveler will not operate while overhead door is in closed position.
- G. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper

size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches (76 mm).

1. Remote-Control Station with Emergency Stop: Weatherproof multibutton control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 4 box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. All ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.
  2. Independent Lip Operation: Electric-powered hydraulic raising and hydraulic lowering of lip, controlled independent of raising and lowering of ramp.
- H. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
1. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
  2. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.
- I. Integral Molded-Rubber Dock Bumpers: Fabricated from 6-inch- (152-mm-) thick, heavy molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240. Provide two dock bumpers for each recessed dock leveler, attached to face of loading dock with expansion bolts.
- J. Accessories:
1. Curb Angles: 3-by-3-by-1/4-inch (76-by-76-by-6-mm) galvanized-steel curb angles for edge of recessed leveler pit, with 1/2-inch- (13-mm-) diameter by 6-inch- (152-mm-) long concrete anchors welded to angle at 6 inches (152 mm) o.c.
  2. Self-Forming Pan: Manufacturer's standard prefabricated, self-forming steel form system for poured-in-place construction of concrete pit.
  3. Night Locks: Manufacturer's standard means to prevent extending lip and lowering ramp when overhead doors are locked.
  4. Side and rear weatherseals.
  5. Abrasive skid-resistant surface.
- K. Finish: Hot-dip galvanize dock levelers after assembly and testing.
1. Toe Guards: Paint safety yellow to comply with ANSI Z535.1.

## 2.3 DOCK BUMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Floor Products Company, Inc.
2. Beacon Industries, Inc.
3. Chalfant Dock Equipment.
4. Durable Corporation.
5. Ellis Industries, Inc.
6. Flexon, Inc.
7. Hugger Dock Equipment Company; Division of Columbus Foam Products, Inc.
8. Pawling Corporation; Architectural Products Division.
9. Pentalift Equipment Corporation.
10. Pioneer Loading Dock Equipment.
11. Rite-Hite Corporation.
12. Rol-Lift Corporation.
13. SPX Dock Products - Kelley.
14. SPX Dock Products - Serco.
15. Super Seal Mfg. Ltd.
16. Tennessee Mat Company, Inc.
17. Vestil Manufacturing Company.

- B. Molded-Rubber Bumpers: Fabricated from molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240; of size and configuration indicated. Fabricate units with not less than two predrilled anchor holes.

1. Configuration: T shape.
2. Thickness: 6 inches (152 mm).

- C. Anchorage Devices: Hot-dip galvanized-steel anchor bolts, nuts, washers, bolts, sleeves, cast-in-place plates, and other anchorage devices as required to fasten bumpers securely in place and to suit installation type indicated.

## 2.4 FOAM-PAD DOCK SEALS

- A. General: Dock seals consisting of fabric-covered foam pads designed to compress 4 to 5 inches (102 to 127 mm) under pressure of truck body to form an airtight seal at jambs and head of loading dock openings; of type, size, and construction indicated.

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the:**
  - a. Beacon Industries, Inc.
  - b. Blue Giant Equipment Corporation.
  - c. Chalfant Dock Equipment.
  - d. DLM, Inc.
  - e. Ellis Industries, Inc.
  - f. Fairborn U.S.A., Inc.
  - g. Flexon, Inc.

- h. Hugger Dock Equipment Company; Division of Columbus Foam Products, Inc.
- i. McGuire, W. B. Co., Inc.; Division of Overhead Door Corporation.
- j. Nordock Inc.
- k. NOVA Technology International, L.L.C.
- l. Pentlift Equipment Corporation.
- m. Pioneer Loading Dock Equipment.
- n. Rite-Hite Corporation.
- o. Rotary Products Inc.
- p. SPX Dock Products - Kelley.
- q. SPX Dock Products - Serco.
- r. Super Seal Mfg. Ltd.
- s. Vestil Manufacturing Company.

B. Door Opening Size: As indicated on Drawings.

C. Stationary Head Pad: 18 inches (457 mm high and same depth as jamb pads; beveled; sized for opening width.

D. Jamb Pads: Beveled;

- 1. Nominal Size: 12 inches (305 mm) wide and sized for opening height.

E. Construction: Consisting of single- or double-ply, coated, fabric-covered, urethane-foam core with supporting frame. Fabricate jamb and head pads of same depth and sized for opening width.

- 1. Steel Support Frame: Steel channel frame of manufacturer's standard weight, shape, and finish; with steel mounting hardware.
- 2. Tapered Side Panels: Taper side panels to angle required to accommodate sloped loading dock approach grades and make sealing edge of dock shelter parallel to back edge of truck. Taper for declined approach.
- 3. Cover Fabric: Neoprene-coated nylon with minimum total weight of 40 oz./sq. yd. (1356 g/sq. m.
  - a. Color: As selected by Architect from manufacturer's full range.

## 2.5 GENERAL FINISH REQUIREMENTS

A. Finish loading dock equipment after assembly and testing.

## 2.6 STEEL FINISHES

A. Galvanizing: Hot-dip galvanize components as indicated to comply with the following:

- 1. ASTM A 123/A 123M for iron and steel loading dock equipment.
- 2. ASTM A 153/A 153M or ASTM F 2329 for iron and steel hardware for loading dock equipment.

- B. Galvanized-Steel and Steel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat in manufacturer's standard color.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of loading dock equipment.
- B. Examine roughing-in for electrical systems for loading dock equipment to verify actual locations of connections before equipment installation.
- C. Examine walls and floors of pits for suitable conditions where recessed loading dock equipment is to be installed. Pits shall be plumb and square and properly sloped for drainage from back to front of loading dock.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Coordinate size and location of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation.
- B. Set curb angles in concrete edges of dock-leveler recessed pits with tops flush with loading platform. Fit exposed connections together to form hairline joints.
- C. Set curb angles in concrete edges of truck-leveler recessed pits with tops flush with driveway. Fit exposed connections together to form hairline joints.
- D. Place self-forming pan system for recessed dock levelers in proper relation to loading platform before pouring concrete.
- E. Clean recessed pits of debris.

### 3.3 INSTALLATION

- A. General: Install loading dock equipment, including motors, pumps, control stations, wiring, safety devices, light-communication systems and accessories as required for a complete installation.
  - 1. Rough-in electrical connections according to requirements specified in Division 26 Sections.

- B. Recessed Dock Levelers: Attach dock levelers securely to loading dock platform, flush with adjacent loading dock surfaces and square to recessed pit.
- C. Truck Levelers: Attach truck levelers securely to driveway construction with expansion anchors and bolts.
- D. Dock Bumpers: Attach dock bumpers to face of loading dock in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.
  - 1. Welded Attachment: Plug-weld anchor holes in contact with steel inserts and fillet weld at other locations.
  - 2. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded-steel plates or angles. If preset anchor bolts, cast-in-place inserts, or threaded studs welded to embedded-steel plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.
  - 3. Screw Attachment: Attach dock bumpers to wood construction with lag bolts as indicated.
- E. Dock Seals: Attach dock-seal support frames securely to building structure in proper relation to openings, dock bumpers, and dock levelers to ensure compression of dock seals when trucks are positioned against dock bumpers.

#### 3.4 ADJUSTING

- A. Adjust loading dock equipment to function smoothly and safely, and lubricate as recommended by manufacturer.
- B. Test dock levelers for vertical travel within operating range indicated.
- C. After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

#### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment.

END OF SECTION 111300

SECTION 11400 – FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of Food Service Equipment is shown on the drawings and by schedules and equipment lists.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract documents, including General and Supplementary Conditions and Division 1- Specification sections apply to work of this section.
- B. Bidder is responsible for information and requirements located and identified on every part of the contract plans and specifications.
- C. Mechanical and Electrical Work: Refer to this project's specification sections Division 15 and Division 16, respectively, for mechanical and electrical services and connections for individual items of Food Service Equipment.

1.3 QUALITY ASSURANCE

- A. Standards:
1. Except as otherwise indicated, comply with the following standards as applicable to the manufacture, fabrication and installation of the work of this section:
  2. NSF Standards: Comply with National Sanitation Foundation standards and criteria, and provide NSF "Seal of Approval" on each manufactured item and on major items of custom-fabricated work.
  3. UL Standards: For electrical components and assemblies provide either UL labeled products or, where no labeling service is available, "recognized markings" to indicate listing in the UL "Recognized Component Index".
  4. ANSI Standards: For gas-burning equipment. Comply with ANSI Z21-Series standard and provide labels indicating name of testing agency. Comply with ANSI B57.1 for compressed Gas Association for compressed gas piping. Comply with ANSI A40.4 and A40.6 for water connection air gaps and vacuum breakers.
  5. NFPA Standards: Comply with NFPA No. 96 for exhaust systems.
  6. ASME Code: Comply with ASME Boiler code requirements for steam generating and steam heated equipment; provide ASME inspection stamp and registration with National Board.
  7. National Electrical Code: comply with NFPA Volume 5 for electrical wiring and devices included with Food Service Equipment, ANSI C2 and C73, and applicable NEMA and NECA standards.
- B. Manufactured Products; Fabrication: Provide standard or custom manufactured products to comply with requirements; otherwise, shop fabricate the work to the greatest extent possible, in shops which are skilled and experienced with a minimum of three years experience in the production of Food Service equipment.

#### 1.4 SUBMITTALS

- A. Production Data:
1. Submit (7) complete sets, prior to ordering and/or fabrication, of manufacturer's or shop fabricator's product information and installation instructions for each item of Food Service Equipment. For operating equipment include data on performance and operating characteristics, power/fuel consumption, rough-in dimensions and sizes, drainage requirements and similar information.
  2. Provide (7) complete sets of bound maintenance manuals, operating instructions, spare parts list, precautions against hazards, manufacturer's warranties and similar information. Distribute an additional copy of installation and start-up instructions to the installer. Mark each data sheet or brochure with the project name and applicable project equipment number(s).
- B. Shop Drawings
1. Submit (7) complete sets, including (1) reproducible set, prior to ordering and/or fabrication, of shop drawings showing layouts, elevations, sections and details of custom fabricated work (work not shown by manufacturer's standard product data sheets). Show plan layouts at 1/4" scale, elevations at 1/2" scale and details at 1 1/2" or larger scales, as required.
- C. Samples
1. Submit (3) samples of each exposed finish on shop-fabricated and field-fabricated Food Service Equipment. Submit 12" squares of sheet materials and 24" lengths of linear materials. Architect for color, pattern, and texture will review samples; compliance with other requirements is the exclusive responsibility of the contractor.

#### 1.5 PRODUCT HANDLING

- A. Protect metal finishes from damage during shipping, storage, handling, installation and construction of other work in the same space. Wrap and crate each item of equipment as needed for protection from damage. Covers exposed stainless steel surfaces with self-adhesive protective paper, of a type recommended by the metal manufacturer, and do not remove until work is installed and ready for cleaning and start-up.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Metals:
1. Stainless Steel (S/S): AISI Type 302/304, hardest workable temper, No. 4 directional polish.
  2. Galvanized Steel Sheet (G.I.): ASTM A526, except ASTM A527 for extensive forming; ASTM A525, G90 zinc coating, chemical treatment. Where painted finish is indicated, provide mill-phosphatized treatment in lieu of chemical treatment.
  3. Steel Sheet: ASTM A 569 hot-rolled carbon steel.
  4. Galvanized Steel Pipe: ASTM A53 or ASTM A120, welded or seamless, schedule 40, galvanized.
  5. Steel Structure Members: Hot rolled or cold formed, carbon steel unless stainless is indicated.
  6. Galvanized Finish (G.I.): ASTM A123 hot-dipped zinc coating applied after fabrication.

7. Aluminum: ASTM B209/B221 sheet, plate and extrusions (as indicated); alloy, temper and finish as determined by manufacturer/fabricator, except 0.40-mil natural anodized finish on exposed work unless another finish is indicated.
- B. Plastic Laminate:
1. NEMA LD3, Type 2, 0.051" thick, except Type 3, 0.042" for post-forming smooth (non-texture) white unless another texture and color is indicated or selected by Architect. Comply with NSF No. 35 where applicable.
- C. Hardwood Work Surfaces:
1. Laminated edge-grained hard maple (*Acer saccharum*), NHLA First Grade with Knots, holes and other blemishes culled out, kiln dried at 8% or less moisture, waterproof glue, machined, sanded, and finished with NSF approved oil-sealer.
- D. Insulation:
1. Cooled Component Insulation: Rigid, closed-cell polyurethane foam; either heat-aged slab stock for adhesive lamination with face sheets, or foamed in place using Freon 11 as expanding agent; k-value of 0.15; not less than 1.7 lbs. Per cu ft. density.
  2. Heated-Component Insulation: Rigid board, semi-rigid blanket or adhesive applied blanket of glass fiber or other mineral fiber insulation, certified by manufacturer to withstand long-term exposure to heat (temperature rating of each insulated equipment item) without deterioration. K-value of not more than 0.30; density of not less than 1.5 lbs. Per cu. Ft.
- E. Joint Materials:
1. Sealant: 1-part or 2-part, polyurethane or silicone based, liquid elastomeric sealant, non-solvent release type, Shore A hardness of 30 except 45 if subject to traffic.
  2. Backer Rod: Polyurethane rod stock, larger than joint width.
  3. Gaskets: Solid or hollow (but not cellular) neoprene or polyvinyl chloride; light gray, minimum of 40 Shore A hardness, self-adhesive or prepared for either adhesive application or mechanical anchorage.
- F. Paint and Coatings:
1. Provide the types of painting and coating materials which, after drying or curing are suitable for use in conjunction with foodservice, and which are durable, non-toxic, non-dusting, non-flaking, mildew resistant, and comply with governing regulations for Food Service.
- G. Sound Deadening:
1. Heavy-bodied resinous coating, filled with granulated cork or other resilient material, compounded for permanent, non-flaking adhesion to metal in a 1/8" thick coating.
    - a. Galvanized Repair Paint: MIL-P-21035.
    - b. Pretreatment: SSPC-PT2 or PT3, or FT C490.
  2. Primer Coating for Metal: FS TT-P-86 type suitable for baking where indicated.
  3. Enamel for Metal: Synthetic types, FS TT-P-491, type suitable for baking where indicated.

## 2.2 FABRICATED PRODUCTS

- A. Hardware:
1. General: Manufacturer's standard, but not less than ANSI 156.9 Type 2 (Institutional), satin finish stainless steel or dull chrome finish on brass, bronze or steel.
    - a. Cabinet Catches: Heavy-duty magnetic type, except as otherwise indicated.
    - b. Drawer Slides: Ball bearing type, side-mounting, self-closing, 250 lb. capacity.

- c. Sliding Door Hardware: Overhead track with tandem nylon wheel hangers for door leaves over 5 sq. ft. area; roller less sanitary slides for smaller doors (comply with NSF standards).

B. Casters:

1. Type and size as recommended by caster manufacturer, NSF approved, for the type and weight of equipment supported; but not less than 4" diameter with 15/16" tread width, with sealed self-lubricating ball bearings, cadmium-plated steel disc wheels and solid light-gray synthetic rubber tires. Provide stainless steel horns and accessories. Unless otherwise indicated, equip each item with 2 swivel-type casters and 2 fixed casters, and provide foot brakes on 2 casters on opposite corners of equipment.
  - a. Caster Bumpers: Unless equipment item is equipped with another form of all-around protective bumper provide circular rotating bumper above each caster, 5" diameter tire of light gray synthetic rubber (hollow or closed-cell) on cadmium-plated disc.

C. Plumbing Fittings, Trim and Accessories:

1. General: Where exposed or semi-exposed, provide bright chrome-plated brass or polished stainless steel units. Provide copper or brass where not exposed.

D. Water Outlets:

1. Water Fill Devices: At sinks and at other locations where water is supplied (by manual, automatic or remote control), provide commercial quality faucets, valves, dispensers or fill devices, of the type and size indicated, and as required to operate as indicated.
2. Vacuum Breakers: Provide with Food Service Equipment where specified/required.
3. Waste Fittings: Except as otherwise indicated, provide 2" remote-lever waste valves, and 3.5" strainer basket. Integrate unit for direct connection with waste grinder where indicated.
4. P-Traps: Include removable P-traps where drains are indicated for direct connection to drainage system.

E. Electrical Materials:

1. General: Provide standard materials, devices and components as recommended by the manufacturer/fabricator, selected and installed in accordance with NEMA standards and recommendations; and as required for safe and efficient use and operation of the Food Service Equipment without objectionable noise, vibration and sanitation problems.
  - a. Controls and Signals: Provide recognized and commercial grade signals, "on-off" push button or switches, and other speed and temperature controls as required for operation, complete with pilot lights and permanent signs and graphics to assist the user of each item. Provide stainless steel cover plates at control and signal electrical boxes.
  - b. Connections: Equip each item requiring electrical power with either a terminal box for permanent connection or cord-and-plug for interruptible connection as indicated. Provide standard ground-type plugs, matching outlets (specified in Division 15), light gray (plug and cord)
  - c. Motors: Totally enclosed type, except drip-proof type where not exposed to a dust or moisture condition; ball bearings, except sleeve bearings and small timing motors; windings impregnated to resist moisture; horse-power and duty-cycle ratings as required for the service indicated.
  - d. Power Characteristics: Refer to Division 16 specifications for project power characteristics. Also, refer to individual equipment requirements for loads and ratings.

## 2.3 FABRICATION OF METALWORK

### A. General Fabrication Requirements:

1. Remove burrs from sheared edges of metalwork, ease the corners and smooth to eliminate cutting hazard. Bend sheets of metal at not less than the minimum radius required avoiding grain-separation in the metal. Maintain flat, smooth surfaces without damage to finish. Reinforce metal at locations of hardware, anchorage and accessory attachments, wherever metal is less than 14 gage or requires mortise application. Conceal reinforcements to the greatest extent possible. Weld in place on concealed faces.
2. Where fasteners are permitted, provide Phillips head, flat or oval head machine screws. Cap threads with acorn nuts unless fully concealed in inaccessible construction, and provide nuts and lock washers unless metal for tapping is at least 12 gauge. Match fastener head finish with finish of metal fastened.
3. Provide removable panels for access to mechanical and electrical service connections that are concealed behind or within foodservice equipment, but only where access is not possible and not indicated through other work.

### B. Metal and Gauges:

1. Except as otherwise indicated, fabricate exposed metalwork of stainless steel; fabricate the following components from the gauge of metal indicated, and other components from not less than 20-gauge metal:
  - a. Table tops, Counter tops, Sinks, Drain-boards: 14 Gauge.
  - b. Shelves: 16 gauge, 18 gauge if less than 12" wide.
  - c. Front Drawer/Door Panels: 18 gauge (double-pan type).
  - d. Single-Pan Doors and Drawer Fronts: 16 gauge
  - e. Enclosed Base Cabinets: 18 gauge
  - f. Enclosed Wall Cabinets: 18 gauge
  - g. Exhaust Hoods: 18 gauge
  - h. Pan Type Inserts and Trays: 16 gauge
  - i. Skirts and Enclosure Panels: 18 gauge
  - j. Closure and Trim strips over 4" wide: 18 gauge
  - k. Hardware Reinforcement: 12 gauge
  - l. Gusset Plates: 10 gauge

### C. Work-Surface Fabrication:

1. Fabricate metal work surfaces by forming and welding to provide seamless construction, using welding rods matching sheet metal, grinding and polishing. Where necessary for disassembly, provide waterproof gaskets draw-type joints with concealed bolting.
2. Reinforce work-surfaces 30" o.c. both ways with galvanized or stainless concealed structural members, reinforce edges which are not self-reinforced by formed edges.
3. Sound deaden underside of metal work-surfaces, including sinks and similar units, with a coating of sound deadening material. Hold coating back 3" from sanitary edges that are open for cleaning.

### D. Structural Framing:

1. Except as otherwise indicated, provide framing of minimum 1"-pipe-size round pipe or tube members, with mitered and welded joints and gusset plates, ground smooth. Provide 14 gauge stainless steel tube joints for exposed framing and galvanized steel pipes for concealed framing.
2. Where indicated, flange rear and end edges up to form splashes integrally with top, with vertical and horizontal corners coved on not less than 1/4" radius, die formed. Turn back splashes 1" to wall across top and ends with rounded edge on break unless otherwise specified.

3. For die-crimped edges, use inverted "V"  $1\frac{1}{2}$ " deep inside and 2" deep on outside, unless otherwise shown. For straight down flanges, make  $1\frac{3}{4}$ " deep on outside. For bull nose edges, roll down  $1\frac{3}{4}$ ".
  - a. Edges: die-formed, integral with top. For rounded corners, form to 1" radius, weld, and polish to original finish.

E. Field Joints:

1. For any field joint required because of size of fixture, butt-joint, reinforce on underside with angles of same material, bolt together with non-corrosive bolts and nuts, field weld, grind and polish.

F. Pipe Bases:

1. Construct pipe bases of 1-5/8" diameter 18 gauge stainless steel tubing. Fit legs with polished stainless steel sanitary adjustable bullet feet to provide for adjustment of approximately  $1\frac{1}{2}$ " without exposing threads.
2. Space legs to provide ample support for tops, preclude any possibility of buckling or sagging and in no case more than 6'-0" centers.

G. Shelves:

1. Construct solid shelves under pipe base tables of 16 gauge stainless steel, with  $1\frac{1}{2}$ " turned down and under edges, and 2" turn up at rear, against walls, welded to pipe legs.

H. Sinks:

1. Construct sinks of 14 gauge stainless steel No. 4 finish inside and outside. Form back, bottom, front, of one piece with ends, partitions, welded into place.
2. Partitions: double thickness, 1" minimum space between walls.
3. Cove interior vertical and horizontal corners of each tub not less than  $\frac{1}{4}$ " radius, die formed. Outside ends of drain boards to have roll rim risers not less than  $2\frac{1}{2}$ " high.
4. Drill faucet holes in splashes  $2\frac{1}{2}$ " below top edge on 8" centers.
5. Weld sinks set into drain boards by  $1\frac{1}{2}$ " x 14 gauge stainless steel angle brackets, securely welded to sinks and galvanized cross angles spot welded to underside of drain boards.
6. Sink Drains: Install in center of bottom of each sink bowl  $1\frac{1}{2}$ " I.P.S. quick opening pop-up lever type drain approximately 4" high, with a  $4\frac{1}{2}$ " flange with lugs, and fit with 3-1/8" stainless steel strainer plate.
7. Lever Handle: Of sufficient length to extend to front of sink, threaded at one end and fitted with tension spring. No riveting, screws or soldering permitted to fit drains to sinks, with all parts of drains easily removable for servicing and replacement.
8. Slope bottom of sink bowls toward outlet. Include chrome-plated tailpiece and trap.

I. Workmanship:

1. Best quality in the trade. Field verify dimensions, check measurements before fabricating; conform all items to dimensions of building; neatly fit around pipes, offsets and other obstructions.
2. Fabricate only in accordance with approved shop drawings, showing all pipes, obstructions to be built around, and location of utilities and services.
3. After the General Contractor has approved Shop Drawings, he is responsible for preventing additional obstructions being placed in way of kitchen equipment.
4. Where equipment is exposed to customer view, provide enclosure of service lines, operating components and mechanical and electrical devices.

J. Enclosures:

1. Provide enclosures, including panels, housings and skirts for service lines, operating components and mechanical and electrical devices associated with the Food Service Equipment, except as specifically indicated to be "open".

K. Casework:

1. At fabricator's option, and unless otherwise indicated, provide either box-type face framing or open-channel-type (complying with NSF requirements in either case).
  - a. Enclosure: Except as otherwise indicated, provide each unit of casework (base, wall, overhead and free-standing) with a complete enclosure metal cabinet, including fronts, backs, tops, bottoms, and sides.
  - b. Door and Drawer Fronts: Except where single-pan construction is indicated, provide double-pan type, not less than 5/8" thick, with seams on inside face. Weld hardware reinforcement inside of inner pan. Sound deaden by either coating both pans on concealed face, or inserting mineral wool insulation between pans.
  - c. Shelves: Except as otherwise indicated, provide adjustable standards for positioning and support of shelves in casework. Turn back-edge of shelf unit up 2" and hem. Turn other edges down to form open channel. Reinforce shelf units to support 40 lbs. per sq. ft. loading, plus 100% impact loading.
  - d. Drawer Bodies: Except as otherwise indicated, draw-form drawer bodies from a single piece of metal to provide seamless construction. Flange top edge to protect slides from spillage.
  - e. Closed Base: Where casework is indicated to be located on a raised-floor base, prepare casework for support without legs, and for anchorage and sealant application, as required for a completely enclosed and concealed base.
  - f. Support from Floor: Equip floor-supported mobile units with casters and equip items indicated as "roll-out" units with manufacturer's standard one-directional rollers. Otherwise, and except for closed-base units, provide pipe or tube legs, with adjustable bullet-design feet for floor-supported items of fabricated metalwork. Provide 1 1/2" adjustment of feet (concealed threading).

L. Exhaust Hood Fabrication:

1. Comply with NFPA -96, including Appendix A.
2. Grease Removal: Provide type indicated (removable filters if not otherwise indicated), with drip-channel gutters, drains and collection basing.
3. Light Fixtures: Fluorescent fixtures, UL listed for hoods with sealed safety lenses flush with inside of hood; stainless steel conduit for wiring/or UL listed for hoods, incandescent fixtures with sealed safety lenses surface mount.
4. Exhaust Duct: Galvanized steel, except stainless steel where exposed to view inside the building.
5. Exhaust Fan: Manufacturer's standard type (complying with section 5 of NFPA-96) (see also Mech. Section).

M. Fire Extinguishing System:

1. Material: System is to utilize a Wet Chemical system complying with NFPA No. 17 and 96 and UL 300.
2. The bidder is responsible to submit the necessary shop drawings and submittals required by the local authorities for a review of the Fire and Life Safety requirements of the specified system(s).
3. Shop Drawings: The Fire Suppression System Contractor is to submit shop drawings for the fire suppression system that are to include:
  - a. The name of the Owner/Occupant.
  - b. Site address and compass orientation indication.
  - c. Installing Fire Suppression Contractor's name, address and telephone number.
  - d. Graphic representation of scale for the drawings.
  - e. Hazard analysis with sufficient detail and dimensions to evaluate the hazard. Details are to include materials involved, location and arrangement and exposure to the hazard, combustibles, air handling equipment and heat sources.
  - f. Information and calculations on the amount of suppression agent to be used.

- g. Indicate the size, length and arrangement of connected piping or piping and hose, including all fittings.
  - h. Indicate the description and location of nozzles to be used including flow rates of nozzles for engineered systems.
  - i. Indicate with details to identify apparatus and devices to be used.
  - j. Indicate location of all alarm-initiating and alarm-signaling devices.
  - k. Indicate location and function of operating devices, auxiliary equipment and electrical circuitry if used.
  - l. Show location of annunciation panel.
  - m. Show location of power connection for fire extinguishing system as applicable including breaker number(s).
  - n. Show location of gas connection and shut off as applicable.
  - o. Identify type and location of manual activating device to operate the fire extinguishing system.
4. Certificate of Compliance: The Fire Suppression System Contractor must provide at the completion of the project, certification that the system has been installed in accordance with the approved plans and the manufacturer's listed installation and maintenance manual.
5. Operation Instructions and As-Built Drawings: The Fire Suppression System Contractor must provide at the completion of the project, one set of manufacturer's listed installation and maintenance manuals or listed owner's manual that describes the system's operation, required maintenance and recharging to the Owner.
6. System Alterations: When field conditions necessitate any substantial changes from the approved plans, the corrected As-Installed plans are to be prepared and submitted.
7. Equipment List: Provide a complete equipment list for approval and before the installation of the fire alarm system identifying:
- a. Type and model of fire extinguishing devices.
  - b. Manufacturer of fire extinguishing devices.
  - c. Manufacturer catalog data sheets for fire extinguishing devices.
  - d. Listing and capability of all equipment with the fire extinguishing system.
- N. Shop Painting:
- 1. Clean and prepare metal surfaces to be painted; remove rust and dirt, apply treatment to zinc-coated surface that has not been mill-phosphatized. Coat welded and abraded areas of zinc-coated surfaces with galvanized repair paint. Apply 1.5 mil (dry film thickness) metal primer coating, followed by 2, 1.0 mil (dry film thickness) metal, enamel finish coatings. Bake primer and finish coatings in accordance with paint manufacturer's instructions for a baked enamel finish.

## 2.4 REFRIGERATION EQUIPMENT

- A. Provide either single or multiple compressor units, as recommended by the manufacturer for the sizes and variations between connected evaporator loads as indicated.
- B. Provide units of the capacities indicated, arranged to respond to multiple-evaporator thermostats and defrosting timers. Include coils, receivers, compressors, motors, motor starters, mounting bases, vibrations insulation units, fans, dryers, valves, piping, insulation, gauges, winter control equipment, high ambient control equipment, and complete automatic control system.
- C. Refrigerant: Pre-charge units with type or types recommended by manufacturer for services indicated, with quick disconnect type connections where specified, ready to receive refrigerant piping runs to evaporators and (where remote) to condensers.

- D. Provide air-cooled condensers, located with the compressors, complete with refrigerant piping installed at the factory. Locate exterior units as shown with weather housings and protective enclosures.
- E. The minimum outdoor operating ambient temperature for design of units is -10 degrees F. Maximum ambient condition for load on the air cooled condenser is 95 degrees F. with 75% relative humidity in basically still air, or units to be provided with high ambient temperature controls.

## 2.5 CARBON DIOXIDE (CO2) EQUIPMENT

- A. Where equipment requires connection with compressor CO2 cylinder for operation, provide 2-cylinders manifold and control system (integral with equipment) with proper connectors for Department of Transportation's (DOT) approved type cylinders, and complete with cylinder safety devices and supports. Comply with ANSA B57.1 "Compressed Gas Cylinder Valve Outlet and Inlet Connections", and comply with applicable standards of the Compressed Gas Association.

## 2.6 MISCELLANEOUS MATERIALS AND FABRICATION

- A. Nameplate:
  - 1. Wherever possible, locate nameplates and labels on manufactured items in accessible position, but not within customer's normal view. Do not apply nameplates or labels on custom-fabricated work, except as required for compliance with governing regulations, insurance requirements or operator performance.
- B. Manufactured Equipment Items:
  - 1. Furnish items as scheduled or herein specified. Verify dimensions, spaces, rough in and service requirements and electrical characteristics before ordering. Provide all trim, accessories, and miscellaneous items for complete installation.

## PART 3 - EXECUTION

### 3.1 INSPECTION AND PREPARATION

- A. The installer of the Food Service Equipment must examine the rough in of mechanical and electrical services by others, and the conditions under which the work is to be done and must verify dimensions of the services and substrates before fabricating the work. Notification of unsatisfactory conditions for the proper installation of the Food Service Equipment must be made in writing to the General Contractor.
- B. Do not proceed with the fabrication and installation until unsatisfactory dimensions and conditions have been corrected in a manner acceptable to the installer.
- C. Bidder is to verify site conditions to allow for the physical installation of each piece of equipment. Any consideration or associated cost required allowing for the installation is to be the responsibility of the bidder.

### 3.2 INSTALLATION

- A. Water Connections: Install water connections and outlets at each item of equipment, with air gaps, vacuum breakers and similar provisions to comply with governing regulations, but not less than compliance with ANSI Standards A40.4 and A40.6.
- B. Gas burners: Install gas burning appliances, including gas vents if necessary, to comply with NFPA No. 54.
- C. Electrical Work: Assemble electrical components of equipment in accordance with applicable "Standards of Installation" by the National Electrical Contractors Association.
- D. Service Line and Equipment Connections: Refer to division 15 sections for piping connections and piping systems. Refer to division 16 sections for electrical work including equipment connections.
- E. Jointing and Anchoring:
  - 1. Set each items of non-mobile and non-portable equipment securely in place and level and adjust to correct height. Anchor to supporting substrate where indicated and where required for sustained operation and use without shifting or dislocation. Conceal anchorage wherever possible. Adjust counter tops and other work surfaces to a level tolerance of 1/6" (maximum offset, and plus-or-minus on dimensions, and maximum variation in 2'-0" run from level of indicated slope).
  - 2. Complete field assemble joints in the work (joints which cannot be completed in the shop) by welding, bolting and gaskets, or similar methods as indicated. Grind welds smooth and restore finish. Set or trim flush, except for "T" gaskets as indicated.
  - 3. Treat enclosed spaces (inaccessible after equipment installation) by covering horizontal surfaces with powdered borax at a rate of 4 oz. per sq. ft..
  - 4. Install closure plates and strips where required, with joints coordinated with units of equipment.
  - 5. Install sealant and gaskets all around each unit to make joints air tight, waterproof, vermin-proof, and sanitary for cleaning purposes.
  - 6. In general, make sealed joints not less than 1/8" wide, and stuff with backer rod to shape sealant bead properly, at 1/4" depth.
  - 7. Shape exposed surfaces of sealant slightly concave, with edges flush with faces of material joint.
  - 8. At internal-corner joints, apply sealant or gasket to form a sanitary cove, of not less than 3/8" radius.
  - 9. Provide sealant-filled or gasket joints up to 3/8" joint width; metal closure strips for wider joints, with sealant application each side of strips. Anchor gaskets mechanically or with adhesives to prevent displacement.

### 3.3 CLEANING:

- A. After completion of installation, and completion of other major work in Food Service areas, remove protective coverings, if any, and clean Food Service Equipment, internally and externally.
- B. Restore exposed and semi-exposed finishes to remove abrasions and other damages; polish exposed-metal surfaces; touch-up painted surfaces. Replace work that cannot be successfully restored.
- C. Remove and dispose off site any and all crating and packaging material.

3.4 TESTING AND START-UP:

- A. Delay the start-up of equipment until service lines have been tested, balanced, and adjusted for pressure, voltage and similar consideration; and until water and steam lines have been cleaned and treated for sanitation.
- B. Test each item of operational equipment to demonstrate that it is operating properly, and that controls and safety devices are functioning. Repair or replace equipment that is found to be defective in its operation, including units that are below capacity or operating with excessive noise or vibration.
- C. Final Cleaning: After testing and start-up, clean and sanitize the Food Service Equipment, and leave in a condition ready for use in food service.

3.5 INSTRUCTIONS AND TRAINING:

- A. Instruct the owner and any and all representatives of the owner in the proper operation and maintenance of each piece of operational equipment.

3.6 WARRANTY:

- A. Each item is to include parts and labor warranty of no less than one year, and longer as standard to the manufacturer's warranty.

3.7 INSTALLATION SCHEDULE:

- A. Bidder is to review the projected construction schedule with the Contractor prior to bidding and be able to accomplish the installation of the Food Service Equipment within the requirements of the project schedule.

3.8 BIDDING FORMAT:

- A. Bidder will provide a completed bid form for each section of work being bid, as per the General Conditions of this specification.
- B. The successful bidder will be required to submit an itemized list with individual costs for each piece of equipment included in the bid. Freight is to be included in the itemized cost for each item. Installation costs are to be itemized separately. A total amount is to be listed that includes all costs to complete the work.
- C. Change orders requested by the owner or required by job conditions to add to the equipment requirements are to be on a 'cost plus' basis. Bidder is to submit a proposal for a percentage amount that will be applied to equipment costs for all change orders.
- D. Change orders to delete equipment items will be directly related to the itemized costs breakdown provided.

3.9 DISCREPANCIES:

- A. Any discrepancies or errors located or identified in or between the specifications and plans are to be brought to the attention of the designer in writing prior to, or with the bid submittal. Any such item not identified which would cause the bid to increase, will be the responsibility of the bidder to correct.

3.10 ACCEPTABLE SUBSTITUTE MANUFACTURERS:

- A. The items listed are to be bid as specified. Manufacturers requesting to be approved as an equal substitute are to submit their request in writing to the Food Service Consultant for consideration at least (7) days prior to the bid date. Manufacturers will be considered approved and will be accepted as part of the bid only after being stated as such in writing in the form of an addendum and will be accepted only if they equally meet the specifications and standards of the specified manufacturer. A list of approved substitute manufacturers is to be submitted with the successful bidders itemized equipment list.
- B. The bidder is solely responsible to insure that the requirements of any alternate or approved equal manufacturer's piece of equipment provided by them, comply with the design intent of these documents including physical size, utility requirements and function.

3.11 EXCLUSIONS:

- A. The Owner reserves the right to exclude any and all items from the final contract.

PART 4 - ITEMIZED LIST OF EQUIPMENT

END FOOD SERVICE EQUIPMENT - SECTION 11400

## SECTION 142400 - HYDRAULIC ELEVATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes hydraulic passenger and service elevators.
- B. Related Sections include the following:
  - 1. Division 03 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
  - 2. Division 04 Section "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
  - 3. Division 05 Section "Structural Steel Framing" for the following:
    - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
    - b. Divider beams.
    - c. Hoist beams.
    - d. Structural-steel shapes for subsills that are part of steel frame.
  - 4. Division 05 Section "Metal Fabrications" for the following:
    - a. Attachment plates and angle brackets for supporting guide-rail brackets.
    - b. Divider beams.
    - c. Hoist beams.
    - d. Structural-steel shapes for subsills.
    - e. Pit ladders.
    - f. Cants in hoistways made from steel sheet.
  - 5. Division 09 Sections "Tiling" and "Resilient Sheet Flooring" for finish flooring in elevator cars.
  - 6. Division 09 painting Sections for field painting of hoistway entrance doors and frames.
  - 7. Division 26 Sections for electrical service for elevators to and including fused disconnect switches at machine room door and standby power source, transfer switch, and connection from auxiliary contacts in transfer switch to controller.
  - 8. Division 27 Section "Communications Horizontal Cabling" for telephone service to elevators.
  - 9. Division 28 Section "Access Control" for security access system equipment used to restrict elevator use.

10. Division 28 Section "Fire Detection and Alarm" for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.
11. Division 31 Section "Earth Moving" for excavating well hole to accommodate cylinder assembly.
12. Division 31 Section "Earth Moving" for disposition of excavated material from cylinder well hole.

### 1.3 DEFINITIONS

- A. Definitions in ASME A17.1 apply to work of this Section.
- B. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
- C. Service Elevator: A passenger elevator that is also used to carry freight.

### 1.4 SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:
  1. Car enclosures and hoistway entrances.
  2. Operation, control, and signal systems.
- B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station and standby power operation control panel. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples for Initial Selection: For finishes involving color selection.
- D. Samples for Verification: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.
- E. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
- F. Qualification Data: For Installer.

- G. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and installer's maintenance personnel.
- H. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- I. Warranty: Special warranty specified in this Section.
- J. Continuing Maintenance Proposal: Service agreement specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain elevators through one source from a single manufacturer.
  - 1. Provide major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.
- C. Regulatory Requirements: Comply with ASME A17.1 and elevator design requirements for earthquake loads in ASCE 7.
  - 1. Effective peak velocity acceleration ( $A_v$ ) for Project's location is greater than or equal to 0.10, but less than 0.20 (seismic risk zone 2).
  - 2. Design earthquake spectral response acceleration, short period ( $S_d$ s) for Project is as indicated.
  - 3. Project's seismic design category is B.
  - 4. Elevator importance factor is 1.5.
- D. Accessibility Requirements: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
- E. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging.

- B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

#### 1.7 COORDINATION

- A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.
- B. Furnish well casing and coordinate delivery with related excavation work.
- C. Coordinate sequence of elevator installation with other work to avoid delaying the Work.
- D. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

#### 1.8 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.
  - 1. Warranty Period: One year from date of Substantial Completion.

#### 1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.
  - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
    - a. Response Time: Two hours or less.
- B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
- C. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner with terms, conditions, and obligations as set forth in, and in the same

form as, "Draft of Elevator Maintenance Agreement" at end of this Section, starting on date initial maintenance service is concluded.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Fujitec America, Inc.
  - 2. KONE Inc.
  - 3. Otis Elevator Co.
  - 4. Schindler Elevator Corp.
  - 5. ThyssenKrupp Elevator.

### 2.2 SYSTEMS AND COMPONENTS

- A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard preengineered elevator systems and as required for complete system.
- B. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations. Provide either of the following:
  - 1. Pump, with fan-cooled squirrel-cage induction motor, mounted on oil tank with vibration isolation mounts. Enclose pump in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board.
  - 2. Submersible pump, with submersible squirrel-cage induction motor, suspended inside oil tank from vibration isolation mounts.
  - 3. Provide motor with solid-state starting.
  - 4. Provide variable-voltage variable-frequency motor control.
- C. Hydraulic Silencers: Provide hydraulic silencer containing pulsation-absorbing material in a blowout-proof housing at pump unit.
- D. Piping: Provide size, type, and weight piping recommended by manufacturer, and provide flexible connectors to minimize sound and vibration transmissions from power unit.
  - 1. Provide dielectric couplings at cylinder units.

2. Casing for Underground Piping: PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
- E. Hydraulic Fluid: Nontoxic, readily biodegradable, fire-resistant fluid made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives. Hydraulic fluid is approved by elevator manufacturer for use with elevator equipment.
  1. Product: Subject to compliance with requirements, provide "Hydro Safe" by Hydro Safe Oil Division, Inc.
- F. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.
- G. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1, of sufficient size to provide not less than 1-inch (25-mm) clearance from cylinder and extending above pit floor. Provide means to monitor casing effectiveness to comply with ASME A17.1.
- H. Corrosion Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler is electrically nonconductive, displaces or absorbs water, and gels or solidifies at temperatures below 60 deg F (16 deg C).
  1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Hydro Safe Oil Division, Inc.; No-Ox-Id Liquid Elevator Casing Filler E-800.
    - b. Union-Gard, a division of Dome Services L.L.C.; Union-Gard 160.
- I. Car Frame and Platform: Welded steel units.
- J. Guides: Provide either roller guides or sliding guides at top and bottom of car and counterweight frames. If sliding guides are used, provide guide-rail lubricators or polymer-coated, nonlubricated guides.

### 2.3 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation system for each elevator or for each group of elevators as required to provide type of operation system indicated.
- B. Single-Car Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
  1. Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by

- switches in control panel located at main lobby. Manual operation causes automatic operation to cease.
2. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.
  3. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.
- C. Group Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators and elevator groups where indicated:
1. Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. Only one car is moved upward at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby. Manual operation causes automatic operation to cease.
  2. Independent Service: Keyswitch in car control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.
  3. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car will respond only to car calls, not to hall calls.
- D. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
1. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car control stations and hall push-button stations. Key is removable only in deactivated position.
  2. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes all cars in a group to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.
- 2.4 DOOR REOPENING DEVICES
- A. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.
  - B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

## 2.5 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- D. Stainless-Steel Bars: ASTM A 276, Type 304.
- E. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- F. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.
- G. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.
- H. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications.

## 2.6 CAR ENCLOSURES

- A. General: Provide enameled-steel car enclosures to receive removable wall panels, with removable car roof, access doors, power door operators, and ventilation.
  - 1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
  - 2. Provide finished car including materials and finishes specified below.
  - 3. Refer to "Allowances" Paragraph, in Part 1 "Summary" Article, for items to be provided under the Elevator Car Allowance. Provide items not included in the Elevator Car Allowance as needed for finished car including materials and finishes specified below.
- B. Materials and Finishes: Provide manufacturer's standards, but not less than the following:
  - 1. Subfloor: Underlayment grade, exterior plywood, 5/8-inch (16-mm) nominal thickness.
  - 2. Floor Finish: Specified in a Division 09 Section.
  - 3. Enameled-Steel Wall Panels, at Service Elevators: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
  - 4. Stainless-Steel Wall Panels, at Passenger Elevators: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
  - 5. Fabricate car with recesses and cutouts for signal equipment.
  - 6. Fabricate car door frame integrally with front wall of car.
  - 7. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.

8. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
9. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
10. Metal Ceiling: Flush panels, with incandescent downlights in the center of each panel. Align ceiling panel joints with joints between wall panels.
11. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

## 2.7 HOISTWAY ENTRANCES

- A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.
  1. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.
- B. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
  1. Enameled-Steel Frames: Formed from cold-rolled or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
  2. Steel Subframes: Formed from cold-rolled or hot-rolled steel sheet with factory-applied enamel finish or corrosion-inhibiting primer. Fabricate to receive applied finish as indicated.
  3. Stainless-Steel Frames: Formed from stainless-steel sheet.
  4. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
  5. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
  6. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
  7. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

## 2.8 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with LEDs.
- B. Car Control Stations: Provide manufacturer's standard recessed or semi-recessed car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.

- C. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28 Section "Fire Detection and Alarm."
- E. Car Position Indicator: Provide digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
  - 1. Include travel direction arrows if not provided in car control station.
- F. Hall Push-Button Stations: Provide hall push-button stations at each landing as indicated.
  - 1. Provide manufacturer's standard wall-mounted units.
  - 2. Provide units with flat faceplate for mounting with body of unit recessed in wall.
  - 3. Equip units with buttons for calling elevator and for indicating desired direction of travel.
  - 4. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Division 28 Section "Fire Detection and Alarm."
- G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following:
  - 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
- H. Hall Position Indicators: Provide digital-display-type position indicators, located above each hoistway entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall.
  - 1. Integrate ground-floor hall lanterns with hall position indicators.
- I. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

## 2.9 ELEVATORS

- A. Elevator Description:

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1. Group Number: as shown on Drawings.
2. Service Elevator Number: as shown on Drawings.
3. Type: Under-the-car single cylinder.
4. Rated Load: 3000 lb (1362 kg).
5. Freight Loading Class for Service Elevators: Class A.
6. Rated Speed: 125 fpm (0.64 m/s).
7. Operation System: Selective collective automatic operation.
8. Auxiliary Operations:
  - a. Standby-powered lowering.
  - b. Automatic dispatching of loaded car.
  - c. Nuisance call cancel.
9. Security Features: Keyswitch operation.
10. Passenger Car Enclosures:
  - a. Inside Width: 68 inches (1727 mm) from side wall to side wall.
  - b. Inside Depth: 87-1/2 inches (2222 mm) from back wall to front wall (return panels).
  - c. Inside Height: 94 inches (2388 mm) to underside of ceiling.
  - d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
  - e. Car Fixtures: Satin stainless steel, No. 4 finish.
  - f. Side and Rear Wall Panels: Satin stainless steel, No. 4 finish.
  - g. Reveals: Enameled steel.
  - h. Door Faces (Interior): Satin stainless steel, No. 4 finish.
  - i. Door Sills: Aluminum, mill finish.
  - j. Handrails: 1/2 by 2 inches (13 by 50 mm rectangular satin stainless steel, No. 4 finish).
  - k. Floor recessed and prepared to receive ceramic tile (specified in Division 09 Section "Tiling").
  - l. Floor Thickness, Including Setting Materials: 3/4" above plywood subfloor.
11. Hoistway Entrances:
  - a. Width: 42 inches (1067 mm).
  - b. Height: 84 inches (2134 mm).
  - c. Type: Single-speed side sliding.
  - d. Fire-Protection Rating: 1-1/2 hours with 30-minute temperature rise of 450 deg F (250 deg C).
12. Hall Fixtures Satin stainless steel, No. 4 finish.
13. Additional Requirements:
  - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
  - b. Provide blanket hooks and one two complete set(s) of full-height protective blankets.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
  - 1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Excavation for Cylinder: Drill well hole in each elevator pit to accommodate installation of cylinder; comply with applicable requirements in Division 31 Section "Earth Moving."
- B. Provide waterproof well casing as necessary to retain walls of well hole.
- C. Install cylinder in protective casing within well hole. Before installing protective casing, remove water and debris from well hole and provide permanent waterproof seal at bottom of well casing.
  - 1. Fill void space between protective casing and cylinder with corrosion protective filler.
- D. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between protective casing and pit floor with 4 inches (100 mm) of nonshrink, nonmetallic grout.
- E. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
- F. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- G. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby eliminate sources of structure-borne noise from elevator system.
- H. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cemented fittings.

- I. Install piping above the floor, where possible. Where not possible, cover underground piping with permanent protective wrapping before backfilling.
- J. Lubricate operating parts of systems as recommended by manufacturers.
- K. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- L. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and direction of travel.
- M. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- N. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
  - 1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
  - 2. Place hall lanterns either above or beside each hoistway entrance.
  - 3. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

### 3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

### 3.4 PROTECTION

- A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for elevator used for construction purposes:
  - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
  - 2. Provide strippable protective film on entrance and car doors and frames.
  - 3. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
  - 4. Do not load elevators beyond their rated weight capacity.
  - 5. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
  - 6. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the

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shop, make required repairs and refinish entire unit, or provide new units as required.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s). Refer to Division 01 Section "Demonstration and Training."
- B. Check operation of each elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.
- C. Check operation of each elevator with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 142400

design development

ustar building #2, utah state university

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logan, utah

project manual  
volume three

December 9, 2008

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**SECTION 210800 - FIRE SUPPRESSION COMMISSIONING**

**1.0 GENERAL**

**1.01 SUMMARY:**

The contractor shall participate fully in commissioning as specified in Division 019113 "Commissioning". See Div 019113 for a specific list of equipment and systems to be covered by the commissioning process.

**END OF SECTION 210800**



## SECTION 211000 - FIRE-SUPPRESSION PIPING

### 1.1 SUMMARY

- A. Fire-suppression piping inside the building:
1. Automatic wet-type, Class I standpipe systems.
  2. Wet-pipe sprinkler systems.

### 1.2 SYSTEM PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Fire-Suppression Standpipe System Design:
1. Minimum Residual Pressure at Each Hose-Connection Outlet:
    - a. NPS 2-1/2 Hose Connections: 100 psig).
- C. Sprinkler Occupancy Hazard Classifications:
1. Building Service Areas: Ordinary Hazard, Group 1.
  2. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
  3. General Storage Areas: Ordinary Hazard, Group 1.
  4. Libraries, Except Stack Areas: Light Hazard.
  5. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
  6. Classrooms, Office and Public Areas: Light Hazard.
- D. Minimum Density for Automatic Sprinkler Piping Design:
1. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft.) area.
  2. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft.) area.
  3. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft.) area.
  4. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft.) area.
  5. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft.) area.
  6. Special Occupancy Hazard: As determined by authorities having jurisdiction.
- E. Maximum Protection Area per Sprinkler: Per UL listing
- F. Maximum Protection Area per Sprinkler:
1. Office Spaces: 225 sq. ft.
  2. Storage Areas: 130 sq. ft.
  3. Mechanical Equipment Rooms: 130 sq. ft.
  4. Electrical Equipment Rooms: 130 sq. ft.
  5. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
- G. Total Combined Hose-Stream Demand Requirement: NFPA 13, unless otherwise indicated.
1. Light-Hazard Occupancies: 100 gpm) for 30 minutes.
  2. Ordinary-Hazard Occupancies: 250 gpm) for 60 to 90 minutes.
  3. Extra-Hazard Occupancies: 500 gpm) for 90 to 120 minutes.

- H. Seismic Performance: NFPA 13 and ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

### 1.3 QUALITY ASSURANCE

- A. Quality Standard:
  1. NFPA 13-07
  2. NFPA 14-06
  3. NFPA 70-05
  4. NFPA 72-07
  5. IBC-2006
  6. IFC-2006

### 1.4 COMPONENTS

- A. Corrosion-protective encasement for piping.
- B. Sprinkler Specialty Fittings: UL listed or FMG approved.
- C. Listed Fire-Protection Valves: UL listed or FMG approved.
- D. Specialty Valves:
  1. Sprinkler system control valves, UL listed or FMG approved.
    - a. Double check valve assembly.
  2. Pressure-regulating valves.
  3. Automatic drain valves.
- E. Sprinklers: UL listed or FMG approved.
- F. Hose Connections: Nonadjustable Pressure-regulating valve operation.
- G. Fire Department Connections:
  1. Flush, Wall Type: One Two Three Four inlet(s).
  2. Exposed, Projecting Wall Type: Two inlets.
  3. Finish: Polished chrome-plated Rough chrome-plated Polished brass.
- H. Alarm Devices:
  1. Alarm: Water-motor Electrically operated.
  2. Water-flow indicator.
  3. Pressure switch.
  4. Valve supervisory switch.
  5. Indicator-post supervisory switch.
- I. Pressure Gages: UL listed, dial type.

**1.5 INSTALLATION**

- A. Fire-Hydrant Flow Test: By Contractor.
- B. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe.
- C. Underground, below Building, Service-Entrance Piping Application: Ductile-iron pipe with mechanical joints and corrosion-protective encasement.
- D. Standard-Pressure, Wet-Type Standpipe Application:
  - 1. Standard-weight black steel pipe with grooved joints.
- E. Standard-Pressure, Wet-Pipe Sprinkler System Application:
  - 1. Standard-weight black steel pipe with threaded grooved joints.
  - 2. Standard-weight black steel pipe with welded joints.
  - 3. Threadable, thinwall steel piping with threaded welded joints.

**END OF SECTION 211000**



**SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING**

**1.1 MATERIALS**

- A. Transition Fittings:
  - 1. AWWA transition couplings.
  - 2. Plastic-to-metal transition fittings.
  - 3. Plastic-to metal transition adaptors.
  - 4. Plastic-to-metal transition unions.
  
- B. Dielectric Fittings: Dielectric unions flanges flange kits couplings and nipples.
  
- C. Mechanical Sleeve Seals: EPDM NBR sealing elements;
  
- D. Sleeves: Galvanized-steel sheet Steel pipe Cast iron Stack sleeve fittings PVC pipe
  
- E. Escutcheons:
  - 1. One-piece, deep pattern.

**END OF SECTION 220500**



**SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT**

**1.1 MATERIALS**

**A. Polyphase Motors: Design B, medium induction motors.**

1. Efficiency: Energy efficient.
2. Service Factor: 1.15.
3. Multispeed Motors: Variable torque Separate winding for each speed.
4. Rotor: Random-wound, squirrel cage.
5. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
6. Temperature Rise: Match insulation rating.
7. Insulation: Class F

**B. Polyphase Motors with Additional Requirements:**

1. Motors used with reduced-voltage and multispeed controllers.
2. Energy- and premium-efficient and Inverter-duty motors used with variable frequency controllers.
3. Severe-duty motors.

**C. Single-Phase Motors:**

1. Motors Larger than 1/20 HP: Permanent-split capacitor; split phase; capacitor start, inductor run; or capacitor start, capacitor run to suit starting torque and requirements of specific motor application.
2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 HP and Smaller: Shaded-pole type.
5. Internal thermal protection.

**END OF SECTION 220513**



**SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING**

**1.1 PRODUCTS**

- A. **Metal-Bellows Expansion Joints:** Single- or multiple Multiple-ply phosphor-bronze for copper piping, single-ply stainless steel for stainless-steel piping, and single- or multiple stainless steel for steel piping.
- B. **Rubber Expansion Joints:**
  - 1. Arch Type: Single or multiple arches.
  - 2. Spherical Type: Single or multiple spheres.
  - 3. Material: BR Buna-N CSM EPDM.
- C. **Flexible-Hose Expansion Joints:** Copper alloy with solder connections for copper piping, and carbon steel with threaded, flanged, and weld ends for steel piping.
- D. **Pipe Alignment Guides:** Factory fabricated, steel.
- E. **Materials for Pipe Anchors:** Steel shapes and plates, and mechanical fasteners.

**END OF SECTION 220516**



**SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING**

**1.1 PRODUCTS**

**A. Thermometers:**

1. Metal-Case, Liquid-in-Glass Type: Aluminum Brass case, organic-liquid filled.
2. Direct-Mounting, Vapor-Actuated Dial Type: Liquid-filled type, steel or aluminum case.
3. Remote-Reading, Vapor-Actuated Dial Type: Dry type, steel or aluminum case.
4. Bimetallic-Actuated Dial Type: Liquid-filled type, stainless-steel case.

**B. Thermowells to hold thermometers.**

**C. Pressure Gages:**

1. Direct-Mounting Dial Type: Liquid-filled type, drawn-steel or cast-aluminum case; Grade A accuracy.
2. Remote-Mounting Dial Type: Dry type, drawn-steel or cast-aluminum case; Grade A accuracy.

**D. Test Plugs: Corrosion-resistant brass or stainless-steel body with core inserts.**

1. Test kit containing pressure gage, low- and high-range thermometers, and carrying case.

**END OF SECTION 220519**



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**SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING**

**1.1 DOMESTIC, HOT- AND COLD-WATER VALVES**

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze Angle Valves: Class 150, bronze nonmetallic disc.
  - 2. Ball Valves: Two piece, full port, brass or bronze with brass trim.
  - 3. Bronze Swing Check Valves: Class 150, bronze nonmetallic disc.
  - 4. Bronze Gate Valves: Class 150, NRS RS.
  
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Iron Ball Valves: Class 150.
  - 2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM NBR seat, stainless-steel disc.
  - 3. Iron, Grooved-End Butterfly Valves: 175 CWP.
  - 4. Iron Swing Check Valves: Class 250, nonmetallic-to-metal seats.

**END OF SECTION 220523**



**SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

**1.1 SUMMARY**

- A. Hangers and supports for plumbing system piping and equipment.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Design supports for multiple pipes and equipment.
- B. Design seismic-restraint hangers and supports and obtain approval from authorities having jurisdiction.

**1.3 SUBMITTALS**

- A. Shop Drawings: Signed and sealed by a qualified professional engineer.

**1.4 COMPONENTS**

- A. Steel pipe hangers and supports.
- B. Trapeze pipe hangers.
- C. Fiberglass pipe hangers.
- D. Metal framing systems.
- E. Fiberglass strut systems.
- F. Thermal-hanger shield inserts.
- G. Pipe positioning systems.
- H. Equipment supports.

**END OF SECTION 220529**



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**SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT**

**1.1 PERFORMANCE REQUIREMENTS**

- A. See section 230548 for plumbing and HVAC Seismic.

**END OF SECTION 220548**



**SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

**1.1 PRODUCTS**

- A. Equipment Labels: Metal.
- B. Warning Signs and Labels: 1/8 inch thick with adhesive.
- C. Pipe Labels: Pretensioned
- D. Stencils: ]Brass
- E. Valve Tags: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness.
- F. Warning Tags: Approximately 4 by 7 inches; brass grommet and wire reinforced grommet and wire or string fasteners.

**END OF SECTION 220553**



## SECTION 220700 - PLUMBING INSULATION

### 1.1 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Flame-spread index of 25, and smoke-developed index of 50 for insulation installed indoors; according to ASTM E 84.

### 1.2 DOMESTIC WATER BOILER BREECHING INSULATION SCHEDULE

- A. Round, Exposed Breeching and Connector Insulation: Calcium silicate or high-temperature mineral-fiber blanket .
- B. Round, Concealed Breeching and Connector Insulation: Calcium silicate high-temperature mineral-fiber blanket or high-temperature mineral-fiber board.

### 1.3 EQUIPMENT INSULATION SCHEDULE

- A. Domestic Water Pump Insulation: mineral-fiber board or polyisocyanurate.
- B. Domestic Hot-Water Storage Tank Insulation: Mineral-fiber board or mineral-fiber pipe and tank.
- C. Domestic Water Storage Tank Insulation: Cellular glass flexible elastomeric mineral-fiber board mineral-fiber pipe and tank phenolic polyisocyanurate or polyolefin.
- D. Piping System Filter-Housing Insulation: Cellular glass mineral-fiber board or mineral-fiber pipe and tank.

### 1.4 PIPING INSULATION SCHEDULE, GENERAL

- A. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Below-grade piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 1.5 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water: Cellular glass flexible elastomeric mineral-fiber, preformed pipe insulation, Type I.
- B. Domestic Hot and Recirculated Hot Water: Cellular glass flexible elastomeric mineral-fiber, preformed pipe insulation, Type I
- C. Roof Drain and Overflow Drain Bodies: Cellular glass flexible elastomeric mineral-fiber, preformed pipe insulation, Type I

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- D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Flexible elastomeric

1.6 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Equipment, Concealed: PVC, Aluminum
- B. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches: PVC, Aluminum
- C. Piping, Exposed: PVC Piping, Exposed: PVC PVC, color-coded by system Aluminum

END OF SECTION 220700

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**SECTION 220800 - PLUMBING COMMISSIONING**

**1.0 GENERAL**

**1.01 SUMMARY:**

The contractor shall participate fully in commissioning as specified in Division 019113 "Commissioning". See Div 019113 for a specific list of equipment and systems to be covered by the commissioning process.

**END OF SECTION 220800**



**SECTION 221116 - DOMESTIC WATER PIPING**

**1.1 UNDER-BUILDING-SLAB, DOMESTIC WATER, BUILDING SERVICE PIPING,**

**A. Pipe NPS 3 and Smaller:**

1. Soft copper tube, ASTM B 88, Type K ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed copper pressure-seal fittings; and pressure-sealed joints.

**B. Pipe NPS 4 to NPS 8 and Larger:**

1. Soft copper tube, ASTM B 88, Type K ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed joints.
2. Mechanical-joint, ductile-iron pipe; standard- or compact- pattern mechanical-joint fittings; and mechanical joints.
3. Push-on-joint, ductile-iron pipe; standard- or compact- pattern push-on-joint fittings; and gasketed joints.

**1.2 UNDER-BUILDING-SLAB, DOMESTIC WATER PIPING**

**A. Pipe NPS 2 and Smaller:**

1. Hard Hard or soft Soft copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed copper pressure-seal-joint fittings; and pressure-sealed joints.

**1.3 ABOVEGROUND DOMESTIC WATER PIPING**

**A. Pipe NPS 2 and Smaller:**

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed soldered joints.
2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B 88, Type L]; copper push-on-joint fittings; and push-on joints.

**B. Pipe NPS 2-1/2 to NPS 4:**

1. Hard copper tube, ASTM B 88, Type L ASTM B 88, cast- or wrought- copper solder-joint fittings; and brazed soldered joints.

**1.4 MANUFACTURED UNITS**

**A. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.**

**B. Flexible Connectors: Stainless-steel hose.**

**END OF SECTION 221116**



**SECTION 221117 - PROCESSED-WATER PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This Section includes deionized -water piping.

**1.3 DEFINITIONS**

- A. PP: Polypropylene plastic.
- B. PVC: Polyvinyl chloride plastic.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Provide components and installation capable of producing piping with the following minimum working-pressure ratings, unless otherwise indicated:
  - 1. Deionized (Reagent grade) Water Piping: 150 psig, unless otherwise indicated.

**1.5 SUBMITTALS**

- A. Product Data: For each type of pipe and fitting indicated.
- B. Welding certificates.
- C. Samples of field quality-control test reports.

**1.6 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing laboratory.
- B. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
- C. ASME Compliance: Comply with ASME B31.3, "Process Piping."

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Do not store plastic pipe and fittings in direct sunlight.
- B. Protect pipe and fittings from dirt and damage.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the manufacturers specified.

**2.2 PIPING MATERIALS**

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.
- B. **Transition Fittings:** Couplings, flanges, or other manufactured fittings, same size as, with pressure rating at least equal to and ends compatible with piping to be joined.

**2.3 PLASTIC PIPE AND FITTINGS**

- A. **Schedule 80, CPVC Pipe and Fittings:** ASTM F 441/F 441M, pipe, with plain ends for solvent-cemented joints with ASTM F 439, socket-type fittings.
  - 1. **Manufacturers:**
    - a. Spears LXT
- B. **PP Pipe and Fittings:** Made from ASTM D 4101, PP resin.
  - 1. **Manufacturers:**
    - a. Asahi/America.
    - b. Fischer, George Inc.
    - c. IPEX Inc.
    - d. NIBCO INC.
    - e. Orion.
    - f. Town & Country Plastics, Inc.
  - 2. **Schedule 40, Pipe and Fittings:** Pipe made to ASTM D 2447, Schedule 40 dimensions and socket- or butt-fusion fittings matching pipe Schedule 40 dimensions.

**2.4 PLASTIC VALVES**

A. CPVC Valves: Made from ASTM D 1784, CPVC compounds.

1. Ball Valves, NPS 2 and Smaller: MSS SP-122, union type with socket ends and pressure rating not less than 150 psig at 73 deg F.
2. Check Valves: Swing or ball type with pressure rating not less than [150 psig at 73 deg F.

B. PP Valves: Made from ASTM D 4101, PP resin.

1. Ball Valves, NPS 2 and Smaller: MSS SP-122, union type with socket ends and pressure rating not less than 150 psig at 73 deg F.
2. Butterfly Valves, NPS 3 and Larger: With lever handle and pressure rating not less than 150 psig] at 73 deg F.
3. Check Valves: Swing or ball type with pressure rating not less than 150 psig] at 73 deg F.

END OF SECTION



**SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES**

**1.1 QUALITY ASSURANCE**

- A. Plastic Piping Components: NSF 14.
- B. Drinking Water System Components: NSF 61.

**1.2 PRODUCTS**

**A. Vacuum Breakers:**

- 1. Pipe-Applied, Atmospheric-Type Vacuum Breakers: Rough-bronze finish.
- 2. Hose-Connection Vacuum Breakers: Chrome- or nickel-plated] finish.
- 3. Pressure vacuum breakers.
- 4. Laboratory-faucet vacuum breakers.
- 5. Spill-resistant vacuum breakers.

**B. Backflow Preventers:**

**1. Intermediate Atmospheric-Vent Backflow Preventers:**

- a. End Connections: Union, solder joint.
- b. Finish: Chrome plated or Rough bronze.

**2. Reduced-Pressure-Principle Backflow Preventers:**

- a. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved steel with interior lining complying with AWWA C550 or that is FDA approved stainless steel for NPS 2-1/2 and larger.
- b. End Connections: Threaded for NPS 2 and smaller; flanged Insert type for NPS 2-1/2 and larger.

**3. Double-Check Backflow-Prevention Assemblies:**

- a. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved steel with interior lining complying with AWWA C550 or that is FDA approved stainless steel for NPS 2-1/2 and larger.
- b. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

**4. Beverage-dispensing-equipment backflow preventers.**

**5. Dual-check-valve backflow preventers.**

- a. Carbonated-beverage-dispenser, dual-check-valve backflow preventers.

**6. Hose-connection backflow preventers.**

**7. Backflow-preventer test kits.**

**C. Water Pressure-Reducing Valves:**

1. Water Regulators:
  - a. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
  - b. Water Control Valves: and smaller; flanged for NPS 2-1/2 and larger.
  
- D. Balancing Valves:
  1. Copper-Alloy Calibrated Balancing Valves: Ball valve.
  2. Cast-iron calibrated balancing valves.
  3. Accessories: Meter kit.
  4. Memory-stop balancing valves.
  
- E. Temperature-Actuated Water Mixing Valves:
  1. Water-Temperature Limiting Devices:
    - a. Connections: Threaded union inlets and outlet.
    - b. Finish: Chrome plated or Rough bronze.
  
- F. Strainers for Domestic Water Piping:
  1. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating for NPS 2-1/2 and larger.
  2. Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  3. Screen: Stainless steel with round perforations, unless otherwise indicated.
  4. Drain: Factory-installed, hose-end drain valve.
  
- G. Hose Bibbs:
  1. Vacuum Breaker: Integral
  2. Finish for Service Areas: Chrome or nickel plated.
  3. Operation for Service Areas: Operating key.
  4. Operation for Finished Rooms: Operating key.
  5. Include integral wall flange with each chrome- or nickel-plated hose bibb.
  
- H. Wall Hydrants:
  1. Nonfreeze Wall Hydrants:
    - a. Outlet: Concealed
    - b. Finish: Polished nickel bronze or Chrome plated.
  
- I. Drain Valves: Ball-valve
  
- J. Water Hammer Arresters: Metal bellows or Copper tube with piston.
  
- K. Air Vents: Bolted
  
- L. Trap-Seal Primer Valves: Supply type.

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**1.3 MANUFACTURED UNITS**

**A. Trap-Seal Primer Systems:**

1. Cabinet: Recessed- mounting steel box with stainless-steel cover.

**END OF SECTION 221119**



**SECTION 221123 - DOMESTIC WATER PUMPS**

**1.1 SUMMARY**

- A. Centrifugal pumps for domestic cold- and hot-water systems.

**1.2 PRODUCTS**

- A. Close-Coupled, In-Line, Sealless Centrifugal Pumps: Hermetically sealed, replaceable-cartridge-type with bronze or corrosion-resistant-material impeller.
- B. Flexible connectors.

**END OF SECTION 221123**



**SECTION 221223 - FACILITY INDOOR POTABLE-WATER STORAGE TANKS**

**1.1 SUMMARY**

- A. Potable-water storage tanks and related accessories for indoor installation.

**1.2 PRODUCTS**

- A. Insulated, Steel, Pressure, Potable-Water Storage Tanks: Vertical, with cylindrical sidewalls.
1. Construction: ASME code, steel Steel, constructed with nontoxic welded joints, working pressure.
  2. Tank Interior Finish: NSF 61 barrier materials for potable-water tank linings.
  3. Insulation: Factory-installed, fiberglass or polyurethane foam; complying with ASHRAE/IESNA 90.1.
  4. Jacket: Steel, with manufacturer's standard finish.

**1.3 SOURCE QUALITY CONTROL**

- A. Test and inspect potable-water storage tanks.
1. Pressure Testing for ASME-Code, Potable-Water Storage Tanks: Hydrostatically test.
  2. Pressure Testing for Non-ASME-Code, Pressure, Potable-Water Storage Tanks: Hydrostatically test at pressure of 50 psig above system operating pressure, but not less than 150 psig.
  3. Nonpressure Testing for Potable-Water Storage Tanks: Fill tanks to water operating level to ensure structural integrity and freedom from leaks.

**END OF SECTION 221223**



**SECTION 221316 - SANITARY WASTE AND VENT PIPING**

**1.1 SUMMARY**

- A. Soil, waste, vent piping inside the building.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Minimum Working-Pressure Ratings:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

- B. Seismic Performance: ASCE 7.

**1.3 MATERIALS**

- A. Cast-Iron Pipe and Fittings:

1. Hub-and-spigot Extra-Heavy class.
2. Hubless with] heavy-duty, shielded, stainless-steel heavy-duty, shielded, cast-iron couplings.

- B. Steel Pipe and Fittings: Standard Weight and Schedule 40, galvanized

- C. Special pipe fittings:

1. Flexible, nonpressure pipe couplings.
2. Shielded, nonpressure pipe couplings.
3. Pressure pipe couplings.
4. Flexible ball joints.
5. Expansion joints.
6. Wall-penetration fittings.

- D. Encasement for Underground Metal Piping: PE film.

**END OF SECTION 221316**



SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

1.1 QUALITY ASSURANCE

- A. Quality Standard for Plastic Piping: NSF 14.

1.2 PRODUCTS

- A. Cleanouts: Metal floor Cast iron, wall

- B. Floor Drains:

1. Cast-Iron Floor Drains:

- a. Pattern: Area Floor
- b. Body Material: Gray iron
- c. Seepage Flange: Required.
- d. Anchor Flange: Required.
- e. Clamping Device: Required.
- f. Backwater Valve: Drain-outlet type Integral, ASME A112.14.1, swing-check type
- g. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel
- h. Sediment Bucket:
- i. Top or Strainer Material: Nickel bronze
- j. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.

- C. Trench Drains:

1. Material: Ductile or gray iron.
2. Flange: Anchor Seepage
3. Clamping Device: Required.
4. Grate Material: Ductile iron or gray iron [
5. Grate Finish: Painted
6. Top Loading Classification: Extra Heavy-Duty

- D. Roof Flashing Assemblies: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 6 inches 8 inches 10 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

- E. Through-Penetration Firestop Assemblies: Listed and labeled assembly of sleeve and stack fitting with firestopping plug.

- F. Miscellaneous Sanitary Drainage Piping Specialties:

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1. Open drains, shop or field fabricate from Service class, hub-and-spigot, cast-iron, soil-pipe fittings.
2. Cast-iron or bronze deep-seal traps.
3. Floor-drain, trap-seal primer fittings.
4. Air-gap fittings.
5. Counterflashing-type, cast-iron stack flashing fittings.
6. Cast-iron body vent caps.
7. Frost-resistant vent terminals.
8. Expansion joints.

**G. Flashing Materials:**

1. Lead sheet.
2. Copper sheet.
3. Zinc-coated steel sheet.
4. Elastic-membrane sheet.

**END OF SECTION 221319**

**SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES**

**1.1 PRODUCTS**

**A. Catch Basins:**

1. Polymer-Concrete Catch Basins: 24 by 12 inches. Include gray-iron slotted grate.
  - a. Frame: Gray iron or galvanized steel for grate.

**B. Through-Penetration Firestop Assemblies:** Listed and labeled assembly of sleeve and stack fitting with firestopping plug; with special corrosion-resistant coating on interior of fittings.

**C. Roof Drains:**

1. Metal Roof Drains:
  - a. Pattern: Roof Scupper drain.
  - b. Body Material: Cast iron Combination Flashing Ring and Gravel Stop: Required.
  - c. Outlet: Bottom Dome Material: Cast iron PE Extension Collars: Required.
  - d. Underdeck Clamp: Required.
  - e. Sump Receiver: Required.

**D. Miscellaneous Drainage Piping Specialties:**

1. Expansion joints.
2. Manufactured, ASTM A 48/A 48M, gray-iron casting ASTM A 74, Service class, hub-and-spigot, cast-iron soil-pipe downspout boots.
3. Bronze body conductor nozzles.

**END OF SECTION 221423**



**SECTION 221429 - SUMP PUMPS**

**1.1 SUMMARY**

- A. Wet-pit-mounted sump Submersible sump Packaged, pedestal, drainage Packaged, submersible, drainage pumps and sump pump basins pits for building storm drainage systems.

**1.2 PRODUCTS**

- A. Submersible Sump Pumps: Centrifugal, end-suction, direct-connected pump.
- B. Sump Pump Basins:
  - 1. Sump Materials: Cast iron or fiberglass.
  - 2. Cover Materials: Cast iron or steel with bituminous coating.
- C. Sump Pump Pits: Cast-in-place concrete with galvanized-steel or bituminous-coated steel curb frames.
  - 1. Cover Material: Cast iron Steel with bituminous coating.
- D. Packaged Drainage Pump Units: Centrifugal, end-suction, automatic-operation, freestanding pump unit.
  - 1. Pedestal Units: Aluminum or brass impeller, with motor mounted vertically.
  - 2. Submersible Units: Metal pump body and brass impeller, with hermetically sealed motor and plastic basin.
  - 3. Controls: Float switch.
- E. Flexible Connectors: Stainless steel.
- F. Building automation system interface.

**END OF SECTION 221429**



**SECTION 221513 - COMPRESSED-AIR SYSTEMS**

**A. PROJECT INCLUDES**

1. Low-pressure, compressed-air system operating at 125 psig.
1. Medium-pressure, compressed-air system operating at 200 psig.
1. High-pressure, compressed-air system operating at 400 psig.

**B. QUALITY ASSURANCE**

1. Compliance: ASTM Code, ASME B31.9 for low-pressure compressed-air piping, ASTM B31.1 for medium and high-pressure compressed-air piping.

**C. PRODUCTS**

1. Equipment and Components:
  - a. Compressor Type: Lubricated reciprocating type.
  - b. Aftercoolers: Air cooled type.
  - c. Air Dryers: Refrigerated type.
  - d. Intercoolers: Air cooled type.
  - e. Quick Connect/Disconnect Hose Couplings: Type suitable for installation.
  - f. Control Panels: NEMA ICS 2 automatic control station with load control and protection functions.
2. Pipe, Fittings, and Valves:
  - a. Steel Pipe: ASTM A 53, Type E welded or Type S seamless, Grade B, Schedule 40, black or hot-dipped zinc coated.
  - b. Copper Tube: ASTM B 88, Type K or Type L, seamless, water tube, hard-drawn temper.
  - c. ABC Plastic Pipe: Acrylonitrile-butadiene-styrene plastic pipe, standard dimension ratio of 9.0.
  - d. Fittings: Suitable for piping type and service class.
  - e. Valves: General duty valves for gate, ball, butterfly, globe, and check valves.

**END OF SECTION**



**SECTION 223100 - DOMESTIC WATER SOFTENERS**

**1.1 SUMMARY**

- A. Commercial water softeners.

**1.2 WARRANTY**

- A. Materials and Workmanship:

1. Commercial Water Softener, Warranty Period:

- a. Mineral Tanks: Five 10 years.
- b. Brine Tanks: Three years.
- c. Controls: Five years.
- d. Underdrain Systems: Three years.

**1.3 COMMERCIAL WATER SOFTENERS**

- A. Description: Factory-assembled, pressure-type water softener.
- B. Configuration: Twin unit with two mineral tanks and one brine tank.
- C. Mineral Tanks: FRP, pressure-vessel quality.
  - 1. Construction: Comply with ASME Boiler and Pressure Vessel Code: Section X, "Fiber-Reinforced Plastic Pressure Vessels."
- D. Controls: Fully automatic; factory mounted on unit and factory wired.
- E. Brine Tank: Combination measuring and wet-salt storing system.
  - 1. Tank and Cover Material: Fiberglass or molded PE.
  - 2. Size: Large enough for at least four regenerations at full salting.

**END OF SECTION 223100**



**SECTION 223400 - FUEL-FIRED DOMESTIC WATER HEATERS**

**1.1 SUMMARY**

- A. Dual-fuel water heaters.

**1.2 QUALITY ASSURANCE**

- A. Quality Standard for Performance Efficiency: ASHRAE/IESNA 90.1 and ASHRAE 90.2.

**1.3 WARRANTY**

- A. Materials and Workmanship:
  - 1. Dual-Fuel Water Heaters: Three years.

**1.4 PRODUCTS**

- A. Dual-Fuel, Gas and Oil-Fired Water Heaters: ANSI Z21.10.3/CSA 4.3 or UL 732 requirements appropriate for dual-fuel water heaters.
  - 1. Storage Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.
  - 2. Interior Finish: Comply with NSF 61.
  - 3. Lining: Cement Glass complying with NSF 61.
  - 4. Temperature Control: Adjustable thermostat.
  - 5. Dual-Fuel Burners: For No. 2 fuel oil and UL 795 for natural-gas fuel.
  - 6. Safety Control: Automatic, high-temperature-limit cutoff.
  - 7. Vent Connection: According to standards of authorities having jurisdiction.
  - 8. Energy management system interface.
- B. Compression Tanks:
  - 1. Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm.
  - 2. Interior Finish: Comply with NSF 61.
  - 3. Air-charging valve.
- C. Water Heater Accessories:
  - 1. Gas Shutoff Valves: Manually operated.
  - 2. Gas Pressure Regulators: Appliance type.
  - 3. Gas Automatic Valves: Appliance, electrically operated.
  - 4. Combination temperature and pressure relief valves.
  - 5. Pressure relief valves.
  - 6. Water heater stand and drain pan units.
  - 7. Water heater stands.
  - 8. Water heater mounting brackets.
  - 9. Drain pans.

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10. Piping Manifold Kits: Manufacturer's factory-fabricated.
11. Piping-Type Heat Traps: Field-fabricated piping.

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1.5 SOURCE QUALITY CONTROL

- A. Water Heater Storage Tanks, Specified to Be ASME-Code Construction: Tested and inspected according to ASME Boiler and Pressure Vessel Code.

END OF SECTION 223400

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**SECTION 224000 - PLUMBING FIXTURES**

**1.1 QUALITY ASSURANCE**

- A. Regulatory Requirement: ICC A117.1 Public Law 90-480 Public Law 101-336.
- B. Regulatory Requirement: Public Law 102-486.
- C. Quality Standard: NSF 61 for fixture materials in contact with potable water.
- D. Quality Standard for Electrical Components, Devices, and Accessories: NFPA 70, Article 100.

**1.2 WARRANTY**

- A. Materials and Workmanship for Whirlpools:
  - 1. Commercial Applications:

**2.0 SCOPE**

- 1. See next submission for plumbing fixture list.

**END OF SECTION 224000**



## SECTION 226600 - CHEMICAL-WASTE PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes piping and specialties for the following systems:
  - 1. Chemical-waste and vent, gravity-flow, nonpressure piping system designated "chemical waste."

#### 1.3 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride plastic.
- B. PP: Polypropylene plastic.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure-Piping Pressure Rating: 10-foot head of water.

#### 1.5 SUBMITTALS

- A. Product Data: For chemical-waste piping materials, and components.

#### 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain pipe, fittings, and joining materials for each piping system through one source from a single manufacturer.
  - 1. Exception: Piping from different manufacturers may be used in same system if indicated and suitable transition fittings matching both piping materials are used.
- B. Piping materials shall bear label, stamp, or other markings of specified testing laboratory.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- D. Comply with ASME B31.3, "Process Piping."
- E. Comply with NFPA 70.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
  - 2. CPV Pipe & Fittings: Spears
  - 3. PP Pipe and Fittings:
    - a. Asahi/America.
    - b. Fischer, George Inc.
    - c. IPEX Inc.
    - d. NIBCO INC.
    - e. Orion.
    - f. Town & Country Plastics, Inc.

### 2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

### 2.3 PIPES, TUBES, AND FITTINGS

- A. PP Drainage Pipe and Fittings: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin with fire-retardant additive complying with ASTM D 4101. Include fusion- and mechanical-joint ends.
  - 1. Exception: Pipe and fittings made from PP resin without fire-retardant additive may be used for underground installation.
- B. CPVC Pipe: ASTM F 441/F 441M, Schedule 40.
  - 2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
- C. PP Pressure Pipe and Fittings: Pipe extruded and fittings molded from PP resin complying with ASTM D 4101. Utilize socket or butt-fusion fittings.

**2.4 JOINING MATERIALS**

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for commonly used joining materials.
- B. **Couplings:** Assemblies with combination of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.
- C. **Adapters and Transition Fittings:** Assemblies with combination of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; and made for joining different piping materials.
- D. **Flanges:** Assemblies of companion flanges gasket complying with ASME B16.21 and compatible with system liquid, and bolts and nuts.

**END OF SECTION**



**SECTION 226700 – DEIONIZED PURE WATER SYSTEM**

**PART 1 - GENERAL**

**1.1 SCOPE OF THE WORK:**

- as  
pure
- A. Furnish and install a complete reverse osmosis system as shown on the drawings and hereinafter specified. Water purification system supplier shall have been in the ultra water purification business for a minimum of 5 years.

**1.2 SUBMITTALS:**

Submit product data:

- A. **Manufacturer's Literature and Data:**
  - 1. Carbon filter
  - 2. Reverse osmosis system
  - 3. Storage tank including vent filters and level controls
  - 4. Ultraviolet sterilizer
  - 5. Repressure pumps
  - 6. Deionizer
  - 7. Pressure maintaining valve
  - 8. Water quality monitor
  
- B. The equipment shall be installed under the supervision of a manufacturer's representative who will place the equipment in service and instruct the owner's personnel in its operation, care, and maintenance.

All brackets, hangers, supports, unions, valves, drains, controls etc. necessary for a complete and operating system shall be provided and installed by this section.

**END OF SECTION**



SECTION 226800 - LABORATORY SYSTEMS

A. PROJECT INCLUDES

1. Laboratory Equipment, Pumps, Piping, and Accessories for the Following Applications:
  - a. Reagent grade water systems.
  - b. Chemical waste and vent systems.
  - c. Laboratory compressed-air and vacuum systems.
  - d. Laboratory gas systems including carbon dioxide and nitrogen.

B. QUALITY ASSURANCE

1. Compliance: NFPA 45, NFPA 99.

C. PRODUCTS

1. Pipe and Applications:
  - a. Reagent Grade Water Systems: Polypropylene plastic pipe, Schedule 80 and stainless steel tube and compatible fittings.
  - b. Chemical Waste Systems Below Ground Systems: Polypropylene plastic pipe, Schedule 40 and compatible fittings.
  - c. Chemical Waste and Vent Systems Above Ground: Polypropylene plastic pipe, Schedule 40 and fire resistant Polyvinyl chloride plastic DWV pipe and compatible fittings.
  - d. Laboratory Special Gas Systems Below Ground: Soft copper tube and compatible fittings.
  - f. Underground Protective Casing: PVC casing pipe and fittings.
  - g. Laboratory Compressed-Air, Vacuum, and Special Gas Systems Above Ground: Hard or ACR copper tube with suitable fittings.
2. Laboratory System Components:
  - a. Valves: Reagent grade water valves, gas valves, zone valve boxes, gate, globe, ball and butterfly valves suitable for use.
  - b. Laboratory Air Compressors: Rotary-Screw type.
  - c. Air Inlet Filters: Combination inlet filter-silencer for each compressor.
  - d. Air Dryers: Refrigerated laboratory air dryers, noncycling, air cooled.
  - e. Air Filter Assemblies: Parallel duplex assemblies suitable for laboratory air.
  - f. Air Purification Systems: Parallel duplex laboratory air purification systems.
  - g. Vacuum Pumps: Liquid-Ring or Rotary-Vane type.
  - h. Reagent Grade Water Pumps: Electric drive, centrifugal or turbine type, end-suction, single-stage, radially split design.
  - i. Laboratory Gases Alarm System: Continuous-service type, with dew-point monitors, pressure and vacuum switches or pressure transducer sensors, carbon dioxide monitors, alarm panels, computer interface cabinet.
3. Laboratory System Accessories:

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- a. Strainers.
- b. Neutralization tanks.
- c. Dilution traps.
- d. Drainline interceptor traps.
- e. Corrosion-resistant traps.
- f. Chemical-resistant floor drains.
- g. Chemical-resistant cleanouts, backwater valves and sink outlets.
- h. Laboratory compressed air and special gas manifolds.
- i. Service outlets.
- j. Pressure control panels.
- k. Cylinder wall and storage racks.

**END OF SECTION**

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**SECTION 230500 - COMMON WORK RESULTS FOR HVAC**

**1.1 MATERIALS**

- A. Transition Fittings:
  - 1. Plastic-to-metal transition fittings.
  - 2. Plastic-to metal transition adaptors.
  - 3. Plastic-to-metal transition unions.
  
- B. Dielectric Fittings: Dielectric unions flanges couplings and nipples.
  
- C. Mechanical Sleeve Seals: EPDM NBR sealing elements; plastic carbon-steel pressure plates.
  
- D. Sleeves: Galvanized-steel sheet steel pipe] molded PVC PVC pipe and PE.
  
- E. Escutcheons:
  - 1. One-piece, deep pattern.
  - 2. One-piece, cast brass.
  - 3. Split-casting, cast brass.
  - 4. One-piece, stamped steel.
  - 5. Split-plate, stamped steel.
  - 6. One-piece, floor plate.
  - 7. Split-casting, floor plate.

**END OF SECTION 230500**



**SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

**1.1 MATERIALS**

- A. Polyphase Motors: Design B, medium induction motors.**
1. Efficiency: Energy efficient.
  2. Service Factor: 1.15.
  3. Multispeed Motors: Variable torque Separate winding for each speed.
  4. Rotor: Random-wound, squirrel cage.
  5. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
  6. Temperature Rise: Match insulation rating.
  7. Insulation: Class F
- B. Polyphase Motors with Additional Requirements:**
1. Motors used with reduced-voltage and multispeed controllers.
  2. Energy- and premium-efficient and Inverter-duty motors used with variable frequency controllers.
  3. Severe-duty motors.
- C. Single-Phase Motors:**
1. Motors Larger than 1/20 HP: Permanent-split capacitor; split phase; capacitor start, inductor run; or capacitor start, capacitor run to suit starting torque and requirements of specific motor application.
  2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
  3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
  4. Motors 1/20 HP and Smaller: Shaded-pole type.
  5. Internal thermal protection.

**END OF SECTION 230513**



**SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING**

**1.1 PRODUCTS**

- A. **Metal-Bellows Expansion Joints:** Single- or multiple Multiple-ply phosphor-bronze for copper piping, single-ply stainless steel for stainless-steel piping, and single- or multiple for stainless steel for steel piping.
- B. **Rubber Expansion Joints:**
  - 1. **Arch Type:** Single or multiple arches.
  - 2. **Spherical Type:** Single or multiple spheres.
  - 3. **Material:** BR Buna-N CR CSM EPDM NR.
- C. **Flexible-Hose Expansion Joints:** Copper alloy with solder connections for copper piping, and carbon steel with threaded, flanged, and weld ends for steel piping.
- D. **Pipe Alignment Guides:** Factory fabricated, steel.
- E. **Materials for Pipe Anchors:** Steel shapes and plates, and mechanical fasteners.

**END OF SECTION 230516**



SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

1.1 PRODUCTS

A. Thermometers:

1. Metal-Case, Liquid-in-Glass Type: Aluminum or Brass case, organic-liquid filled.
2. Plastic-Case, Liquid-in-Glass Type: organic-liquid filled.
3. Duct, Liquid-in-Glass Type: [Aluminum] case, mercury or organic-liquid filled.
4. Direct-Mounting, Vapor-Actuated Dial Type: [Liquid-filled] type, [steel or aluminum] [case].
5. Remote-Reading, Vapor-Actuated Dial Type: Dry type, steel or aluminum case.
6. Bimetallic-Actuated Dial Type: [Liquid-filled] type, stainless-steel case.

B. Thermowells to hold test thermometers.

C. Pressure Gages:

1. Direct-Mounting Dial Type: [Liquid-filled] type, [drawn-steel or cast-aluminum] [metal]] case; Grade [A] accuracy.
2. Remote-Mounting Dial Type: Dry type, drawn-steel or cast-aluminum case; Grade A accuracy.

D. Test Plugs: Corrosion-resistant brass or stainless-steel body with core inserts.

1. Test kit containing pressure gage, low- and high-range thermometers, and carrying case.

E. Flowmeters:

1. Wafer-Orifice Type: Cast-iron body and brass valves with permanent indicators.
2. Venturi Type: Bronze, brass, or steel body with permanent indicators.

F. Flow Indicators: Bronze or stainless-steel body with sight glass and plastic pelton-wheel indicator.

END OF SECTION 230519



## SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

### 1.1 CHILLED-WATER and CONDENSER WATER VALVES

#### A. Pipe NPS 2 and Smaller:

1. Bronze Angle Valves: Class 150, bronze nonmetallic disc.
2. Ball Valves: Two piece, full port, brass or bronze with brass bronze stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze nonmetallic disc.

#### B. Pipe NPS 2-1/2 and Larger:

1. Iron Ball Valves: Class 150.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, aluminum-bronze stainless-steel disc.
3. Iron, Grooved-End Butterfly Valves: 300 CWP.
4. High-Performance Butterfly Valves: Class 150 single flange.
5. Iron Swing Check Valves: Class 125 metal nonmetallic-to-metal seats.
6. Iron Swing Check Valves with Closure Control: Class 125, lever and spring
7. Iron, Grooved-End Check Valves: 300 CWP.

### 1.2 HEATING-WATER VALVES

#### A. Pipe NPS 2 and Smaller:

1. Bronze Angle Valves: Class 150, bronze nonmetallic disc.
2. Ball Valves: Two piece, full port, brass or bronze with brass bronze stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze nonmetallic] disc.
4. Bronze Gate Valves: Class 150, NRS RS.
5. Bronze Globe Valves Class 150, bronze nonmetallic disc.

#### B. Pipe NPS 2-1/2 and Larger:

1. Iron Ball Valves: Class 150.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, aluminum-bronze ductile-iron stainless-steel disc.
3. Iron, Grooved-End Butterfly Valves: 175 CWP.
4. High-Performance Butterfly Valves: Class 150, single flange.
5. Iron Swing Check Valves: Class 250, metal nonmetallic-to-metal seats.
6. Iron Swing Check Valves with Closure Control: Class 125, lever and spring
7. Iron, Grooved-End Check Valves: 300 CWP.

### 1.3 LOW-PRESSURE STEAM VALVES (15 PSIG OR LESS)

#### A. Pipe NPS 2 and Smaller:

1. Bronze Angle Valves: Class 150, bronze nonmetallic disc.
2. Ball Valves: Three piece, full port, brass or bronze with brass bronze stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze nonmetallic disc.

4. Bronze Gate Valves: Class 150, NRS RS.
5. Bronze Globe Valves: Class 150, bronze nonmetallic disc.

**B. Pipe NPS 2-1/2 and Larger:**

1. Iron Ball Valves: Class 150.
2. High-Performance Butterfly Valves: Class 150], single flange.
3. Iron Swing Check Valves: Class 250, nonmetallic-to-metal seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring].
5. Iron Gate Valves: Class 250, NRS OS&Y.
6. Iron Globe Valves: Class 250.

**1.4 HIGH-PRESSURE STEAM VALVES (MORE THAN 15 PSIG)**

**A. Pipe NPS 2 and Smaller:**

1. Bronze Angle Valves: Class 125 Class 150, bronze nonmetallic disc.
2. Ball Valves: Three piece, full or bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Gate Valves: Class 150, NRS RS, bronze.
5. Globe Valves: Class 150, bronze, bronze nonmetallic disc.

**B. Pipe Sizes NPS 2-1/2 and Larger:**

1. Ball Valves: Class 150, iron.
2. High-Performance Butterfly Valves: Class 300, single flange.
3. Iron Swing Check Valves: Class 250, nonmetallic-to-metal seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
5. Iron Gate Valves: Class 250, NRS OS&Y.
6. Iron Globe Valves: Class 250.

**1.5 STEAM-CONDENSATE VALVES**

**A. Pipe NPS 2 and Smaller:**

1. Bronze Angle Valves: Class 150, bronze nonmetallic disc.
2. Ball Valves: Three piece, full port, brass or bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze nonmetallic disc.
4. Bronze Gate Valves: Class 150, NRS RS.
5. Bronze Globe Valves: Class 150, bronze nonmetallic disc.

**B. Pipe NPS 2-1/2 and Larger:**

1. Iron Ball Valves: Class 150.
2. High-Performance Butterfly Valves: Class 300, single flange.
3. Iron Swing Check Valves: Class 250, nonmetallic-to-metal seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring
5. Iron Gate Valves: Class 250, NRS OS&Y.

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**END OF SECTION 230523**

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**SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**1.1 SUMMARY**

- A. Hangers and supports for HVAC system piping and equipment.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Design supports for multiple pipes and equipment.
- B. Design seismic-restraint hangers and supports and obtain approval from authorities having jurisdiction.

**1.3 SUBMITTALS**

- A. Shop Drawings: Signed and sealed by a qualified professional engineer.

**1.4 COMPONENTS**

- A. Steel pipe hangers and supports.
- B. Trapeze pipe hangers.
- C. Fiberglass pipe hangers.
- D. Metal framing systems.
- E. Fiberglass strut systems.
- F. Thermal-hanger shield inserts.
- G. Equipment supports.

**END OF SECTION 230529**



**SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT**

**1.1 PERFORMANCE REQUIREMENTS**

**A. Seismic-Restraint Loading:**

1. Site Class as Defined in the IBC: For this area.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: For this area

**1.2 COMPONENTS**

**A. Vibration Isolators:**

1. Isolator Pads: Neoprene and Rubber.
2. Mounts: Double-deflection type.
3. Restrained Mounts: All directional mountings with seismic restraint; cast-ductile-iron housing.
4. Spring Isolators: Freestanding, laterally stable, open-spring type.
5. Restrained Spring Isolators: Freestanding, steel, open-spring type with seismic restraint.
6. Housed Spring Mounts: Ductile-iron or steel housing, with integral, vertically adjustable seismic snubbers.
7. Elastomeric Hangers: Double-deflection type.
8. Spring Hangers: Combination coil-spring and elastomeric-insert hangers with spring and insert in compression.
9. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hangers with spring and insert in compression and with vertical-limit stop.
10. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor.
11. Resilient pipe guides.

**B. Air-Mounting Systems:**

1. Air Mounts: Freestanding, single or multiple, compressed-air bellows.
2. Restrained Air Mounts: Housed compressed-air bellows.

**C. Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail; with spring isolators mounted on elastomeric isolation pads, and snubber bushings.**

**D. Vibration Isolation Equipment Bases:**

1. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
2. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for field-applied, cast-in-place concrete.

**E. Seismic-Restraint Devices:**

1. Snubbers: Welded structural-steel shapes and replaceable resilient isolation washers and bushings.
2. Channel Support System: MFMA-3 slotted steel channels.

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3. Restraint Cables: Galvanized- Stainless-steel cables.
4. Anchor Bolts: Mechanical type, seismic rated.
5. Resilient Isolation Washers and Bushings: Molded neoprene.

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END OF SECTION 230548

**SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

**1.1 QUALITY ASSURANCE**

- A. Quality Standard for Piping Identification: ASME A13.1.

**1.2 PRODUCTS**

- A. Equipment Labels: Metal.
- B. Warning Signs and Labels: 1/8 inch thick with fasteners adhesive.
- C. Pipe Labels: Pretensioned.
- D. Duct Labels 1/8 inch thick with fasteners adhesive.
- E. Stencils: Brass
- F. Valve Tags: Brass, 0.032-inch.

**END OF SECTION 230553**



SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

1.1 SUMMARY

- A. Testing, adjusting, and balancing for the following:
1. Air Systems: [Constant-volume] and [variable-air-volume] systems.
  2. Hydronic Systems: Variable and primary-secondary-flow systems.
  3. Steam systems.
  4. Heat exchangers.
  5. Motors.
  6. Chillers.
  7. Cooling towers.
  8. Condensing units.
  9. Boilers.
  10. Heat-transfer coils.
  11. Temperature measurements.
  12. Space pressurization measurements and adjustments.
  13. Vibration measurements.
  14. Sound-level measurements.
  15. Stair-tower pressurization system measurements and adjustments.
  16. Smoke-control system testing.
  17. Indoor-air quality measurements.
  18. Existing systems.
  19. Temperature-control verification.

1.2 QUALITY ASSURANCE

- A. Testing, Adjusting, and Balancing Agent Qualifications: AABC or NEBB certified.

1.3 WARRANTY

- A. Guarantee: AABC national project performance or NEBB guarantee that a certified agent has performed TAB and optimum performance capabilities have been achieved.

1.4 EXECUTION

- A. Examination: Contract Documents, approved submittal data, Project Record Documents, design data, equipment performance data, system and equipment installations, systems and equipment test reports, and automatic controls for deficiencies that may preclude proper TAB of systems and equipment.
1. Deficiencies report.
- B. Testing, adjusting, and balancing plan.
- C. Systems readiness checks.
- D. Testing, Adjusting, and Balancing Procedures: AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." NEBB's "Procedural

Standards for Testing, Adjusting, and Balancing of Environmental Systems." SMACNA's "HVAC Systems HVAC Systems - Testing, Adjusting, and Balancing."

- E. Equipment settings marked to show final settings.
- F. HVAC Systems Airflow and Water Flow Rate Tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 percent to plus 10 percent.
  - 2. Air Outlets and Inlets: 0 to minus 10 percent.
  - 3. Heating-Water Flow Rate: 0 to minus 10 percent.
  - 4. Cooling-Water Flow Rate: 0 to minus 5 percent.
- G. Reporting:
  - 1. Initial Construction-Phase Report: Based on examination of the Contract Documents, on adequacy of design for systems' balancing devices.
  - 2. Status Reports: As Work progresses.
  - 3. Final Report: Certification sheet with content and format according to AABC NEBB SMACNA standard forms.
- H. Inspections:
  - 1. Initial Inspections: Random checks by TAB firm to verify final TAB report.
  - 2. Final Inspections: Random checks by Owner Architect to verify final TAB report.
- I. Additional Tests:
  - 1. Performed within 90 days to verify that balance conditions are being maintained.
  - 2. Seasonal tests.

END OF SECTION 230593

**SECTION 230700 - HVAC INSULATION**

**1.1 QUALITY ASSURANCE**

- A. **Fire-Test-Response Characteristics:** Flame-spread index of 50 for insulation installed indoors according to ASTM E 84.

**1.2 BOILER BREECHING INSULATION SCHEDULE**

- A. Round, Exposed Breeching and Connector Insulation: Calcium silicate
- B. Round, Concealed Breeching and Connector Insulation: Calcium silicate
- C. **DUCT INSULATION SCHEDULE, GENERAL**
- D. **Plenums and Ducts Requiring Insulation:**
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air. and penetration of building exterior.
  - 3. Outdoor, concealed supply and return.
  - 4. Outdoor, exposed supply and return.
- E. **Items Not Insulated:**
  - 1. Fibrous-glass ducts.
  - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  - 3. Factory-insulated flexible ducts.
  - 4. Factory-insulated plenums and casings.
  - 5. Flexible connectors.
  - 6. Vibration-control devices.
  - 7. Factory-insulated access panels and doors.

**1.3 INDOOR DUCT AND PLENUM INSULATION SCHEDULE**

- A. **Concealed, Round and Flat-Oval, Supply-Air Duct Insulation:** Flexible elastomeric mineral-fiber blanket.
- B. **Concealed, Round and Flat-Oval, Return-Air Duct Insulation:** Flexible elastomeric mineral-fiber blanket.
- C. **Concealed, Round and Flat-Oval, Outdoor-Air Duct Insulation:** Flexible elastomeric mineral-fiber blanket [.
- D. **Concealed, Round and Flat-Oval, Exhaust-Air Duct Insulation:** Flexible elastomeric mineral-fiber blanket.
- E. **Concealed, Rectangular, Supply-Air Duct Insulation:** Flexible elastomeric mineral-fiber blanket.

- F. Concealed, Rectangular, Return-Air Duct Insulation: Flexible elastomeric mineral-fiber blanket
- G. Concealed, Rectangular, Outdoor-Air Duct Insulation: Flexible elastomeric mineral-fiber blanket.
- H. Exposed, Round and Flat-Oval, Supply-Air Duct Insulation: Flexible elastomeric mineral-fiber blanket
- I. Exposed, Round and Flat-Oval, Return-Air Duct Insulation: Flexible elastomeric mineral-fiber blanket.
- J. Exposed, Round and Flat-Oval, Outdoor-Air Duct Insulation: Flexible elastomeric mineral-fiber blanket.
- K. Exposed, Rectangular, Supply-Air Duct Insulation: Flexible elastomeric mineral-fiber blanket.
- L. Exposed, Rectangular, Return-Air Duct Insulation: Flexible elastomeric mineral-fiber blanket.
- M. Exposed, Rectangular, Outdoor-Air Duct Insulation: Flexible elastomeric mineral-fiber blanket
- N. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket board blanket or board; thickness as required to achieve 2-hour fire rating.

#### 1.4 EQUIPMENT INSULATION SCHEDULE

- A. Chillers flexible elastomeric.
- B. Heat-Exchanger (Water-to-Water for Heating Service) Insulation: Calcium silicate
- C. Steam-to-Hot-Water Converter Insulation: Calcium silicate.
- D. Chilled-Water Pump Insulation: Cellular glass mineral-fiber board phenolic or polyisocyanurate.
- E. Condenser-Water Pump Insulation: Cellular glass
- F. Steam Condensate Pump and Boiler Feedwater Pump Insulation: Calcium silicate
- G. Chilled-Water Expansion/Compression Tank Insulation: Cellular glass flexible elastomeric mineral-fiber board
- H. Condenser-Water Expansion/Compression Tank Insulation: Cellular glass flexible elastomeric .
- I. Heating-Hot-Water Expansion/Compression Tank Insulation: Calcium silicate cellular glass].

- J. Chilled-Water Air-Separator Insulation: Cellular glass flexible elastomeric
- K. Heating-Hot-Water Air-Separator Insulation: Calcium silicate
- L. Deaerator Insulation: Calcium silicate
- M. Steam Condensate Tank and Receiver Insulation: Calcium silicate
- N. Steam Flash-Tank, Flash-Separator, and Blow-Off-Tank Insulation: Calcium silicate.
- O. Piping System Filter-Housing Insulation: Cellular glass

#### 1.5 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F: Cellular glass flexible elastomeric
- B. Chilled Water and Brine, 40 Deg F and below: Cellular glass mineral-fiber, preformed pipe, Type I
- C. Chilled Water and Brine, above 40 Deg F: Cellular glass flexible elastomeric
- D. Condenser-Water Supply and Return: Cellular glass flexible elastomeric.
- E. Heating-Hot-Water Supply and Return, 200 Deg F and below: Cellular glass
- F. Steam and Steam Condensate, 350 Deg F and below: Calcium silicate
- G. Refrigerant Suction and Hot-Gas Piping: Cellular glass flexible elastomeric.
- H. Refrigerant Suction and Hot-Gas Flexible Tubing: Flexible elastomeric or polyolefin.
- I. Hot Service Vents: Calcium silicate

#### 1.6 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Chilled Water and Brine: Cellular glass flexible elastomeric
- B. Condenser-Water Supply and Return: Cellular glass flexible elastomeric
- C. Heating-Hot-Water Supply and Return, 200 Deg F and below: Cellular glass
- D. Steam and Steam Condensate, 350 Deg F and below: Calcium silicate cellular glass
- E. Refrigerant Suction and Hot-Gas Piping: Cellular glass flexible elastomeric
- F. Refrigerant Suction and Hot-Gas Flexible Tubing: Flexible elastomeric

**1.7 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Ducts and Plenums, Exposed: PVC or Aluminum
- B. Equipment, Concealed: PVC PVC, color-coded by system Aluminum Painted aluminum Stainless steel.
- C. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches: PVC PVC, color-coded by system Aluminum Painted aluminum Stainless steel.
- D. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches: Aluminum Painted aluminum Stainless steel.
- E. Piping, Concealed: PVC PVC, color-coded by system Aluminum Painted aluminum Stainless steel.
- F. Piping, Exposed: PVC PVC, color-coded by system Aluminum Painted aluminum Stainless steel.

**END OF SECTION 230700**

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**SECTION 230800 - HVAC COMMISSIONING**

**1.0 GENERAL**

**1.01 SUMMARY:**

The contractor shall participate fully in commissioning as specified in Division 019113 "Commissioning". See Div 019113 for a specific list of equipment and systems to be covered by the commissioning process.

**END OF SECTION 230800**



**SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC**

**1.1 SUMMARY**

- A. Control equipment for HVAC systems and components.

**1.2 QUALITY ASSURANCE**

- A. Quality Standard: Comply with ASHRAE 135 for DDC system components.

**1.3 COMPONENTS**

- A. DDC Equipment:
1. Operator Workstation: microcomputer(s) with printer.
  2. Printer: Color, ink-jet type.
  3. Application Software: With dynamic color graphic displays, alarm and event processing, automatic restart, and data collection.
  4. Diagnostic Terminal Unit: Portable notebook-style microcomputer.
  5. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
  6. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
  7. Hardwired I/O interface.
  8. Power supplies.
  9. Power line filtering.
- B. Unitary Controllers: Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
- C. Alarm Panels: Unitized cabinet with suitable brackets for wall or floor mounting. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.
- D. Analog Controllers:
1. 6- or 10-stage-type step controllers.
  2. Remote-bulb or bimetal rod-and-tube-type, electric outdoor-reset controllers.
  3. Wheatstone-bridge-amplifier-type electronic controllers.
  4. Solid-state fan-speed controllers.
  5. Single- or multiple-input receiver controllers.
- E. Time Clocks: Solid-state, programmable time control with separate programs.
- F. Electronic Sensors: Wall, immersion, or duct mounting.
1. Thermistor temperature sensors and transmitters.
  2. RTDs and transmitters.
  3. Humidity sensors.
  4. Pressure transmitters/transducers.

**G. Pneumatic Sensors:**

1. Pneumatic Transmitters:
  - a. Space-temperature sensors.
  - b. Room return-air temperature sensors.
  - c. Duct-mounted or immersion-type temperature sensors.
  - d. Temperature transmitters.
  - e. Space and duct humidity transmitters.
  - f. Differential-pressure transmitters.
  - g. Differential-air-pressure transmitters.
2. Digital-to-pneumatic transducers.
3. Pneumatic valve/damper position indicators.

**H. Status Sensors:**

1. Status inputs for fans.
2. Status inputs for pumps.
3. Status inputs for electric motors.
4. Voltage transmitters (100- to 600-V ac).
5. Power monitors.
6. Current switches.
7. Electronic valve/damper position indicators.
8. Water-flow switches.

**I. Gas Detection Equipment:**

1. Carbon monoxide detectors.
2. Carbon dioxide sensor and transmitters.
3. Oxygen sensor and transmitters.
4. Occupancy sensors.

**J. Duct airflow station.**

**K. Thermostats:**

1. Combination thermostat and fan switches.
2. Electric, solid-state, microcomputer-based room thermostats.
3. Low-voltage, on-off thermostats.
4. Line-voltage, on-off thermostats.
5. Remote-bulb thermostats.
6. Fire-protection thermostats.
7. Pneumatic room thermostats.
8. Immersion thermostats.
9. Airstream thermostats.
10. Electric, low-limit duct thermostats.
11. Electric, high-limit duct thermostats.
12. Heating/cooling valve-top thermostats.

**L. Actuators:**

1. Electric motors.
2. Electronic actuators.
3. Pneumatic valve and damper operators.

**M. Control Valves:**

1. Globe Valves: Bronze body for NPS 2 and smaller; iron body for NPS 2-1/2 and larger.
2. Butterfly Valves: Cast-iron or ductile-iron body.

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3. Terminal Unit Control Valves: Bronze body.
4. Self-Contained Control Valves: Bronze body.

N. Dampers: AMCA-rated, design, for standard-pressure and low-leak applications.

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O. Air Supply:

1. Tank: ASME storage tank.
2. Air Compressor: Duplex[,] scroll type.
3. Refrigerated air dryers.
4. Desiccant dryers.
5. Pressure gages.
6. Instrument pressure gages.
7. Diaphragm control and instrument valves.
8. Gage cocks.
9. Relays.
10. Switches.
11. Pressure regulators.
12. Particle filters.
13. Combination filter/regulators.
14. Airborne oil filters.
15. Pressure relief valves.

P. Pressure-reducing stations.

END OF SECTION 230900



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**SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS**

**1.1 SUMMARY**

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- A. Control sequences for HVAC systems, subsystems, and equipment see next submission.

**END OF SECTION 230993**



**SECTION 231113 - FACILITY FUEL-OIL PIPING**

**1.1 SUMMARY**

- A. Fuel-oil distribution systems, including storage tanks, piping, valves, and specialties.
- B. The storage tank shall be an below grade fiberglass double wall tank.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Maximum Operating-Pressure Ratings: 3 psig.

**1.3 MATERIALS**

A. Piping Specialties:

- 1. Metallic flexible connectors.
- 2. Manual air vents.

B. Manual Fuel-Oil Shutoff Valves:

- 1. One-piece, bronze ball valves with bronze trim.
- 2. Two-piece, full-port, bronze ball valves with bronze trim.

C. Specialty Valves:

- 1. Pressure relief valves.
- 2. Oil safety valves.
- 3. Emergency shutoff valves.
- 4. Mechanical leak detector.

D. Vertical, Steel, Fuel-Oil AST Double wall.

E. Horizontal, Steel, Fuel-Oil AST: Double wall with steel supports welded to tank or cast-iron cradles for field installation.

F. Containment-Dike, Steel, Fuel-Oil AST: Single wall, horizontal.

G. Insulated, Steel, Fuel-Oil AST: Double wall, horizontal.

H. Concrete-Vaulted, Steel, Fuel-Oil AST: Double wall, insulated, horizontal.

I. Steel, Fuel-Oil UST with STI-P3: Type I II, double wall, horizontal.

J. Composite, Steel, Fuel-Oil UST: STI F894, Type I II, double wall, horizontal.

K. Jacketed, Steel, Fuel-Oil UST: Horizontal, steel.

- L. FRP Fuel-Oil UST: Double wall, with integral hydrostatic, leak-detection and monitoring system.
- M. Fuel-Oil AST Accessories:
  - 1. Tank manholes.
  - 2. Ladders.
- N. Fuel-Oil UST Accessories:
  - 1. Tank manholes.
  - 2. Steel tank masonry supports.
  - 3. Ladders.
  - 4. Containment sumps.
  - 5. Sump entry boot.
  - 6. Anchor straps.
  - 7. Overfill prevention valves.
- O. Fuel-Oil Storage Tank Piping Specialties:
  - 1. Spill-containment fill boxes.
  - 2. Fill boxes.
  - 3. Locking fill boxes.
  - 4. Metal manholes.
  - 5. Monitoring well caps.
- P. Submersible Fuel-Oil Pumps: Turbine fuel-oil pumps with pump controller panel and interface controller to HVAC controls.
- Q. Duplex Fuel-Oil Transfer Pump Sets: Packaged unit, skid mounted, with positive-displacement, rotary gear or vane type, with V-belt gear reducer direct close-coupled drive and interface controller to HVAC controls.
- R. Fuel Maintenance System: Steel-gear-with-crescent, positive-displacement, direct-coupled, rotary type pump. Programmable logic controller with alarms and interface controller to HVAC controls.
- S. Liquid-Level Gage Systems: UL 180 with floats UL 1238 with probes with annunciator panel.
- T. Leak-Detection and Monitoring System: Cable sensor Hydrostatic system complying with UL 180 with floats UL 1238 with probes and annunciator panel.
- U. Fuel Oil:
  - 1. Grade No. 1
- V. Escutcheons to cover pipe opening in finished spaces.
- W. Labeling and Identifying: Detectable warning tape buried above tank and piping.
- X. Precast concrete manholes with cast-iron frame and cover.

**1.4 OUTDOOR PIPING SCHEDULES**

- A. Underground, Fuel-Oil Piping: Flexible [double-containment piping.
- B. Underground, Fuel-Oil-Tank, Fill and Vent Piping: Steel, with protective coating where underground.
- C. Containment Conduit: Steel with welded joints and protective coating.
- D. Aboveground, Fuel-Oil and Vent Piping:
  - 1. NPS 2 and Smaller: Steel pipe with welded joints
  - 2. NPS 2-1/2 and Larger: Steel pipe with welded joints

**1.5 INDOOR PIPING SCHEDULES**

- A. NPS 1/2 and Smaller: Steel pipe with threaded joints NPS 5/8 to NPS 2 and Smaller:
- B. NPS 2-1/2 and Larger: [Steel pipe with welded joints

**END OF SECTION 231113**



## SECTION 231123 - FACILITY NATURAL-GAS PIPING

## 1.1 SUMMARY

- A. Natural-gas piping within the building and distribution on the Project site.

## 1.2 MATERIALS

## A. Piping Specialties:

1. Appliance flexible connectors.
2. Quick-disconnect devices.
3. Y-Pattern strainers.
4. Weatherproof vent cap.

## B. Manual Gas Shutoff Valves:

1. One- and two-piece ball valves.
2. Two-piece, full port bronze ball valves with bronze trim.
3. Bronze plug valves.
4. Cast-iron, lubricated plug valves.
5. PE ball valves.
6. Valve boxes.

## C. Electrically operated motorized gas valves.

## D. Earthquake Valves: Cast-aluminum body with nickel-plated chrome steel stainless-steel internal parts.

## E. Pressure Regulators:

1. Service pressure regulators.
2. Line pressure regulators.
3. Appliance pressure regulators.

## F. Service Meters:

1. Furnished by natural-gas supplier.
2. Service-meter bars.
3. Service-meter bypass fittings.

## G. Dielectric Fittings: Dielectric unions dielectric flanges and dielectric-flange kits.

## H. Sleeves: Steel and cast-iron pipe.

## I. Mechanical sleeve seals.

## J. Escutcheons:

1. One piece; deep pattern.
2. One piece; cast brass.
3. Split casting; cast brass.

4. One piece; stamped steel.
5. Split plate; stamped steel.
6. One piece; floor plate.
7. Split casting; floor plate.

K. Detectable warning tape for underground piping.

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### 1.3 OUTDOOR PIPING SCHEDULE

- A. Underground Piping: PE pipe with heat-fusion joints
- B. Aboveground Piping: Steel pipe with welded joints

### 1.4 INDOOR PIPING SCHEDULE FOR PRESSURES MORE THAN 0.5 PSIG 5 PSIG

- A. Aboveground Branch Piping NPS 1 and Smaller: Corrugated stainless-steel tubing with mechanical fittings Steel pipe with threaded joints.
- B. Aboveground Distribution Piping: Steel pipe with welded joints
- C. Underground Piping: Steel pipe with threaded joints Steel pipe with welded joints.
- D. Containment Conduit and Vent Piping: Steel pipe with welded joints.

### 1.5 INDOOR PIPING SCHEDULE FOR PRESSURES MORE THAN 5 PSIG

- A. Aboveground Branch Piping: Steel pipe with welded joints.
- B. Aboveground Distribution Piping: Steel pipe with welded joints

END OF SECTION 231123

**SECTION 232113 - HYDRONIC PIPING**

**1.1 SUMMARY**

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
1. Hot-water heating piping.
  2. Chilled-water piping.
  3. Condenser-water piping.
  4. Glycol cooling-water piping.
  5. Makeup-water piping.
  6. Condensate-drain piping.
  7. Blowdown-drain piping.
  8. Air-vent piping.
  9. Safety-valve-inlet and -outlet piping.

**1.2 QUALITY ASSURANCE**

- A. Quality Standard: ASME B31.9.

**1.3 PRODUCTS**

- A. Valves:
1. Bronze, Calibrated-Orifice, Balancing Valves: Ball or plug type.
  2. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves: Ball, plug, or globe pattern.
  3. Pressure-Reducing Valves: Bronze or brass.
  4. Safety Valves: Bronze or brass.
  5. Automatic Flow-Control Valves: Brass or ferrous metal body; stainless-steel corrosion-resistant piston and spring assembly; combination assemblies include bronze or brass-alloy ball valve.
- B. Air Control Devices:
1. Air Vents: Manual and automatic.
  2. Expansion Tanks: ASME labeled with bladder or diaphragm.
  3. Air Separators: In-line
- C. Bypass chemical feeder and chemicals and glycol for first year of operation.
- D. Hydronic Piping Specialties:
1. Strainers: Y-pattern, basket, and T-pattern.
  2. Flexible Connectors: Stainless-steel bellows with woven-wire jacket

**1.4 PIPING APPLICATIONS**

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, Insert pipe size range shall be any of the following:**
1. Copper tubing and soldered joints.
  2. Steel pipe, cast malleable-iron fittings, and threaded joints.
  3. Steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, range shall be any of the following:**
1. Copper tubing and soldered brazed joints.
  2. Steel pipe and welded and flanged joints.
  3. Steel pipe and grooved, mechanical joints.
- C. Chilled-water piping, aboveground, NPS 2 and smaller, range shall be any of the following:**
1. Copper tubing and soldered joints.
  2. Steel pipe; cast malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
  3. Steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
- D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:**
1. Copper tubing and soldered brazed joints.
  2. Steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
  3. Steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- E. Condenser-water piping, aboveground, NPS 2 and smaller, shall be any of the following:**
1. Steel pipe; cast malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
  2. Steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
- F. Condenser-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:**
1. Steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
  2. Steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
  3. Condenser
- G. Glycol cooling-water piping, aboveground, NPS 2 and smaller, shall be any of the following:**
1. Copper tubing, wrought-copper fittings, and soldered brazed pressure-seal joints.
  2. Steel pipe; cast malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
  3. Steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.

- H. Glycol cooling-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
  - 1. Copper tubing, wrought-copper fittings, and soldered brazed joints.
  - 2. Steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
  - 3. Steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- I. Makeup-water piping installed aboveground shall be either of the following:
  - 1. Copper tubing, wrought-copper fittings, and soldered brazed joints.
  - 2. CPVC plastic pipe and fittings, and solvent-welded joints.
- J. Makeup-Water Piping Installed Belowground and within Slabs: Annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- K. Condensate-Drain Piping: Copper tubing, wrought-copper fittings, and soldered joints or PVC plastic pipe and fittings and solvent-welded joints.
- L. Condensate-Drain Piping: PVC plastic pipe and fittings and solvent-welded joints.
- M. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- N. Air-Vent Piping:
  - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
  - 2. Outlet: Copper tubing with soldered or flared joints.
- O. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

#### 1.5 VALVE APPLICATIONS

- A. Shutoff-duty valves are for each installation in branch connection to supply mains, and at supply connection to each piece of equipment.
- B. [Calibrated-orifice, balancing valves are for installation in return pipe of each heating or cooling terminal.
- C. Check valves are for installation in each pump discharge and elsewhere as required to control flow direction.
- D. Safety valves are for installation in hot-water generators.
- E. Pressure-reducing valves are for installation in makeup-water connection to regulate system fill pressure.

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**1.6 CHEMICAL TREATMENT**

- A. Chemical Treatment: Water analysis by Contractor.
  - B. Glycol solutions for freeze protection see drawings.
- 

**END OF SECTION 232113**

**SECTION 232123 - HYDRONIC PUMPS**

**1.1 SUMMARY**

- A. Close-coupled, in-line centrifugal pumps.
- B. Close-coupled, end-suction centrifugal pumps.
- C. Separately coupled, horizontal, in-line centrifugal pumps.
- D. Separately coupled, vertical, in-line centrifugal pumps.
- E. Automatic condensate pump units.

**1.2 QUALITY ASSURANCE**

- A. Quality Standard: UL 778.

**1.3 PRODUCTS**

**A. Close-Coupled, In-Line Centrifugal Pumps:**

- 1. Casing: Radially split, cast iron.
- 2. Impeller: Cast bronze.
- 3. Pump Shaft: Stainless steel.
- 4. Seal: Mechanical
- 5. Pump Bearings: Permanently lubricated ball bearings

**B. Close-Coupled, End-Suction Centrifugal Pumps:**

- 1. Casing: Radially split, cast iron.
- 2. Impeller: Cast bronze.
- 3. Pump Shaft: Stainless steel.
- 4. Seal: Mechanical.
- 5. Pump Bearings: Permanently lubricated ball bearings

**C. Separately Coupled, Horizontal, In-Line Centrifugal Pumps:**

- 1. Casing: Radially split, cast iron.
- 2. Impeller: Cast bronze.
- 3. Pump Shaft: Stainless steel.
- 4. Seal: Mechanical.
- 5. Pump Bearings: Permanently lubricated ball bearings
- 6. Shaft Coupling: Molded rubber insert with interlocking spider
- 7. Motor: Rigidly mounted.

**D. Separately Coupled, Vertical, In-Line Centrifugal Pumps:**

- 1. Casing: Radially split, cast iron.

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2. Impeller: Cast bronze.
3. Pump Shaft: [Stainless steel].
4. Seal: Mechanical.
5. Pump Bearings: Permanently lubricated ball bearings
6. Shaft Coupling: Axially split spacer coupling.
7. :

- E. Automatic Condensate Pump Units: Package units with corrosion-resistant pump, plastic tank with cover, and automatic controls.

END OF SECTION 232123

**SECTION 232213 - STEAM AND CONDENSATE HEATING PIPING**

**1.1 SUMMARY**

- A. Steam and condensate piping for systems inside the building.

**1.2 QUALITY ASSURANCE**

- A. Quality Standard: ASME B31.1, "Power Piping" and ASME B31.9, "Building Services Piping."

**1.3 PRODUCTS**

- A. Dielectric Fittings:

1. Dielectric unions.
2. Dielectric flanges.
3. Dielectric-flange kits.

- B. Strainers:

1. Y-pattern.
2. Basket.

- C. Flash Tanks: Fabricated according to ASME Boiler and Pressure Vessel Code.

- D. Safety Valves: ASME labeled; bronze and cast iron.

- E. Pressure-Reducing Valves: Cast iron; pilot operated; diaphragm type.

- F. Steam Traps:

1. Thermostatic.
2. Thermodynamic.
3. Float and thermostatic.
4. Inverted bucket.

- G. Thermostatic air vents.

- H. Vacuum breakers.

- I. Steam Meters: Venturi Vortex interface with central workstation.

- J. Condensate Meters: Turbine type; interface with central workstation.

**1.4 PIPING APPLICATIONS**

- A. LP Steam Piping Applications:

1. LP Steam Piping, NPS 2 and Smaller: Steel pipe, cast-iron fittings, and threaded joints.
2. LP Steam Piping, NPS 2-1/2 through NPS 12: Steel pipe; wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
  - a. Steel pipe, cast-iron fittings, and threaded joints.
3. Condensate Piping above Grade, NPS 2-1/2 and Larger:
  - a. Steel pipe; wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

**B. HP Steam Piping Applications:**

1. HP Steam Piping, NPS 2 and Smaller: Steel pipe, cast-iron fittings, and threaded joints.
2. HP Steam Piping, NPS 2-1/2 through NPS 12: Steel pipe; wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
3. Condensate Piping above Grade, NPS 2 and Smaller:
  - a. Steel pipe, cast-iron fittings, and threaded joints.
  - b. RTRP and RTRF with adhesive or flanged joints.
4. Condensate Piping above Grade, NPS 2-1/2 and Larger:
  - a. Steel pipe; wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

END OF SECTION 232213

**SECTION 232223 - STEAM CONDENSATE PUMPS**

**1.1 SUMMARY**

- A. This Section includes electric-driven and pressure-powered steam condensate pumps.

**1.2 QUALITY ASSURANCE**

- A. Quality Standard: ASME Boiler and Pressure Vessel Code.

**1.3 PRODUCTS**

- A. Electric-Driven Steam Condensate Pumps:  
See Drawings
- B. Pressure-Powered Steam Condensate Pumps:  
See drawings
- C. Startup services.
- D. Demonstration and training of Owner's personnel.

**END OF SECTION 232223**



## SECTION 232500 - HVAC WATER TREATMENT

### 1.1 SUMMARY

A. This Section includes the following HVAC water-treatment systems:

1. Bypass chemical-feed equipment and controls.
2. Biocide chemical-feed equipment and controls.
3. Ozone-generator biocide equipment and controls.
4. UV-irradiation unit, biocide equipment, and controls.
5. Chemical treatment test equipment.
6. HVAC water-treatment chemicals.
7. Makeup water softeners.
8. RO equipment for HVAC makeup water.
9. Water filtration units for HVAC makeup water.

### 1.2 MAINTENANCE

A. Chemical and Service Program: For one year following date of Substantial Completion.

### 1.3 PRODUCTS

A. Manual Chemical-Feed Equipment: Bypass feeders.

B. Automatic Chemical-Feed Equipment:

1. Water Meters: Turbine-type totalization meters.
2. Inhibitor injection timers with interface to HVAC controls.
3. pH controllers with interface to HVAC controls.
4. TDS controllers with interface to HVAC controls.
5. Biocide feeder timers with interface to HVAC controls.
6. Polyethylene chemical solution tanks.
7. Polyethylene chemical solution tubing.
8. Positive-displacement chemical solution injection pumps.
9. Injection assembly.

C. Chemical treatment test equipment with the following components:

1. Test kit.
2. Sample cooler.
3. Corrosion test-coupon assembly.

D. Filtration Equipment:

1. Multimedia filters.
2. Self-cleaning strainers.
3. Centrifugal separators.

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1.4 WATER ANALYSIS

A. Water Analysis: Contractor.

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END OF SECTION 232500

**SECTION 233113 - METAL DUCTS**

**1.1 MATERIALS**

- A. Single-wall rectangular ducts and fittings.
- B. Double-wall rectangular ducts and fittings.
  - 1. Fibrous-glass Flexible elastomeric duct liner for interstitial insulation.
  - 2. Solid inner duct.
- C. Single-wall round and flat-oval ducts and fittings.
- D. Double-wall round and flat-oval ducts and fittings.
  - 1. Fibrous-glass Flexible elastomeric duct liner for interstitial insulation.
  - 2. Perforated Solid inner duct.
- E. Sheet Metal Materials:
  - 1. Galvanized sheet steel.
  - 2. PVC-coated, galvanized sheet steel.
  - 3. Carbon-steel sheets.
  - 4. Stainless-steel sheets.
  - 5. Aluminum sheets.
  - 6. Factory-applied antimicrobial coating.
- F. Duct Liner:
  - 1. Fibrous glass, Type I, flexible Type II, rigid.
    - a. With antimicrobial erosion-resistant coating.
  - 2. Flexible elastomeric.
  - 3. Natural fiber.
- G. Sealant Materials:
  - 1. Two-part tape sealing system.
  - 2. Water-based joint and seam sealant.
  - 3. Solvent-based joint and seam sealant.
  - 4. Flanged joint sealant.
  - 5. Flange gaskets.
  - 6. Round duct joint O-ring seals.

**1.2 SEISMIC-RESTRAINT DEVICES**

- A. Channel support system.

- B. Galvanized steel restraint cables.
- C. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

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**1.3 DUCT CLEANING**

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Clean the following items:
  - 1. Air outlets and inlets.
  - 2. Supply, return, and exhaust fans.
  - 3. Air-handling units.
  - 4. Coils and related components.
  - 5. Return-air ducts, dampers, actuators, and turning vanes.
  - 6. Supply-air ducts, dampers, actuators, and turning vanes.
  - 7. Dedicated exhaust and ventilation components and makeup air systems.

**1.4 DUCT SCHEDULE**

- A. All ducts shall be galvanized steel.

**END OF SECTION 233113**

SECTION 233119 - HVAC CASINGS

1.1 PERFORMANCE REQUIREMENTS

- A. Static-Pressure Classes:
  - 1. Upstream from Fan(s): 2-inch wg.
  - 2. Downstream from Fan(s): 2 6-inch wg

1.2 QUALITY ASSURANCE

- A. Welding Qualifications and Procedures: AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports

1.3 MATERIALS

- A. Sheet Metal Materials: Galvanized-steel sheet.
- B. Factory- or shop-applied, standard color, antimicrobial coating on interior surfaces.
- C. Reinforcement Shapes and Plates: Black and galvanized steel.
- D. Seal Class: A.
- E. Access doors.
- F. Condensate Drain Pans: Double wall; stainless steel.
- G. Fibrous-Glass Liner: 1 inch thick.
- H. Sealant Materials: Water-based joint and seam sealant
- I. Shop-Fabricated Casings:
  - 1. Single-wall casings.
  - 2. Double-wall casings.
    - a. Inner Panel: Solid.
    - b. Interstitial Insulation: Polyurethane foam
  - 3. Standing seams with angle-iron reinforcement.
  - 4. Close-off sheets bolted to frame flanges and housings.
  - 5. Casing Reinforcement: Galvanized-steel angles.
- J. Manufactured Casings: Double wall, insulated, pressurized.
  - 1. Solid exterior wall and solid interior wall of galvanized-steel sheets.
  - 2. Wall Thickness: 2 inches

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3. Exterior and interior walls welded to perimeter; to interior, longitudinal, galvanized-steel channels; and to box-end internal closures.
  4. Interstitial insulation.
  5. Panel Joints: Tongue and groove or self-locking.
  6. Trim: 0.052-inch galvanized sheet steel.
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K. Casing Liner: Fibrous glass Flexible elastomeric

L. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer.

END OF SECTION 233119

SECTION 233300 - AIR DUCT ACCESSORIES

1.1 QUALITY ASSURANCE

- A. Installation Standards: NFPA 90A and NFPA 90B.

1.2 PRODUCTS

- A. Backdraft and Pressure Relief Dampers: Multiple, center-pivoted blade, parallel action, gravity balanced.
- B. Barometric Relief Dampers: Horizontal or vertical mounting.
- C. Manual Volume Dampers: Low-leakage steel, multiple or single blade, parallel- or opposed-blade design, with linkage outside airstream.
- D. Control Dampers: Opposed-blade design.
- E. Fire Dampers Static and dynamic, Ceiling Dampers: Replaceable heat-responsive device.
- F. Smoke Dampers:
1. Curtain type with blades inside airstream  
Curtain type with blades outside airstream  
Multiple-blade type [
- G. Combination Fire and Smoke Dampers: [Static and dynamic,
- H. Flange connectors.
- I. Duct Silencers: Factory fabricated and tested, round or rectangular.
- J. Turning Vanes: galvanized sheet steel.
- K. Remote damper operators.
- L. Duct-Mounted Access Doors: Double wall, rectangular, galvanized sheet steel with insulation.
- M. Flexible Ducts: Insulated.
- N. Duct security bars.
- O. Duct accessory hardware.

END OF SECTION 233300



**SECTION 233413 – MIXED-FLOW FANS**

**1.1 SUMMARY**

- A. Mixed-flow fans.

**1.2 QUALITY ASSURANCE**

- A. Performance Requirements: AMCA-Certified Ratings Seal.

**1.3 MANUFACTURED UNITS**

- A. Fan wheel and housing, straightening vane section, factory-mounted motor with belt drive or direct drive,
- B. Housings: Steel Wheels: Cast aluminum with airfoil-shaped blades mounted on cast-iron wheel plate Fiberglass-reinforced plastic cured under pressure with airfoil-shaped blades Cast-aluminum hub assembly, machined and fitted with threaded bearing wells to receive blade-bearing assemblies with replaceable, cast-aluminum blades.
- C. Accessories:
1. Companion flanges.
  2. Inspection door.
  3. Propeller access section door.
  4. Swingout construction.
  5. Inlet and outlet screens.
  6. Backdraft dampers.
  7. Stall alarm probe.
  8. Flow measurement port.
  9. Shaft seal.
  10. Motor cover.
  11. Inlet bell.
  12. Inlet cones.
  13. Outlet cones.
  14. Stack cap.
- D. Motors: NEMA MG 1.
1. Enclosure: Totally enclosed, fan cooled .
- E. Factory Finish: Primed sheet metal parts; baked-enamel exterior surfaces.

**END OF SECTION 233413**



SECTION 233416 - CENTRIFUGAL HVAC FANS

1.1 SUMMARY

- A. Airfoil centrifugal backward-inclined centrifugal forward-curved centrifugal plenum and plug fans.

1.2 QUALITY ASSURANCE

- A. Performance Requirements: AMCA-Certified Ratings Seal.

1.3 AIRFOIL CENTRIFUGAL FANS

- A. Factory-fabricated, -assembled, -tested, and -finished, belt-driven fans with housing, wheel, motor, drive assembly, and support structure.
- B. Housings: Reinforced steel.
- C. Wheels: Airfoil; steel with special coating.
- D. Shafts: Statically and dynamically balanced; steel with keyway.
- E. Bearings: Prelubricated and sealed Grease-lubricated, ball or roller type, with rating life 120,000 hours.
- F. Belt Drives: Factory mounted and field adjustable.
1. Service Factor: 1.5
  2. Fan Pulleys: Cast iron or cast steel; split, tapered.
- G. Accessories:
1. Scroll access doors.
  2. Gasketed quick-opening, latch-type cleanout door.
  3. Companion flanges.
  4. Variable inlet vanes.
  5. Inlet screens.
  6. Shaft cooler.
  7. Spark-resistant construction.
  8. Shaft seals.
  9. Weather cover.
- H. Motors: NEMA MG 1.
1. Enclosure: Totally enclosed, fan cooled.

#### 1.4 BACKWARD-INCLINED CENTRIFUGAL FANS

- A. Factory-fabricated, -assembled, -tested, and -finished, belt-driven fans with housing, wheel, motor, drive assembly, and support structure.
- B. Housings: Reinforced steel.
- C. Wheels: Backward inclined; steel welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.
- D. Shafts: Statically and dynamically balanced; steel with keyway.
- E. Bearings: Prelubricated and sealed] type, with rating life of 120,000 hours.
- F. Belt Drives: Factory mounted and field adjustable.
  - 1. Service Factor: 1.5
  - 2. Fan Pulleys: Cast iron or cast steel; split, tapered.
- G. Accessories:
  - 1. Scroll access doors.
  - 2. Gasketed, quick-opening, latch-type cleanout door.
  - 3. Scroll drain connection.
  - 4. Companion flanges.
  - 5. Inlet screens.
  - 6. Shaft cooler.
  - 7. Spark-resistant construction.
  - 8. Shaft seals.
  - 9. Weather cover.
- H. Motors: NEMA MG 1.
  - 1. Enclosure: Totally enclosed, fan cooled.

#### 1.5 PLENUM FANS

- A. Factory-fabricated, -assembled, -tested, and -finished, belt-driven fans with wheel, motor, drive assembly, and support structure.
- B. Wheels: Airfoil; steel with special coating.
- C. Shafts: Statically and dynamically balanced; steel with keyway.
- D. Bearings: Prelubricated and sealed type, with rating life of 120,000 hours.
- E. Belt Drives: Factory mounted and field adjustable.
  - 1. Service Factor: 1.5.
  - 2. Fan Pulleys: Cast iron or cast steel; split, tapered.

F. Accessories:

1. Shaft cooler.
2. Spark-resistant construction.
3. Shaft seals.

G. Motors: NEMA MG 1.

1. Enclosure: Totally enclosed, fan cooled.

1.6 PLUG FANS

A. Factory-fabricated, -assembled, -tested, and -finished, belt-driven fans with wheel, motor, drive assembly, and support structure.

B. Wheels: Airfoil; steel with special coating.

C. Shafts: Statically and dynamically balanced; steel with keyway.

D. Bearings: Prelubricated and sealed type, with rating life of 120,000 hours.

E. Belt Drives: Factory mounted and field adjustable.

1. Service Factor: 1.5.
2. Fan Pulleys: Cast iron or cast steel split, tapered.

F. Accessories:

1. Shaft cooler.
2. Spark-resistant construction.
3. Shaft seals.

G. Motors: NEMA MG 1.

1. Enclosure: Totally enclosed, fan cooled.

1.7 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Tested according to AMCA 300.

B. Fan Performance Ratings: Tested and rated according to AMCA 210.

END OF SECTION 233416



## SECTION 233423 - HVAC POWER VENTILATORS

### 1.1 SUMMARY

- A. Power Ventilators:
  - 1. Centrifugal roof ventilators.
  - 2. In-line centrifugal fans.

### 1.2 QUALITY ASSURANCE

- A. Performance Requirements: AMCA-Certified Ratings Seal.

### 1.3 CENTRIFUGAL ROOF VENTILATORS

- A. Direct- or belt-driven centrifugal type, with housing, wheel, motor, drive assembly, and curb base.
  - 1. Housing: Removable, spun-aluminum hinged subbase.
  - 2. Fan Wheels: Aluminum with backward-inclined blades.
  - 3. Belt-Driven Drive Assembly: Steel shaft, permanently lubricated and sealed bearings, and cast-iron adjustable-pitch pulley.
  - 4. Accessories:
    - a. Variable-speed controller.
    - b. Disconnect switch outside fan housing.
    - c. Bird screens.
    - d. Backdraft dampers.
    - e. Motorized dampers.
  - 5. Roof Curbs: Galvanized steel; built-in raised cant and mounting flange.
    - a. Overall Height: 12 inches

### 1.4 CENTRIFUGAL WALL VENTILATORS

- A. Direct- or belt-driven centrifugal type, with housing, wheel, motor, and drive assembly.
  - 1. Housing: Removable, spun aluminum.
  - 2. Fan Wheel: Aluminum with backward-inclined blades.
  - 3. Belt-Driven Drive Assembly: Steel shaft, permanently lubricated and sealed bearings, cast-iron adjustable-pitch pulley, with fan and motor isolated from airstream.
  - 4. Accessories:
    - a. Variable-speed controller.
    - b. Disconnect switch.
    - c. Bird screens.
    - d. Wall grille.

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- e. Backdraft dampers.
- f. Motorized dampers.

#### 1.5 IN-LINE CENTRIFUGAL FANS

- A. In-line, direct belt-driven centrifugal type, with housing, wheel, outlet guide vanes, motor, and drive assembly.
  - 1. Housing: Split, spun aluminum.
  - 2. Direct-Driven Units: Motor mounted in airstream.
  - 3. Belt-Driven Units: Motor mounted on adjustable base.
  - 4. Fan Wheels: Aluminum.
  - 5. Accessories:
    - a. Variable-speed controller.
    - b. Volume-control damper.
    - c. Companion flanges.
    - d. Fan guards.
    - e. Motor and drive cover (belt guard).

END OF SECTION 233423

**SECTION 233600 - AIR TERMINAL UNITS**

**1.1 SUMMARY**

- A. Single-duct air terminal units.

**1.2 QUALITY ASSURANCE**

- A. Installation Standard: NFPA 90A.

**1.3 PRODUCTS**

- A. Shutoff Single-Duct Air Terminal Units:

1. Configuration: Volume damper assembly inside unit casing.
2. Casing: Steel with removable access panels.
  - a. Casing Lining: 1/2-inch-thick, coated, fibrous-glass duct liner. Liner covered with nonporous foil. Liner covered with nonporous foil and perforated metal.
  - b. Casing Lining: Adhesive attached, 3/4-inch-thick, polyurethane foam insulation.
3. Regulator Assembly: Aluminum or steel, automatic flow-control assembly
4. Volume Damper: Galvanized steel with maximum airflow leakage of 2 6-inch wg.
  - a. Damper Position: Normally open
5. Hot-Water Heating Coil: Copper tube and aluminum fins.
6. Controls: DDC microprocessor based.

- B. Air terminal units rated according to ARI 880.

**END OF SECTION 233600**



**SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES**

**1.1 PRODUCTS**

**A. Diffusers:**

1. Round ceiling diffusers, fully adjustable
2. Rectangular and square ceiling diffusers,
3. Perforated diffusers, surface-mounted
4. Perforated diffusers,
5. Louver face diffusers.
6. Linear bar diffusers.
7. Linear slot diffusers.
8. Linear floor diffuser plenums.
9. TAD Diffusers for Lab applications.

**B. Registers and Grilles:**

1. Modular core supply grilles
2. Fixed face
3. Linear bar grilles

**END OF SECTION 233713**



**SECTION 234100 - PARTICULATE AIR FILTRATION**

**1.1 SUMMARY**

- A. Factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

**1.2 QUALITY ASSURANCE**

- A. Installation Standard: NFPA 90A or NFPA 90B.
- B. Quality Standard: ARI 850.
- C. Testing and Rating Standard: ASHRAE 52.1 and ASHRAE 52.2.

**1.3 PRODUCTS**

- A. Disposable Panel Filters: Viscous-coated, flat-panel type, with holding frames.
  - 1. Media: Interlaced glass fibers and anti-microbial agent.
  - 2. Frame: Cardboard frame with perforated metal retainer
- B. Filter Gages: Manometer type.

**END OF SECTION 234100**



**SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS**

**1.1 SUMMARY**

- A. Listed double-wall vents

**1.2 QUALITY ASSURANCE**

- A. Welding Standard: AWS D1.1/D1.1M and AWS D9.1/D9.1M.

**1.3 WARRANTY**

- A. Materials and Workmanship for Venting System Components: 15 Insert number years.

**1.4 PRODUCTS**

- A. Listed Building-Heating-Appliance Chimneys: Double-wall metal vents, rated for 1000 deg F continuously, or 1700 deg F 1400 deg F continuously, for 10 minutes.
  - 1. Inner Shell: Stainless steel.
  - 2. Outer Jacket: Stainless steel.
  - 3. Termination: Exit cone with drain section incorporated into riser.
- B. Guying and Bracing: Galvanized, stranded wire cable pipe angle iron.

**END OF SECTION 235100**



**SECTION 235233 - BOILERS AND ACCESSORIES**

**A. PROJECT INCLUDES**

1. Boilers and accessories for HVAC systems.

**B. QUALITY ASSURANCE**

1. Compliance: NFPA 31, 54; ASME Code; IRI.

**C. PRODUCTS**

1. Steam Boilers:

- a. Packaged Flextube Boilers: Gas burners, factory-assembled and tested, packaged, multi-pass, horizontal of capacity suitable for use.

2. Hydronic Boilers:

- a. Condensing boilers.

2. Boiler Accessories:

- a. Boiler Valves: Stop and check valves; Y-type blowdown valves.
- b. Safety and Relief Valves: Steam safety valves; water relief valves
- c. Boiler Blowdown Separators: Carbon steel tank, temperature regulating valve.
- d. Boiler Water Treatment Feeders: One-shot-feeders; bypass feeders; treatment pump feeders.
- e. Boiler Economizers: Finned horizontal tube counter-current flow boiler economizers.

3. Breechings, Chimneys, and Stacks:

- a. Double Wall Metal Vents, Oil or Solid Fuel Appliances: Stainless steel inner jacket, aluminum coated steel outer jacket
- b. Fabricated Metal Breechings and Chimneys: ASTM A 569 black hot-rolled steel

9. Deaerators & Surge Tank:

- a. Spray Type Horizontal Deaerators: Packaged, factory-assembled unit, storage tank and accessories, capacity suitable for use.

10. Boiler Water Treatment Systems:

- a. Systems: Boiler water treatment to inhibit scale, corrosion and biological growth in hot water boiler system, steam boiler system, deaerator system, boiler blowdown system.
- b. Equipment: Shot feeder, chemical treatment controller, chemical

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feeder pump, chemical solution reservoir, test kits, chemicals.

**END OF SECTION**

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SECTION 235316 - DEAERATORS

1.1 MANUFACTURED UNITS

- A. Horizontal tray, single-compartment type; and separate packaged surge tank with transfer pumps to supply feedwater to the deaerator.
- B. No pumps and controls.
- C. Material for Wetted Components: Type 316 stainless steel.
- D. Adjustable Spray Valves: Type 316 stainless steel.
- E. Deaerator and Storage Tank:
  - 1. Material: Welded carbon steel galvanized after fabrication; with thickness allowance electrolytic inhibitor anode for corrosion protection.
  - 2. Factory-Applied Insulation and Jacket: Minimum thickness of 2 inches > for mineral-fiber pipe and tank insulation. Cover insulation with painted steel jacket.
- F. Factory-Installed Pipe and Fittings: Schedule 80 carbon-steel pipe; Class 250, cast 150, iron fittings.
- G. Accessories:
  - 1. Pump suction piping with vortex breaker, isolation valve, strainer, and flexible connector.
  - 2. Pump discharge piping with check valve, isolation valve, and liquid-filled pressure gage.
  - 3. Pump-discharge bypass relief valve with orifice plate.
  - 4. Mechanical makeup water assembly with three-valve bypass and inlet strainer.
  - 5. Steam operated pressure-reducing valve with three-valve bypass.
  - 6. Overflow drain.
  - 7. Safety valves.
  - 8. Vents: Manual and automatic vent valves.
  - 9. Vacuum breaker.
  - 10. Meters and Gages: Water-level gage glass with stop valves, thermometer, and pressure gage.
  - 11. Provision for chemical injection quill.
  - 12. Sampling connection with valve.
  - 13. Tank drain connection with valve.
  - 14. Oxygen test kit.
- H. Feedwater Pump: Cast-iron,] base-mounted volute; with stainless-steel, multistage centrifugal impeller; with] totally enclosed, fan-cooled motor.
- I. Feedwater Pump Control Panel:
  - 1. NEMA 250, Type 1 enclosure.
  - 2. Single-point, field power connection to fused disconnect switch Motor controller and hand-off-auto switch.

3. Visual indication of status and alarm with momentary test push button.
  4. Audible alarm and silence switch.
  5. Visual indication of elapsed run time, graduated in hours.
  6. Fusible, control-circuit transformer.
  7. Feedwater Pump Control Sequence: Start-stop with lead/lag alternator and, visual indications, and visual and audible alarms.
- J. Building Management System Interface: Factory install hardware to enable building management system to monitor and display on/off status for each pump, failure alarm for each pump, low-water-level alarm, high-water-level alarm, feedwater temperature.
- K. Surge Tank: Factory-assembled and -tested unit consisting of condensate receiver, transfer pumps, and controls.
1. Accessories:
    - a. Pump suction piping with vortex breaker, isolation valve, strainer, and flexible connector.
    - b. Pump discharge piping with check valve, isolation valve, and liquid-filled pressure gage.
    - c. Pump-discharge bypass relief valve with orifice plate.
  2. Factory-Installed Pipe and Fittings: Schedule 80 carbon-steel pipe; Class 250, cast iron fittings.
  3. Tank Material: Stainless steel; with thickness allowance electrolytic inhibitor anode for corrosion protection.
  4. Factory-Applied Insulation and Jacket: Minimum thickness of 2 inches Insert thickness for mineral-fiber pipe and tank insulation. Cover insulation with painted steel] jacket.
  5. Transfer Pump: multistage, radially split-case centrifugal, with totally enclosed, fan-cooled motor.
  6. Transfer Pump Control Panel:
    - a. NEMA 250, Type 1 enclosure.
    - b. Single-point, field power connection to fused disconnect switch Motor controller and hand-off-auto switch.
    - c. Visual indication of status and alarm with momentary test push button.
    - d. Audible alarm and silence switch.
    - e. Visual indication of elapsed run time, graduated in hours.
    - f. Fusible, control-circuit transformer.
    - g. Transfer Pump Control Sequence: Continuous; with lead/lag alternator, and audible alarms.
  7. Building Management System Interface: Factory install hardware to enable building management system to monitor and display on/off status for each pump, failure alarm for each pump, low-water-level alarm, high-water-level alarm.
- L. Finishes: Factory paint.

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1.2 SOURCE QUALITY CONTROL

- A. Deaerator Tanks: Tested and inspected according to ASME Boiler and Pressure Vessel Code.
- 

END OF SECTION 235316



**SECTION 235700 - HEAT EXCHANGERS FOR HVAC**

**1.1 SUMMARY**

- A. Shell-and-tube and plate heat exchangers.

**1.2 QUALITY ASSURANCE**

- A. Quality Standard: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

**1.3 PRODUCTS**

- A. Shell-and-Tube Exchangers:

1. Configuration: See Drawings
2. Shell Material: Steel
3. Head Material: Fabricated steel with removable cover
4. Tube Material: Seamless copper
5. Tubesheet Material: Steel
6. Baffle Material: Steel
7. Piping Connections:
  - a. Shell Flanged inlet and outlet fluid connections, threaded drain, and vent connections.
  - b. Head: Flanged inlet and outlet fluid connections.
8. Support Saddles: Fabricated of material similar to shell. Foot mount with provision for anchoring to support.

- B. Gasketed Plate Heat Exchangers:

1. Configuration: Freestanding assembly consisting of frame support, top and bottom carrying and guide bars, fixed and movable end plates, tie rods, individually removable plates, and one-piece gaskets.
2. Frame: Capacity to accommodate 20 percent additional plates. Painted carbon steel with provisions for anchoring to support.
3. Top and Bottom Carrying and Guide Bars: Painted carbon steel, aluminum, or stainless steel.
4. End-Plate Material: Painted carbon steel.
5. Plate Material 0.031 inch thick before stamping; Type 316 stainless steel.
6. Gasket Material: Nitrile rubber.

END OF SECTION 235700



**SECTION 235710 – STEAM TO STEAM HEAT EXCHANGERS FOR HVAC**

**1.1 SUMMARY**

- A. Provide a clean steam to steam heat exchanger.

**1.2 QUALITY ASSURANCE**

- A. Quality Standard: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

**1.3 PRODUCTS**

- A. Shell-and-Tube Exchangers:

1. Configuration: See Drawings
2. Shell Material: Steel
3. Head Material: Fabricated steel with removable cover
4. Tube Material: Seamless copper
5. Tubesheet Material: Steel
6. Baffle Material: Steel
7. Piping Connections:
  - a. Shell Flanged inlet and outlet fluid connections, threaded drain, and vent connections.
  - b. Head: Flanged inlet and outlet fluid connections.
8. Support Saddles: Fabricated of material similar to shell. Foot mount with provision for anchoring to support.

**END OF SECTION 235700**



SECTION 236416 - CENTRIFUGAL WATER CHILLERS

1.1 QUALITY ASSURANCE

- A. Certification: ARI 550.
- B. Compliance: ASHRAE 15 and 147, ASHRAE/IESNA 90.1, ASME, NFPA 70, UL,
- C. Performance Rating: ARI 550/590.
- D. Sound Rating: ARI 575.

1.2 COMPONENTS

- A. Compressor-Drive Assembly: Variable displacement with open or hermetic, direct or gear drive.
- B. Refrigeration:
  - 1. Refrigerant See drawings.
- C. Evaporator: Shell-and-tube design with carbon steel shell and individually replaceable tubes with enhanced or smooth internal finish and marine water box.
- D. Condenser: Shell-and-tube design with carbon steel shell and individually replaceable tubes with enhanced or smooth internal finish and marine water box.
- E. Insulation for Cold Surfaces: Closed cell, flexible elastomeric.
- F. Electrical: Single-point, field-power connection to fused disconnect switch
  - a. Push-button stations.
  - b. Time-delay relays.
  - c. Elapsed-time meters.
  - d. Panel-type meters.
  - e. Multifunction digital-metering monitor.
  - f. Phase-failure and undervoltage relays.
- G. Controls: Microprocessor based.
  - 1. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, digital display.
  - 2. BAS Interface: Communication interface.
- H. Accessories:
  - 1. Flow switch: Pressure differential type.
  - 2. Vibration Isolation: Neoprene pads Sound Barrier: Removable and reusable sound-barrier covers over the compressor housing, hermetic motor, compressor suction and discharge piping, and condenser shell.

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- I. **Packaged Refrigerant Recovery Unit:** Packaged portable unit consisting of compressor, air-cooled condenser, recovery system, tank pressure gages, filter-dryer, and valving.
  - J. **Heat-Exchanger, Brush-Cleaning System:** Furnish on each chiller condenser consisting of brushes in individual tubes, four-way automatic flow-diverting valve, and control panel.
- 

### 1.3 SOURCE QUALITY CONTROL

- A. **Factory run tested.**
- B. **Evaporator and Condensers:** Factory tested and inspected according to ASME Boiler and Pressure Vessel Code.

END OF SECTION 236416

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**SECTION 236500 - COOLING TOWERS**

**A. PROJECT INCLUDES**

1. Cooling towers for rejecting condenser heat from water-cooled air conditioning systems or process cooling water.

**B. PRODUCTS**

1. Factory build Towers:
  - a. Induced Draft, Propeller Fan, Counter Flow Cooling Towers: Stainless steel. Provide with fan screen low oil level switch, vibration cutout, and motor suitable for VFD Control.

**END OF SECTION**

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**SECTION 237200 - ENERGY RECOVERY EQUIPMENT**

**1.1 QUALITY ASSURANCE**

- A. Quality Standard: ARI 1060, ASHRAE 84, UL 1812, and UL 1815.

**1.2 PRODUCTS**

- A. Run around coils: Copper tubes and aluminum fins, filled with Glycol.
  - 1. Coating: Thermoplastic vinyl Epoxy Synthetic resin Phenolic

**END OF SECTION 237200**



SECTION 237313 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

1.1 SUMMARY

- A. Constant-air-volume, single-zone air-handling units.
- B. Variable-air-volume, single-zone air-handling units.

1.2 QUALITY ASSURANCE

- A. Quality Standards: ARI 430, NFPA 70, and NFPA 90A.

1.3 COMPONENTS

A. Unit Casing:

- 1. Outside Casing: Galvanized steel
- 2. Coatings.
- 3. Inside Casing: Galvanized steel
- 4. Floor Plate: Galvanized steel Stainless steel.
- 5. Cabinet Insulation: 2 inches thick.
- 6. Inspection access panels and access doors.
- 7. Condensate Drain Pans: Double-wall, Mounting Frame: Galvanized-steel channels with seismic restraints.

B. Supply Fan Section:

- 1. Drive: V-belt Direct.
- 2. Fan Wheels: See Drawing schedules.
- 3. Variable-inlet vanes.
- 4. Discharge dampers.
- 5. Internal vibration control.
- 6. Motors.
- 7. Variable frequency controllers.

C. Return Fan Section:

- 1. Drive: V-belt Direct.
- 2. Fan Wheels: See Drawing Schedules
- 3. Discharge dampers.
- 4. Internal vibration control.
- 5. Motors.
- 6. Variable frequency controllers.

D. Coils:

- 1. Coil Sections: Common or individual, insulated, galvanized-steel casings.
- 2. Heating Coil: Hot water
- 3. Cooling Coil: Chilled water.

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4. Water Coils: Self-draining Cleanable.

- a. Tubes: Copper.
- b. Fins: Aluminum.
- c. Frames: Stainless steel.

E. Prefilters:

- 1. Disposable panel.

F. Finel Filters:

- 1. Disposable panel.

G. Filter gages.

H. Dampers:

- 1. Leakage Rate: Not to exceed 2 percent at 2000-fpm

I. Humidifier: Steam grid

J. Heat recovery coils: See drawing schedules

K. Evaporative Media.

- 1. 12" celdex media pad and pumps and dampers.

1.4 INSTALLATION

- A. Equipment Mounting: Install air-handling units on concrete bases using elastomeric pads

END OF SECTION 237313

**SECTION 238216 - AIR COILS**

**1.1 SUMMARY**

- A. Coils installed in ducts and field-fabricated air-handling casings.

**1.2 COMPONENTS**

A. Hot-Water Coils:

1. Tubes: Copper.
2. Fins: Aluminum
3. Headers: Copper
4. Frames: Stainless steel.

B. Chilled-Water Coils:

1. Tubes: Copper.
2. Fins: Aluminum
3. Headers: Copper.
4. Frames: Stainless steel.

C. Steam Coils:

1. Tubes: Copper.
2. Fins: Aluminum
3. Headers: Cast iron Copper
4. Tube Type: Single or distributing as indicated.
5. Frames: Stainless steel.

**END OF SECTION 238216**



**SECTION 238413 - HUMIDIFIERS**

**1.1 SUMMARY**

- A. The Following Types of Humidifiers:  
1. Steam injection.

**1.2 QUALITY ASSURANCE**

- A. Quality Standard: ARI 640.
- B. Steam-Injection Humidifiers:
1. Manifold: Stainless steel, steam jacketed and insulated.
  2. Steam-jacketed discharge nozzle, aluminum blade propeller fan.
  3. Stainless-steel steam separator with separate humidifier control valve.
  4. Control Valve: Electric actuator.
  5. Accessories:
    - a. Duct-mounting, high-limit humidistat.
    - b. Aquastat mounted on steam condensate return piping to prevent cold operation.
    - c. In-line strainer.
    - d. Airflow switch for preventing humidifier operation without airflow.

**END OF SECTION 238413**



## SECTION 238415 – ENVIRONMENTAL MONITORING SYSTEM

### 1.1 SUMMARY

- A. Provide a system to perform following tasks on a room by room basis.
1. Set high/low warning and emergency alarm limits for temperature ( $\pm 2^{\circ}$  and  $\pm 4^{\circ}$  from range), humidity (below 30% and above 70%), supply air flow ( $\pm 15\%$  and  $\pm 20\%$  from set point), exhaust air flow ( $\pm 15\%$  and  $\pm 20\%$  from set point) and pressure relationship regulations (one year recording time is required). Display shall be green for acceptable, yellow for warning and red for emergency.
  2. Alarm upon pressurization loss or space directional airflow loss. Local horn-strobe alarms as well as building automation system notification is required.
  3. Set time and duration of animal level lighting. Record and alarm all lighting states that do not conform to set times.
  4. Provide written system log reports (continuous chronological list of all alarm conditions system wide), daily environmental reports (temperature, humidity, air flow and pressure average over 24-hour period with high and low value and time of occurrence), daily alarm reports (chronological list of all alarm conditions over 24-hour period by room) and selective historical reports.
  5. Certain system parameters shall be monitored and controlled locally and remotely.
  6. System shall be equipped with a telephone and IP addressable network [and/or pager] alarm system. System can be programmed to send selected alarm parameters of specific duration (condition is not corrected in a specified amount of time) to one or more telephone [and/or pager] numbers. Voice [and/or digital pager read-out] will state alarm parameter and room number (i.e. "High Temperature, Room #104).
  7. All system parameters and formats (displays, alarms, reports) shall be coordinated with animal care staff. Central control for animal facility shall only control and monitor animal facility, not entire building.

### 1.2 LOCAL CONTROLS

- A. Provide following at each animal holding room door mounted in corridor:
1. Digital temperature monitor
  2. Digital relative humidity monitor.
  3. Digital relative pressure monitor. Relative pressure monitor must be visible from both sides of the door.

### 1.3 PRODUCTS

- A. Approved Manufacturers are Edstrom and Rees.

END OF SECTION 238415



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SECTION 260010 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Architectural, Structural, Mechanical and other applicable documents also apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. The contract documents indicate the extent of electrical work. Provide all labor, materials, equipment, supervision and service necessary for a complete electrical system as described in divisions 26, 27, and 28.

1.3 RELATED SECTIONS:

- A. Other Divisions relating to electrical work apply to the work of this section. See other applicable Divisions including, but not necessarily limited to:
  - 1. Division 1 - General and Supplementary Conditions
  - 2. Division 2 - Existing Conditions
  - 3. Division 3 - Concrete
  - 4. Division 5 - Metals
  - 5. Division 6 - Wood, Plastics, and Composites
  - 6. Division 7 - Thermal and Moisture Protection
  - 7. Division 8 - Openings
  - 8. Division 9 - Finishes
  - 9. Division 21 - Fire Suppression
  - 10. Division 22 - Plumbing
  - 11. Division 23 - Heating Ventilating and Air Conditioning
  - 12. Division 27 - Communications
  - 13. Division 28 - Electronic Safety and Security

1.4 INTERPRETATIONS OF DRAWINGS AND SPECIFICATIONS:

- A. Prior to bidding the job, submit requests for clarification in writing to the Architect/Engineer prior to issuance of the final addendum.
- B. After signing the contract, provide all materials, labor, and equipment to meet the intent, purpose, and function of the contract documents.
- C. The following terms used in Division 26, 27, and 28 documents are defined as follows:
  - 1. "Provide" - Means furnish, install, and connect, unless otherwise indicated.
  - 2. "Furnish" - Means purchase new and deliver in operating order to project site.
  - 3. "Install" - Means to physically install the items in-place.

4. "Connect" - Means make final electrical connections for a complete operating piece of equipment. This includes providing conduit, wire, terminations, etc. as applicable.
5. "Or Equivalent" - Means to provide equivalent equipment. Such equipment must be approved by the Engineer prior to bidding.

1.5 EXAMINATION OF SITE:

- A. Visit the site and verify existing field conditions prior to submitting bid.
- B. All costs arising from site conditions and/or preparation shall be included in the base bid. No additional charges will be allowed due to inadequate site inspection.

1.6 QUALITY ASSURANCE:

- A. Perform work in accordance with all governing codes, rules, and regulations including the following minimum codes (latest editions or as otherwise accepted by the Authorities Having Jurisdiction):
  1. National Electric Code (NEC)
  2. International Building Code (IBC)
  3. International Fire Code (IFC)
  4. International Mechanical Code (IMC)
  5. International Plumbing Code (IPC)
  6. American Disability Act (ADA)
  7. National Electrical Safety Code (NESC)
  8. Local Codes and Ordinances
  9. The State Building Board Requirements
  10. State Fire Marshall Requirements
  11. University of Utah Requirements
- B. Comply with all standards where applicable for equipment and materials including the following minimum standards:
  1. Underwriter's Laboratories (UL)
  2. American Society for testing Materials (ASTM)
  3. Certified Ballast Manufacturers (CBM)
  4. Insulated Cable Engineers Association (ICEA)
  5. National Electrical Manufacturer's Institute (NEMA)
  6. American National Standards Institute (ANSI)
  7. Electrical Testing Laboratories (ETL)
  8. National Fire Protection Association (NFPA)
  9. Institute of Electrical and Electronics Engineers (IEEE)
  10. American Institute of Electrical Engineer's Electrical Power
  11. Systems and Grounding in Commercial Construction
  12. Illuminating Engineers Society (IES)
  13. National Electrical Safety Code (NESC) - Handbook No. H-30, H-43, H-81, United States of American Standards Association (USAS)
- C. Provide new electrical equipment conforming to all requirements as set forth in the above standards. Provide UL labeled equipment where such label is applicable.
- D. Comply with all state and local codes and ordinances. When conflicts occur among codes,

standards, drawings, and/or specifications, the most stringent requirements shall govern.

- E. Obtain all permits, inspections, etc. required by authority having jurisdiction. Include all fees in bid. Provide a certificate of approval to the owner's representative from the inspection authority at completion of the work.
- F. Provide only first-class workmanship from competent workers, conforming to the best electrical construction practices.
- G. The contractor shall have a current state contracting license applicable to type of work to be performed under this contract.

#### 1.7 SUBMITTALS:

- A. Submit in accordance with general provisions.
- B. Shop Drawings: After the contract is awarded, but prior to manufacture or installation of any equipment, submit eight (8) complete sets of shop drawings. Partially complete sets of shop drawings are not acceptable. Submit all shop drawings in one complete submittal package. Prior to submitting shop drawings, review and certify that they are in compliance with the contract documents; Sign all approved shop drawings. Allow a minimum of two weeks for architect/engineer to review shop drawings. Refer to architectural general provision section for additional requirements.
- C. Provide equipment catalog "cut sheets", brochures and/or drawings which clearly describe the proposed equipment. Include plans, elevations, sections, isometrics, and detailed engineering and dimensional information as applicable including equipment room layouts. Electrical room layouts are required to show all electrical equipment locations for all projects that include electrical rooms. Do not submit catalog sheets which describe several different items in addition to those items to be used, unless all relevant information is clearly identified. Bind each information set in three ring binder or binders of sufficient size or sizes to enclose all information. Organize all information by section. Provide separate tabbed covers for each section of Divisions 26, 27, and 28, indicating section number for each section requiring submittals.
- D. Include on front cover of binder or binders the name and location of the project, architect, electrical engineer, general contractor, electrical contractor, subcontractors, supplier/vendor, order number, volume, date, and any other applicable information. Certify that shop drawings are submitted in accordance with the contract documents with a written statement indicating compliance. Submittals will be reviewed and comments produced two times maximum. Additional reviews will be billed at current rates.

#### 1.8 OPERATION AND MAINTENANCE MANUALS:

- A. Submit four (4) complete sets of operating instruction and maintenance manuals for all equipment and materials provided under Divisions 26, 27, and 28.
- B. Provide manufacturer's recommended operating and maintenance instructions, cleaning and servicing requirements, serial and model number of each piece of equipment, complete list of replacement parts, performance curves and data, wiring diagrams, warranties, and vendor's name, address, and phone numbers. Do not submit information which describes several different items in addition to those items to be used, unless all relevant information is

clearly identified. Assemble all data in completely indexed volume or volumes. Engrave the job title, and name, address, and phone numbers of the contractor on the front cover and on the spine. Incomplete O&M manuals will be returned to the contractor for corrections / additions.

- C. Operation and Maintenance Manuals must be electronically-copied data in a self-executable, searchable \*.pdf format.
1. Confirm that all data and instruction sheets are marked to indicate the plan symbol, model, number, and options installed for each item of equipment furnished and installed. These data sheets are to be presented as reviewed and approved submittals, or shall be accompanied by such.
  2. Confirm that the serial numbers of each item of equipment installed are listed along with the model numbers and plan symbols.
  3. Additionally, confirm that the following information is included:
    - a. A Table of Contents.
    - b. A complete parts list(s) and source of supply for each piece of equipment, marked with model, size, and plan symbol(s).
    - c. Copies of the approved submittals for each piece of equipment.
    - d. The balance report, when applicable.
    - e. Performance curves and capacity data, marked with model and size, in addition to plan, symbols.
    - f. Wiring diagrams, marked with model and size, in addition to plan, symbols.
  4. The following information is to appear on the front cover of the CD submittal:
    - a. "Operation and Maintenance Manual"
    - b. Project Name (and volume number, if manual consists of more than one volume)
    - c. Project number (the seven-digit University number)
    - d. Building name, number, and street address
    - e. "University of Utah"
    - f. Consultant's name
    - g. Applicable Sub-Consultant's name
    - h. General Contractor's name
    - i. Mechanical Contractor's name
  5. Require contact lists for each item with complete contact information, including addresses and phone numbers

#### 1.9 RECORD DRAWINGS:

- A. Maintain on a daily basis a complete set of "Red-Lined Drawings", reflecting an accurate record of all work including addendums, revisions, and changes. Indicate precise dimensioned locations of all concealed work and equipment, including concealed or embedded conduit, junction boxes, etc. Record all "Red-Lined Drawing" information on a set of full sized prints of the contract drawings.
- B. Certify the "Red Lined Drawings" for correctness. Indicate on each drawing the name of the general and electrical contractors with signatures of each representative responsible for the work.
- C. The electrical engineering design firm will create record (as-built) drawings from the certified red-lined drawings; however, the general and electrical contractors retain the responsibility for the accuracy of the record drawings.

- D. Provide and permanently mount one set of Record Electrical Drawings in the main electrical room, at completion of the project.
- E. Provide and permanently mount one laminated Record One-line Diagram adjacent to main distribution panel(s).

1.10 WARRANTY:

- A. Ensure that the electrical system installed under this contract is in proper working order and in compliance with drawings, specifications, and/or authorized changes and is free from electrical defects. Without additional charge, replace or repair, to satisfaction of the owner's representative, except from ordinary wear and tear, any part of the installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance or as otherwise indicated in individual sections, but in no case less than one year. Warranty incandescent and fluorescent lamps only for a period of two months from the date of substantial completion.
- B. Provide complete warranty information for each item including beginning of warranty period, duration of warranty, names, addresses, and telephone numbers and procedures for filling a claim and obtaining warranty services. Written warranties and guarantees are to be submitted separately as:
  - 1. Originals bound in a binder clearly identified with the title, "WARRANTIES AND GUARANTEES," the project name, the project number, and the Contractor's business name.
  - 2. Electronic documents in \*.pdf format.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. All materials shall be new and shall bear the manufacturer's name, trade name, and the approved testing laboratory such as the UL label in every case where a standard has been established for that particular material. Used materials are acceptable only if specifically indicated on drawings.

2.2 SUBSTITUTION OF MATERIALS:

- A. Provide only specified products or products approved by addendum. Substitutions will be considered if two copies of the proposal is received at the architect's/engineer's office eight (8) working days prior to the bid day. Include in the proposal the specified and proposed catalog numbers of the equipment under consideration and a catalog cut sheet(s) with pictorial and descriptive information. Certify that the equipment proposed is equal to that specified, that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents.
- B. It is the responsibility of the contractor to make all substituted equipment comply with the intent of the contract documents and bear all cost associated with conflicts arising from the use of

substituted equipment.

- C. Provide samples if so required by the architect or engineer before or after bid day.

### 2.3 SPARE PARTS:

- A. Provide spare parts as specified in Divisions 26, 27, and 28 sections. Deliver all spare parts to owner's representative prior to substantial completion.

## PART 3 – EXECUTION

### 3.1 GENERAL:

- A. Workmanship: Provide only first class workmanship from competent workers. Defective materials or workmanship will not be allowed on the project. Provide competent supervision for the work to be accomplished. Keep same foreman on the job, unless a change is authorized by the engineer.
- B. Coordination: Prior to construction, layout electrical work and coordinate work with other trades. Sequence, coordinate, and integrate installation of materials and equipment for efficient flow of the work. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components. Coordinate with all utilities including power, communication, and data installations.
- C. Provide cutting, drilling, channeling, etc. only as necessary for proper completion of the work. Do not cut structural members unless authorization is issued in writing by the architect/engineer.
- D. Repairs: Repair damage to building, grounds, or utilities as a result of work under this contract at no additional cost to the owner.
- E. Dimensioning: Electrical drawings indicate locations for electrical equipment only in their approximate location, unless specifically dimensioned. Do not scale electrical drawings for dimensional information. Refer to architectural drawings and shop drawings where applicable for locations of all electrical equipment. Field verify all dimension on the job site.
- F. Provide block-outs, sleeves, demolition work, etc., required for installation of work specified in this division.
- G. Standards: Provide electrical installation in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- H. All workmen doing work of any nature on State of Utah projects must at all times carry their electrician's license with them and show it upon request. The acceptable ratio of apprentice to journeyman electricians on the job is 1:1.

3.2 REQUESTS FOR INFORMATION:

- A. When it is clearly apparent that information is not adequately described in the construction documents or when a coordination problem exists, submit a request for information (RFI) through proper contractual channels. The electrical engineering design firm will provide a response through its contractual channel. Although verbal direction may be given to expedite changes, responses are not considered part of the contract documents until a change order has been issued and signed by the Owner or his designated representative. The Contractor shall bear all costs associated with proceeding on any change order that has not been approved by the Owner or his designated representative.
- B. Any damages caused by construction delays due to frivolous RFI's, will be born solely by the Contractor.

3.3 SAFETY PRECAUTIONS:

- A. Provide all necessary guards or construction barriers and take all necessary precautions to insure the safety of life and property.

3.4 CLEAN:

- A. Clean up all equipment, conduit, fittings, wire, packing cartons, plastic, and other debris that is a direct result of the installation of the work of this division, both during the execution, and at the conclusion, of the project. Keep the site clean and safe during the progress of the work. Clean fixtures, interior and exterior of all equipment, and raceways prior to final acceptance. Vacuum interior of all electrical panels and equipment. Correct any damaged equipment. Touch-up or repaint if necessary.

3.5 TEMPORARY POWER:

- A. Make arrangements with the proper institution authority for all temporary electricity.
- B. Provide temporary power, complete with metering and wiring for lighting and power outlets for construction tools and equipment. Report the initial meter reading to the owner/institution, or otherwise as may be directed.
- C. Service shall be provided with a main disconnect and all 20 ampere receptacles protected by 20 amp GFI, single-pole breakers. No attempt is made herein to specify construction power requirements for equipment in detail. Provide all electrical equipment and wiring as required.
- D. As soon as permanent power and metering is available, the temporary power supply shall be disconnected and removed from the project site.
- E. All temporary wiring shall meet the requirements of NEC Article 305 and the State Industrial Commission.

3.6 POWER OUTAGES:

- A. All power outages required for execution of this work shall occur during non-standard working hours and at the convenience of the owner. Any electrical service interruption will be

coordinated at least 7 days in advance of the power shut-off. Include all costs for overtime work in bid. Coordinate all outages and proceed only after receiving authorization from the owner's representative. Keep all outages to an absolute minimum.

### 3.7 STORAGE AND PROTECTION OF MATERIALS:

- A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. Lost or damaged materials will be replaced at no additional cost to owner. Do not store materials and apparatus in any public thoroughfare or in any area on the site where such storage would constitute a hazard to persons in the vicinity. Protect completed work, work underway, and apparatus against loss or damage.

### 3.8 EXCAVATING FOR ELECTRICAL WORK:

- A. Verification: Prior to excavating, locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling. Observe all State and Local codes prior to excavating. Do not disturb walls, footings, and other structural members in any way.
- B. Protection: Provide barricades, warning signs, and illumination to protect persons from injury at excavations. Provide temporary coverings and heat as necessary to protect bottoms of excavations from freezing and frost action. Do not install electrical work on frozen excavation bases or subbases.
- C. Coordination: Do not excavate for electrical work until the work is ready to proceed without delay.
- D. Excavated Materials: Temporarily store excavated materials near excavation in manner which will not interfere with or damage excavation or other work. Dispose of and remove excavated materials which are either in excess of quantity needed for backfilling or do not comply with the requirements for backfill material.
- E. Burial Depths: Burial depths must comply with NEC Section 300-5 (or State of Utah requirements, whichever is more stringent), unless noted otherwise on drawings.
- F. Excavation Permits: Obtain all shut-down and excavation permits as may be required for proper completion of the work.

### 3.9 BACKFILL MATERIALS:

- A. For buried conduits or cables (other than below slab-on-grade, or concrete-encased), provide 2" thickness of well-graded sand on all sides of conduits or cables.
- B. For trench backfill to within 6" of final grade, provide soil material suitable for compacting to required densities.
- C. For top 6" of excavation, provide top soil.
- D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment:

1. Lawn/Landscaped Areas: 85 percent for cohesive soils, 95 percent for cohesionless soils.
2. Paved Areas, other than roadways: 90 percent for cohesive soils, 95 percent for cohesionless soils.

- E. Where subsidence is observable at electrical work excavations during project warranty period, remove surface, add backfill material, compact, and replace surface treatment. Restore surface to original condition.

### 3.10 ROOF PENETRATIONS:

- A. Where raceways and/or cables penetrate roofing, provide 26 gauge galvanized iron roof jack sized to fit tightly to raceway and/or cable for weather-tight seal, and with flange extending a minimum of 9" under roofing on all sides. Seal opening between raceway and roof jack with approved sealant. Coordinate all work with division 7.

### 3.11 FIRE PENETRATION SEALS:

- A. Seal all raceway and/or cable penetrations through fire-rated floors, wall, and ceilings to prevent the spread of smoke, fire, toxic gas or water through the penetration either before, during or after fire. Provide penetration sealants and fittings of ratings to match the rating of the penetrated materials so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the NEC.
- B. Sealant Systems: Provide sealants, wall wraps, partitions, caps, and other accessories complying with UL 1479 (ASTM E-814) from the following where applicable:
1. 3M Fire Barrier Sealing Penetration System
  2. Chase Foam Fire Stop System
  3. Thomas and Betts Flame Safe Fire Stop System
  4. Nelson Fire Stop Products
- C. Fittings: Where applicable, provide OZ Type CFSF/I and CAFSF/I fire seal fittings for conduit and cable penetrations through concrete and masonry wall, floor, slabs, and similar structures.
- D. Install sealants and fittings in accordance with all manufacturer's written instructions.

### 3.12 LABELING:

- A. Engraved black plastic laminated, with white-core labels, 1/16" thick, shall be permanently attached on both the interior and exterior the following electrical equipment:
1. Branch panels
  2. Switchgear
  3. Disconnect switches
  4. Motor starter and controls junction boxes (power and auxiliary)
  5. Push buttons
  6. Thermal switches
  7. Time switches
  8. Motor control centers
  9. Transformer

10. Similar equipment.
11. Lighting contactors and associated switches
12. Junction boxes larger than 4x4x1/2.

B. The labels shall have 1/4" high, engraved letters, such as EF-1, AC-1, Panel A, etc.

C. Label for motor starters and/or thermal overload switches shall include heater size and F.L.A.

D. Labels shall be red where serving emergency loads.

E. Labels on UPS equipment must be orange with white lettering.

### 3.13 CONCRETE BASES:

A. Housekeeping Pads: Unless otherwise noted, provide 4" high reinforced concrete bases for all floor-mounted or floor-standing electrical equipment, including but not necessarily limited to the following:

1. Transformers
2. Switchgear
3. Motor control centers
4. Generators
5. Battery racks
6. Similar Equipment

B. Extend bases 6" beyond equipment or mounting rails on all sides or as shown on the drawings. Notwithstanding this requirement, coordinate with equipment manufacturer, shop drawings, and height of base to ensure compliance with NEC 380-82.

C. Concrete bases: Refer to Section 260551 – exterior area lighting.

D. Transformer Pads: Provide and locate properly sized concrete pads for power company furnished pad mounted transformers in accordance with power company clearance requirements.

### 3.14 TESTS:

A. Notify engineer prior to all testing specified herein at least three business days prior to testing. Engineer shall observe all tests to insure the proper operation of the electrical system.

### 3.15 PROJECT FINALIZATION AND START-UP:

A. Upon completion of the work, have each factory representative and/or subcontractor assist in start-up and testing of their respective systems.

B. Have each representative give personal instructions on operating and maintenance of their equipment to the owner's maintenance and/or operation personnel.

C. Have representatives certify each system with a written statement indicating that they have performed start-up and final check out of their respective systems.

### 3.16 FINAL REVIEW:

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- A. Have the project foreman accompany their reviewing parties and remove coverplates, panel covers, access panels, etc. as requested, to allow review of the entire electrical system.

END OF SECTION 260010

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SECTION 260070 - ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to electrical connections.

1.2 DESCRIPTION OF WORK:

- A. Extent of electrical connections for equipment include all final electrical connections for all equipment having electrical requirements including, but not necessarily limited to the following:
  - 1. Equipment specified under all divisions of the contract. Refer to other divisions for specific electrical requirements.
  - 2. Owner-furnished equipment
  - 3. Kitchen Equipment
  - 4. Etc.

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.
- B. SHOP DRAWINGS: Not required.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Provide all materials for electrical connections including, but not necessarily limited to the following:
  - 1. Raceways
  - 2. Fittings
  - 3. Conductors
  - 4. Cords
  - 5. Cord caps
  - 6. Wiring devices
  - 7. Pressure connectors
  - 8. Lugs (CU-AL)
  - 9. Electrical insulating tape
  - 10. Heat-shrinkable tubing

11. Cable ties
12. Wire nuts
13. Other items and accessories as required.

- B. Crimp on or slip-on type splicing materials designed to be used without wire stripping are not acceptable.
- C. Power Distribution Blocks: Provide Square D Type LB or Equivalent.
- D. Refer to other Division 26, 27, and 28 Sections for specification of electrical materials as applicable.

### PART 3 - EXECUTION

#### 3.1 GENERAL:

- A. Make electrical connections in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

#### 3.2 CONNECTIONS:

- A. Permanently Installed Fixed Equipment:
  1. Install conductors in flexible conduit from junction box to equipment control panel or connection point.
  2. Where such installations are subject to moisture, install in liquid-tight flexible conduit.
- B. Movable equipment:
  1. Provide wiring devices, cord caps, and multi-conductor cables as required.
- C. Other methods as required by the NEC and/or as required by special equipment or field conditions.
- D. Power Distribution Blocks: Unless noted otherwise on drawings, provide power distribution blocks only for tapping of feeders and branch circuits. Locate in junction box or gutter in NEMA ratings to suit application.

#### 3.3 MANUFACTURER'S INSTRUCTIONS:

- A. Obtain manufacturer's instruction and wiring diagram regarding electrical connections of each piece of equipment and provide connections in accordance therewith.

#### 3.4 VERIFICATION OF LOAD CHARACTERISTICS:

- A. Verify electrical load characteristics of all equipment prior to rough-in. Review respective shop drawings of all other Divisions and Owner's equipment manuals. Report any variances from electrical characteristics noted in the contract documents to the Architect/Engineer prior to

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rough-in.

- B. Value of rough-in work, electrical equipment, etc. installed and/or purchased by the contractor not meeting equipment requirements shall be credited back to the owner.

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END OF SECTION 260070



SECTION 260072 - ELECTRICAL SUPPORTS AND SEISMIC RESTRAINTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY:

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Seismic restraints for electrical equipment and systems.
  - 3. Construction requirements for concrete bases.

1.3 DEFINITIONS:

- A. IBC: International Building Code.
- B. Seismic Restraint: A structural support element such as a metal framing member, a cable, an anchor bolt or stud, a fastening device, or an assembly of these items used to transmit seismic forces from an item of equipment or system to building structure and to limit movement of item during a seismic event.

1.4 SUBMITTALS:

- A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support and seismic-restraint component used.
  - 1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
  - 2. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Shop Drawings: Indicate materials and dimensions and identify hardware, including attachment and anchorage devices, signed and sealed by a qualified professional engineer. Include the following:
  - 1. Fabricated Supports: Representations of field-fabricated supports not detailed on Drawings.
  - 2. Seismic Restraints: Detail anchorage and bracing not defined by details or charts on Drawings. Include the following:
    - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    - b. Details: Detail fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions

- and values of forces transmitted to the structure during seismic events.
- c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

- C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
  - D. Welding certificates.
  - E. Qualification Data: For professional engineer and testing agency.
  - F. Field quality-control test reports.
- 1.5 QUALITY ASSURANCE:
- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
  - B. Testing of Seismic Anchorage Devices: Comply with testing requirements in Part 3.
  - C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

### 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS:

- A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.
- B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly.
  - 1. Available Manufacturers:
    - a. Cooper B-Line; a division of Cooper Industries.
    - b. ERICO International Corporation.
    - c. Allied Support Systems; Power-Strut Unit.
    - d. GS Metals Corp.
    - e. Michigan Hanger Co., Inc.; O-Strut Div.

- f. National Pipe Hanger Corp.
  - g. Thomas & Betts Corporation.
  - h. Unistrut; Tyco International, Ltd.
  - i. Wesanco, Inc.
2. Finishes:
- a. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.
3. Channel Dimensions: Selected for structural loading and applicable seismic forces.
- C. Raceway and Cable Supports: As described in NECA 1.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
- 1. Verify suitability of fasteners in subparagraph below for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick.
  - 2. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Available Manufacturers:
      - 1) Hilti, Inc.
      - 2) ITW Construction Products.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co. Inc.
  - 3. In the following subparagraph, use stainless steel anchors in corrosive environments.
  - 4. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Available Manufacturers:
      - 1) Cooper B-Line; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc
      - 3) Hilti, Inc.
      - 4) ITW Construction Products.
      - 5) MKT Fastening, LLC.
      - 6) Powers Fasteners.
  - 5. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  - 6. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
  - 7. Toggle Bolts: All-steel springhead type.
  - 8. Hanger Rods: Threaded steel.

## 2.3 SEISMIC-RESTRAINT COMPONENTS:

- A. Rated Strength, Features, and Application Requirements for Restraint Components: As defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least five times the maximum seismic forces to which they will be subjected.
- B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.
- C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.
1. Available Manufacturers:
    - a. Amber/Booth Company, Inc.
    - b. Loos & Co., Inc.
    - c. Mason Industries, Inc.
  2. Seismic Mountings, Anchors, and Attachments: Devices as specified in Part 2 "Support, Anchorage, and Attachment Components" Article, selected to resist seismic forces.
  3. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod, of design recognized by an agency acceptable to authorities having jurisdiction.
  4. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to type and size of anchor bolts and studs used.
  5. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

## 2.4 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES:

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 5 Section "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for raceways as within 12 inches of coupling, fitting, and box, at each 90 degrees bend,

minimum of two supports per ten foot run. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

- C. Multiple Raceways: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

- 1. Secure raceways and cables to these supports with single-bolt conduit clamps, or as otherwise required by an agency acceptable to authorities having jurisdiction.

### 3.2 SUPPORT AND SEISMIC-RESTRAINT INSTALLATION:

- A. Comply with NECA 1 for installation requirements, except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, raceways may be supported by openings through structure members, as permitted in NFPA 70.
- C. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.
- D. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- E. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
  - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 Spring-tension clamps.
  - 7. To Light Steel: Sheet metal screws.
  - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- G. Do not drill or core cut holes for anchors or use powder-activated fasteners in post-tension slabs, joists, and beams.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS:

- A. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES:

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and seismic criteria at Project.
- B. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so expansion anchors will be a minimum of 10 bolt diameters from edge of the base.
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of the base.
  - 2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 6. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3 Section "Cast-in-Place Concrete."

3.5 INSTALLATION OF SEISMIC-RESTRAINT COMPONENTS:

- A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Restraint Cables: Provide slack within maximums recommended by manufacturer.
- D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.6 FIELD QUALITY CONTROL:

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

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- B. Testing: Test pullout resistance of seismic anchorage devices.
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  5. Test to 90 percent of rated proof load of device.
  6. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Record test results.

END OF SECTION 260072



SECTION 260110 - CONDUIT RACEWAYS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to conduit raceways.

1.2 DESCRIPTION OF WORK:

- A. Extent of raceways is indicated by drawings and schedules.
- B. Types of raceways in this section include the followings:
  - 1. Rigid Metal Conduit
  - 2. PVC Externally Coated Rigid Steel Conduit
  - 3. Intermediate Metal Conduit
  - 4. Electrical Metallic Tubing
  - 5. Flexible Metal Conduit
  - 6. Liquid-tight Flexible Metal Conduit
  - 7. Rigid Non-metallic Conduit

1.3 QUALITY ASSURANCE:

- A. Standards: Refer to Section 260010 - Electrical General Provisions as applicable. Provide conduit raceway installation in accordance with recommendations of the American Iron and Steel Institute "Design Manual on Steel Electrical Raceways", latest edition.
- B. Manufacturers: Firms regularly engaged in the manufacture of raceway of types and sizes required, whose products have been in satisfactory service for not less than three (3) years.
- C. Shop Drawings: Not required.

PART 2 – PRODUCTS

2.1 CONDUITS:

- A. Rigid Metal Conduit (RMC): Provide zinc-coated, hot-dipped galvanized, rigid metallic conduit in accordance with Federal Specification WW-C-0581 and ANSI C80.1.
- B. PVC Externally Coated Rigid Metal Conduit: Provide hot-dipped galvanized, rigid metallic conduit externally coated with Polyvinyl Chloride (PVC) in accordance with ANSI C80.1 and NEMA Std. Pub. No. RN 1.

- C. Intermediate Metal Conduit (IMC): Provide hot-dipped galvanized, intermediate metal conduit in accordance with Federal Specification WW-C-581.
- D. Electric Metallic Tubing (EMT): Provide electric metal tubing in accordance with Federal Specification WW-C-563 and ANSI C80.3.
- E. Flexible Metal Conduit: Provide zinc-coated, flexible metal conduit in accordance with Federal Specification WW-C-566.
- F. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight, flexible metal conduit, constructed of single strip, flexible continuous, interlocked, and double-wrapped steel, galvanized inside and outside, coated with liquid-tight jacket of flexible Polyvinyl Chloride (PVC).
- G. Rigid Non-Metallic Conduit: Provide rigid non-metallic conduit (PVC) in accordance with ANSI/NEMA TC 2, Type 1 for concrete encasement, Type 2 for direct burial.

## 2.2 FITTINGS:

- A. Rigid Metal Conduit, Intermediate Metal Conduit, and PVC Externally Coated Rigid Metal Conduit: Provide fully-threaded, malleable steel fittings, rain-tight and concrete-tight as applicable. Provide double locknuts and metal bushings at all conduit terminations. Install OZ Type B bushings on conduits 1-1/4" and larger.
- B. Electric Metallic Tubing: Provide insulated throat, non-indenter, set screw, malleable steel fittings. Screws must have a full set. Provide concrete-tight compression-type fittings in suspended slabs. All EMT fittings shall be fabricated from steel. Die-cast fittings or fittings made from pot metal shall not be allowed. Indenter type fittings are not acceptable. Install OZ Type B bushings on conduits 1" and larger.
- C. Flexible Metal Conduit: Provide flexible metal conduit fittings in accordance with Federal Specification W-F-406, Type 1, Class 1, and Style A. Commercial "greenfield" not less than 1/2" diameter or as otherwise specified on drawings is acceptable.
- D. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit fittings in accordance with Federal Specification W-F-406, Type 1, Class 3, Style G.
- E. Non-Metallic Conduit: Provide non-metallic conduit fittings (PVC) in accordance with ANSI/NEMA TC 3 to match conduit types and materials.
- F. Expansion Fittings: OZ Type AX, or equivalent to suit application.
- G. Sealing Bushings: Provide OZ Type FSK, WSK, or CSMI as required by application. Provide OZ Type CSB internal sealing bushings.
- H. Cable Supports: Provide OZ cable supports for vertical risers, type as required by application.

## 2.3 SIZES:

- A. Provide conduits in sizes as indicated in contract documents or as otherwise specified herein, but not less than 3/4".

### PART 3 – EXECUTION

#### 3.1 GENERAL:

- A. Install raceway and accessories in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

#### 3.2 LOCATIONS:

- A. Rigid Metal Conduit and Fittings: Use for conduit bends greater than 22 degrees where buried below grade or slab on grade. Install RMC where raceway passes vertically through slab-on-grade. Where raceways penetrate building, manholes, or vault walls and floors below grade, provide RMC for a minimum distance of 10' on the exterior side of the floor or wall. Use RMC for exposed runs where conduit is subject to moisture, weather, or mechanical injury. Use in hazardous locations in accordance with all NEC requirements.
- B. Intermediate Metal Conduit and Fittings: Use for exposed runs where conduit is subject to moisture, weather, or mechanical injury. Use in hazardous locations in accordance with all NEC requirements.
- C. Electric Metal Tubing and Fittings: Use for above-grade feeders, branch circuits, and signal and control circuit, unless specifically noted otherwise on drawings. Install in suspended slabs subject to local code requirements and fire rating considerations.
- D. Flexible Metal Conduit and Fittings: Use as whips for lighting fixtures, fixed equipment where not exposed to weather or moisture, other devices where required by NEC, and as requested by the Engineer. Maximum length not to exceed 6', unless specifically approved by the Electrical Engineer.
- E. Liquid-Tight Flexible Metal Conduit and Fittings: Use for connection to motor terminal boxes, fixed equipment where subject to moisture or weather, and other equipment subject to movement or vibration. Maximum length not to exceed 6', unless specified otherwise.
- F. Rigid Non-Metallic Conduit and Fittings: Use for below-grade service entrances, feeders, branch circuits, and signal and control circuit, unless specifically noted otherwise on drawings. Do not use above grade.

#### 3.3 METHODS:

- A. Maintain a minimum of 12" clearance between steam or hot water lines or other hot surfaces. Where such clearance is impractical, insulate conduit with approved materials.
- B. Install conduits parallel with or at right angles to lines of the structure. Route conduits symmetrically where possible.
- C. Field bends and offsets shall be made without flattening, kinking, rippling or destroying the smooth internal bore or surface of the conduit and to not less than NEC minimum radius.

Conduit that shows signs of rippling or kinking shall not be installed. Conduits installed with wrinkles or kinks or otherwise in an unworkmanlike manner shall be replaced at no additional cost to owner.

- D. Precaution shall be exercised to prevent accumulation of water, dirt or concrete in the conduits during the execution of the project. Conduits in which water or foreign matter has been permitted to accumulate shall be thoroughly cleaned or the conduits runs replaced where such accumulation cannot be removed by methods approved the engineer.
- E. Any conduit which pierces airtight spaces or plenums shall be sealed to prevent air leakage with mastic acceptable to the Architect.

#### 3.4 CONCEALING:

- A. All raceways shall be concealed within the ceilings, walls, and floors, except in locations where exposed raceways are specifically permitted, such as equipment rooms and unfinished storage areas. In equipment rooms, if lighting raceways are run exposed, installation shall not be done until piping and duct work layout has been determined in order that lighting boxes may be located so as to avoid being covered by overhead ducts and piping. If lighting raceways in equipment rooms are concealed in the structural ceiling slab, after mechanical work is complete, exposed conduit extensions shall be run to locate lighting fixtures where they are not obscured by work of other trades.

#### 3.5 BURIED CONDUITS:

- A. Comply with all burial depths as defined in NEC Section 300-5. Bury all conduits at least 24" below grade, unless specifically indicated otherwise on drawings. Provide magnetic 6" wide "Yellow Warning" ribbon 12" directly above conduit and 6" below finished grade measured from the top of the conduit or duct bank. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single marker.
- B. Slope all conduits toward manholes or pull boxes for proper drainage. Use weep holes. Gravel drainage pockets are not permitted.
- C. Coat all metal conduits with an approved asphaltic compound or wrap with two layers of PVC tape.
- D. Under Concrete Slab on Grade: Horizontal conduit must be installed a minimum of 2" below the bottom of the concrete slab. Conduits should not be installed in concrete slabs.
- E. Concrete Encasement: Where concrete-encasement is indicated on drawings, provide ductbank construction using red 3000 psi at 28 day strength concrete. Provide minimum 4" cover on all sides of exterior conduits. Provide conduit spacers where applicable. Coat all metal conduits with an approved asphaltic compound or wrap with two layers of PVC tape.
- F. Where conduits are extended for future use, cap and clearly mark.

#### 3.6 ELECTRICAL CONTINUITY:

- A. Provide electrically continuous conduit systems throughout.

3.7 FIELD CUTS AND THREADS:

- A. Cut all conduits square. Remove all sharp or rough edges and ream all burrs, inside and outside. Provide clean sharp threads on RMC and IMC.
- B. Engage at least five full threads on all RMC and IMC fittings. Before couplings or fittings are attached, apply one coat of red lead or zinc chromate to male threads of RMC or IMC. Apply coat of red lead, zinc chromate or special compound recommended by manufacture to conduit where conduit protective coating is damaged.

3.8 SUSPENDED SLABS:

- A. When conduit is installed in the suspended slab, it shall be limited to conduits having a diameter of 1" (25 mm) or less, or less than 1/3 the concrete cover, and no crossovers occur, and conduit spaced at least 18" (450 mm) apart with a 3/4" (20 mm) cover.

3.9 CONDUIT ENDS:

- A. Cap all spare conduits. Cap or plug conduit ends during construction to prevent entrance of foreign material.

3.10 SPARE CONDUITS:

- A. Provide five (5) 3/4" empty conduits from panel stubbed into accessible ceiling space and five (5) 3/4" conduits into accessible floor space. When floor is not accessible, provide six (6) 3/4" empty conduits from panel stubbed into accessible ceiling space. Cap and label all conduits.
- B. Install a 200 lb. polypropylene pull cord in each empty conduit run.

3.11 HAZARDOUS LOCATIONS:

- A. Install RMC and IMC in all hazardous locations as defined by the NEC. Provide suitable fittings, seal-offs, boxes, etc. to comply with all NEC requirements and/or as shown on the drawings. Provide inspection fittings with hazardous location rated drains to prevent water from accumulating in conduit runs.

3.12 CLEANING:

- A. Pull mandril and swab through all conduits before installing conductors.

END OF SECTION 260110



SECTION 260111 - RACEWAY SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to raceway systems.

1.2 DESCRIPTION OF WORK:

- A. Extent of raceway systems is indicated by drawings and schedules.
- B. Types of raceway systems in this section include the following:
  - 1. Cable Tray

1.3 QUALITY ASSURANCE:

- A. Standards: Refer to Section 260010 - Electrical General Provisions as applicable. Cable tray shall meet all the requirements of NEMA VE-1.
- B. Shop Drawings: Submit dimensioned drawings and manufacturer's data of raceway systems showing layout of raceways and fittings and spatial relationships to associated equipment.

PART 2 - PRODUCTS

2.1 CABLE TRAY SYSTEMS:

- A. General: Provide UL-listed cable tray systems of sizes and types indicated. Provide ladder type cable tray, 12" wide, 4" high, 12" rung spacing, NEMA class 8A, and hot-dip galvanized finish (after fabrication) or aluminum with Engineers written approval.
- B. Fittings and accessories: Provide all fittings and accessories as required for a complete system. Provide bends having radii of 12", intersections, expansion joints, transition fittings, reducers, barrier strips, conduit-to-tray clamps, hangers, supports, retaining clips, etc.
- C. Supports: Provide center hung tray support systems. Provide support systems including lateral and longitudinal bracing to meet the requirements of Section 260072 - Electrical Support and Seismic Restraints.
- D. Grounding: Provide cable tray systems that are completely continuous.
- E. Manufacturers: Subject to compliance with requirements, provide cable tray systems of one of the following:

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Utah State University  
Life Sciences Research Center  
Logan, Utah

1. B-Line
  2. P/W Industries
  3. Globe Metal Products
  4. Square D
  5. Thomas&Betts
  6. T.J. Cope
- 

### PART 3 – EXECUTION

#### 3.1 GENERAL:

- A. Install raceway systems and accessories in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

#### 3.2 CABLE TRAYS:

- A. Grind all rough edges, drip concentrations, etc. to a smooth finish. Apply cold zinc spray to all field cut surfaces.

END OF SECTION 260111

SECTION 260120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to conductors and cables.

1.2 DESCRIPTION OF WORK:

- A. This section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.
- B. Types of conductors and cables in this section include the following:
  - 1. Copper Conductors.
  - 2. Flexible Cords.
- C. Applications for conductors and cables required for project include:
  - 1. Electrical service.
  - 2. Feeders.
  - 3. Branch Circuits.

1.3 SUBMITTALS:

- A. Product Data: For each type of conductor and/or cable indicated.
- B. Field Quality-Control Test Reports: From Contractor. Refer to Section 260010 – General Electrical Provisions.

1.4 QUALITY ASSURANCE:

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Manufacturers: In other Part 2 articles where subparagraph titles below introduce lists, provide

products by the manufacturer specified, subject to compliance with requirements.

- B. Ambient Conditions: Conductors used for branch circuits in areas where the ambient conditions exceed 30 degree C. shall be provided with insulation approved for that temperature.

- C. Wire Sizes: As indicated on electrical drawings or as specified herein, but in no case less than No. 12 AWG.

## 2.2 COPPER CONDUCTORS:

- A. Manufacturers:

1. American Insulated Wire Corporation; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

- B. Refer to Part 3 "Conductor and Cable Applications" Article for application requirements.

- C. References and Ratings:

1. ICEA S-95-658 / NEMA WC70.
2. ASTM.
3. UL Standard 83.
4. UL Standard 1063 (MTW).
5. Federal Specification J-C-30B.
6. NEC.

- D. Conductor Material: Copper.

- E. Stranding: Solid conductor for No. 12 AWG, stranded for No. 10 AWG and larger.

- F. Conductor Insulation Types: Thermoplastic-insulated, Type THHN / THWN-2.

## 2.3 FLEXIBLE CORDS:

- A. Manufacturers:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

- B. Refer to Part 3 "Conductor and Cable Applications" Article for application requirements.

- C. References and Ratings:

1. ASTM.
2. ICEA.
3. UL 62.
4. Pendant or portable.

5. Damp locations.
6. 600 Volts.
7. NEC Article 400.

D. Conductor Material: Copper.

E. Stranding: Class K, flexible stranded conductor.

F. Conductor Insulation Types: Heat- and moisture-resistant TPE insulation.

G. Fillers and Wrapping: Non-wicking polypropylene fillers, with tissue-paper separator wrapped around the assembly.

H. Outer Jacket: Black-colored, heat-, moisture-, and oil-resistant TPE jacket.

I. Grounding: Insulated green grounding conductor.

J. Cord Type: SO, hard-usage.

#### 2.4 CONNECTORS AND SPLICES:

A. Manufacturers:

1. AMP Incorporated/Tyco International.
2. Hubbell/Anderson.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. Splices for wire sizes #10 and smaller shall be screw-on type similar to scotch or ideal wing nut connectors. Crimp-on splices designed to be used without wire stripping are not acceptable.

### PART 3 – EXECUTION

#### 3.1 GENERAL:

A. Install conductors, cables, and accessories as indicated, in compliance with manufacturer's written instruction, applicable requirements of NEC, NECA's "Standards of Installation", and in accordance with recognized industry practices to ensure that products fulfill requirements.

#### 3.2 CONDUCTOR AND CABLE APPLICATIONS:

A. Service Entrance: As indicated on the electrical drawings.

B. Feeders: As indicated on the electrical drawings.

C. Branch Circuits:

1. Exposed, including in crawlspaces: Copper conductors in raceway.
2. Concealed in ceilings, walls, and partitions: Copper conductors in raceways.
3. Concealed in concrete and below slabs-on-grade: Copper conductors in raceway.

D. Cord Drops, Reels, and Portable Appliance Connections: Flexible cord.

E. Class 1 Control Circuits: Copper conductors in raceway.

### 3.3 INSTALLATION:

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

D. When raceway is not required, install concealed cables parallel and perpendicular to surfaces of structural members, and follow surface contours where possible.

E. Support cables according to other applicable specification sections.

F. Seal around cables penetrating fire-rated elements to comply with applicable fire stop specification sections.

G. Color Coding: Color code secondary service, feeder, and branch circuit conductors. Colors shall remain consistent throughout the project and shall match existing coding system where applicable.

1. Conductor sizes No. 6 AWG and smaller: Colored insulation.
2. Conductors sizes No. 4 AWG and larger: 2 inch (51 mm) band of Colored adhesive marking tape applied at all terminations, junction boxes, and pull boxes.
3. Branch circuit switched-legs and travelers: Colored insulation (in colors other than those indicated below).
4. Color-code 120/208V system conductors:
  - a) Phase A: Black.
  - b) Phase B: Red.
  - c) Phase C: Blue.
  - d) Neutral: White.
  - e) Ground: Green.
  - f) Isolated Ground: Green with yellow tracer.
5. Color-code 277/480V system conductors:
  - a) Phase A: Brown.
  - b) Phase B: Orange.
  - c) Phase C: Yellow.
  - d) Neutral: White with colored stripe or gray.
  - e) Ground: Green.

### 3.4 HOMERUN CIRCUITS:

A. Homerun circuits may be combined in common conduits at the option of the contractor in compliance with the following:

1. Three-Phase Installations: Not more than three single-phase circuits with common neutral in one conduit, unless specifically noted otherwise, if each circuit is from a different phase (a, b, or c).
2. Single-Phase Installations: Not more than two single-phase circuits with common neutral in one conduit, unless specifically noted otherwise, if each circuit is from a different phase (a or b).

### 3.5 NEUTRAL CONDUCTORS:

- A. LIGHTING CIRCUITS: Where multiple circuits serving lighting are run in a single raceway (see paragraph above for allowable number or circuits per conduit), a common neutral shall be allowed. When any one circuit is serving fluorescent lighting loads, provide an oversized neutral conductor. Size the neutral conductor one size (AWG) larger than the largest phase conductor.
- B. OUTLET CIRCUITS: Where multiple circuits serving electrical outlets are run in a single raceway (see paragraph above for allowable number of circuits per conduit), a shared common neutral is allowed.

### 3.6 SYSTEM FURNITURE CIRCUITS:

- A. Coordinate system furniture wiring requirements and termination locations with supplier/installer prior to rough-in. Coordinate placement of connection boxes in walls and columns (where applicable) to insure that adequate accessibility is maintained.
- B. 4-Circuit, 3+D Wiring: Provide a total of 8 conductors to each system furniture connection consisting of three circuits with shared equipment ground and shared oversized neutral; and one dedicated circuit with dedicated isolated ground and dedicated neutral. Size the shared neutral conductor one size (AWG) larger than the largest phase conductor.
- C. 3-Circuit, Shared Neutral Wiring: Provide a total of 5 conductors to each system furniture connection consisting of three circuits with shared equipment ground and shared oversized neutral. Size the shared neutral conductor one size (AWG) larger than the largest phase conductor.
- D. 4-Circuit, 3I+1 Wiring: Provide a total of 8 conductors to each system furniture connection consisting of three circuits with shared isolated ground and shared oversized neutral; and one dedicated circuit with dedicated equipment ground and dedicated neutral. Size the shared neutral conductor one size (AWG) larger than the largest phase conductor.
- E. 3-Circuit, Separate Neutral Wiring: Provide a total of 8 conductors to each system furniture connection consisting of two circuits with two dedicated neutrals and shared isolated ground; and one dedicated circuit with dedicated equipment ground and dedicated neutral.
- F. 4-Circuit, 2+2 Wiring: Provide a total of 8 conductors to each system furniture connection consisting of two circuits with shared equipment ground and shared oversized neutral; and two circuit with shared isolated ground and shared oversized neutral. Size the shared neutral conductors one size (AWG) larger than the largest phase conductor.

3.7 VOLTAGE DROP:

- A. Provide branch circuit conductors in sizes such that voltage drop for branch circuits do not exceed 3 percent at the farthest outlet. Provide service, feeder, and branch circuit conductors so that the voltage drop on the entire electrical system does not exceed 5 percent at the farthest outlet. This shall be strictly followed regardless of the conductor sizes indicated on the electrical drawings. Increase conductor sizes (and conduits where necessary to comply with NEC conduit fill requirements) as necessary to accommodate this requirement. Calculations shall be based on the following:

1. Lighting Branch Circuits: Connected load plus 25% spare.
2. Appliance and Equipment Branch Circuits: Nameplate or NEC required load.
3. 120V Convenience Outlet Branch Circuits: 12 amps minimum, but in no case less than NEC loading requirements. Use the following schedule:

<u>Distance (feet)</u>	<u>Wire Size (AWG)</u>
0-80	#12
81-125	#10
126-200	#8
201-320	#6

4. Use the NEC method to calculate voltage drop.

3.8 CONNECTIONS:

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack. Use pig tails when wiring outlets.

3.9 FIELD QUALITY CONTROL:

- A. Testing: Perform the following field quality-control testing:
1. Visual and Mechanical Inspection:
    - a) Inspect cables for physical damage and proper connection in accordance with the electrical construction documents.
    - b) Test cable mechanical connections to manufacturer's recommended values with a calibrated torque wrench.
    - c) Check cable color coding for compliance with electrical specifications.
  2. Electrical Tests:
    - a) Perform insulation resistance test on each conductors for feeders 100 amps and greater with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute.
    - b) Perform continuity test to insure proper cable connection.
  3. Test Values:

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Utah State University  
Life Sciences Research Center  
Logan, Utah

a) Minimum insulation resistance values shall not be less than two megohms.

B. Test Reports: Prepare a written report and submit to the Electrical Engineer at the completion of the project. The report shall include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 260120



SECTION 260135 - ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to electrical boxes and fittings.

1.2 DESCRIPTION OF WORK:

- A. Extent of electrical boxes and fittings work is indicated by drawings and schedules.
- B. Types of electrical boxes and fittings in this section include the following:
  - 1. Outlet Boxes
  - 2. Junction Boxes
  - 3. Pull Boxes
  - 4. Floor Boxes
  - 5. Conduit Bodies
  - 6. Bushings
  - 7. Locknuts
  - 8. Knockout Closures
  - 9. Miscellaneous Boxes and Fittings

1.3 QUALITY ASSURANCE:

- A. Standards: Refer to Section 260010 - Electrical General Provisions as applicable.
- B. Manufacturers: Firms regularly engaged in the manufacturer of boxes and fittings required, whose products have been in satisfactory service for not less than three years.
- C. Shop Drawings: Submit shop drawings on floor boxes only where required.

PART 2 - PRODUCTS

2.1 INTERIOR OUTLET BOXES:

- A. General: Provide one piece, galvanized or cadmium-plated, flat-rolled, sheet steel interior outlet boxes of types, shapes, and sizes to suit respective location and installation. Construct with stamped knockouts on back and sides and with threaded screw holes. Provide corrosion-resistant screws for securing boxes, covers, and wiring devices. Size all junction boxes in accordance with NEC Table 370-16(a), with a minimum box size of 4" x 4" x 1-1/2". Where three raceway entries are made, provide outlet boxes with a minimum depth of 2-1/8". Where four or more raceway entries are made, provide outlet boxes with a minimum depth of

4-11/16". Gangable boxes shall not be used.

- B. Switch, Telephone, and Receptacle Outlets: Provide outlet boxes not less than 4" square, with adapting tile or plaster covers where necessary to set flush with finished surfaces. Where three raceway entries are made, provide outlet boxes with a minimum depth of 2-1/8". Gang boxes shall be used where more than one switch or device is located at one point. Sectional Boxes are not acceptable. In masonry walls where tile or plaster ring cannot be used, install a single-gang 3-1/2" deep box minimum, unless otherwise noted. Where four or more raceway entries are made, provide outlet boxes with a minimum depth of 4-11/16".

C. Lighting Outlets:

1. Lay-in Grid: Outlets for recessed fixtures in acoustical tile ceilings shall be located to center on a single tile or at the intersection of four tiles.
2. Surface-mounted: Provide 4" square octagonal outlet boxes for surface-mounted, ceiling fixture outlets. Mount each box independently of the conduit on standard 3/8" stud or approved box hanger where applicable. Include backing and supports as required to carry 200 lbs. Where three or more raceway entrances are made, use a minimum box depth of 2-1/8".

2.2 WEATHERPROOF OUTLET BOXES:

- A. Provide corrosion-resistant, cast-metal weatherproof outlet boxes, of types, shapes, and sizes, with threaded conduit ends, cast metal coverplates with spring-hinged waterproof caps, face plate gaskets, and corrosion-resistant fasteners.

2.3 JUNCTION AND PULL BOXES:

- A. Provide code-gauge sheet steel junction and pull boxes, with removable screw-on covers and welded seams, of types, shapes, and sizes to suit each respective location and installation. Size all junction and pull boxes in accordance with NEC 370-28. Provide stainless steel nuts, bolts, screws, and washer.

2.4 FLOOR BOXES:

- A. Provide steel or PVC, weatherproof, concrete-tight floor boxes of types, shapes, and sizes to suit each respective location and installation. Where multi-service floor boxes are indicated, provide floor boxes sized to accommodate wiring devices and communication outlets shown on drawings. Construct floor boxes with fully adjustable leveling screws, and knockouts as required to accommodate specified conduits.

- B. Provide floor boxes from the following manufacturers:

1. Bell Electric
2. Crouse-Hinds
3. Hubbell
4. Steel City
5. Thomas&Betts
6. Wiremold

2.5 CONDUIT BODIES:

- A . Provide galvanized, cast-metal conduit bodies of type, shapes, and sizes to suit respective locations and installation. Construct with threaded conduit entrance ends and removable covers. Provide corrosion-resistant screws.
- B . Aluminum boxes and fitting shall not be permitted.

## 2.6 CONDUIT CONNECTIONS:

- A . Box connectors 3/4" and larger shall be insulated, throat-type or equal type plastic bushings. Provide double locknuts and insulating plastic bushings for RMC and IMC terminating at panels and boxes.
- B . Where RMC penetrates building, manholes, or vault walls and floors below grade, provide sealing bushings with external membrane clamps as applicable. Provide segmented internal sealing bushings in all raceways penetrating building walls and slabs below grade, and in all above grade raceway penetrations susceptible to moisture migration into building through raceway. Where RMC terminates in manhole, vault, or pull box, provide insulated grounding bushings. Also see Section 260135 – Electrical Boxes and Fittings.
- C . Install OZ type "B" connectors for all conduits 1" and larger.
- D . Provide cable supports in all vertical risers in accordance with NEC 300-19.

## 2.7 EXPANSION FITTINGS:

- A . Provide expansion joint fittings in all conduit runs crossing structural expansion joints, whether above-grade, in slab-on-grade, or in suspended slabs. Provide OZ type "AX" or approved equivalent, size to the raceway.

## 2.8 ACCESSORIES:

- A . Provide all accessories including, but not necessarily limited to, bushings, knockout closures, locknuts, offset connectors, etc. of types, shapes, and sizes to suit respective locations and installation. Construct of corrosion-resistant steel.

## PART 3 – EXECUTION

### 3.1 GENERAL:

- A. Install electrical boxes and fittings in accordance with manufacturer's written instruction, applicable requirements of the NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

### 3.2 METHODS:

- A. Where outlet boxes are subject to weather or moisture, install weatherproof outlet boxes.
- B. Remove knockouts only for entering conduits. Provide knockout closures to cap unused knockout holes where blanks are mistakenly removed.

- C. Do not use condulets in place of elbows or junction boxes. Condulets in sizes 2" or larger shall not be used, unless specifically approved by the electrical engineer.
- D. Install boxes and conduit bodies in readily accessible locations. Install recessed boxes with faces of boxes or rings flush with finished surfaces. Seal all openings between outlet box and adjacent surfaces with plaster, grout, or similar suitable material.
- E. For stud construction, install boxes with rigid supports using metal bar hangers, or 2" X 4", 1" X 6" wood bridging between studs with screws. Welding or nailing boxes directly to metal joist and studs is not acceptable. Boxes set opposite in common wall shall have at least 10" of conduit between them. Securely fasten outlet boxes to structural surfaces to which attached.
- F. For concrete or masonry construction, solidly embed electrical boxes in concrete and masonry. Provide box supports as required to keep outlet boxes flush with finished surfaces.
- G. Coordinate location of all outlet boxes with millwork, back splashes, tackboards, etc.
- H. Install junction boxes or condulets in conduit runs as required at 100 foot maximum intervals on long runs. This shall apply to concrete junction boxes in grade and junction boxes within the building.
- I. Provide electrical connections for installed boxes.

3.3 IDENTIFICATION:

- A. Mark circuit number on exterior side of junction boxes located in ceilings such that circuit numbers are readily identifiable. For outlet boxes in wall, mark circuit numbers on interior sides of outlet boxes.

- B. Identification labels shall be as follows:

Normal Power	Black with White letters
Emergency Power	Red with White Letters
	UPS
Isolated ground	White with Orange Letters

- C. Label and paint the covers of the systems junction boxes as follows:

<u>System</u>	<u>Color (All Colors are Kwal Howells)</u>
Fire Alarm	Red Alert AC118R
Sound/IC	Neon Blue 7076A
Telephone	Competition Yellow 7225A
Data	Java Green AC098N
MATV	Flat Black
Security	Orange Fiesta AC107Y
ATC	Flat White

END OF SECTION 260135

SECTION 260140 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to wiring devices.

1.2 DESCRIPTION OF WORK:

- A. Extent of wiring device work is indicated by drawings and schedules.
- B. Types of electrical wiring devices in this section include the following:
  - 1. Toggle Switches
  - 2. Receptacles
  - 3. Floor Service Outlets
  - 4. Poke-Through Assemblies
  - 5. Dimmers
  - 6. Special Purpose Outlets
  - 7. Multioutlet Assemblies
  - 8. Cord Caps and Connectors
  - 9. Occupancy Sensors

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.
- B. SHOP DRAWINGS:
  - 1. Submit manufacturer's data on all electrical wiring devices.
  - 2. Where occupancy sensors are required, provide scaled drawing showing manufacturer's recommended locations.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Provide factory-fabricated wiring devices, in types, and electrical ratings for applications indicated and complying with NEMA standards Pub No. WD 1. nylon construction, 20 amp rating minimum.
- B. Provide wiring devices in colors selected by Architect/Engineer. Provide red receptacle outlets and toggle switches where devices are circuited to emergency power. Provide orange

receptacle outlets where devices are circuited to UPS power.

2.2 TOGGLE SWITCHES:

A. Provide toggle switches from one of the following manufacturers (Fed-Spec):

<u>Manufacturer</u>	<u>1-Pole</u>	<u>3-Way</u>	<u>4-Way</u>	<u>W/Pilot</u>
Hubbell	HBL1221	1223	1224	1221-PL
Pass & Seymour	20AC1	20AC3	20AC4	20AC1-RPL
Leviton	1221	1222	1223	1221-PLR
Cooper	2221	2223	2224	2221-PL
Bryant	4901	4903	4904	4901-PL

B. Abbreviations are defined as follows:

1. 1-Pole - Single-Pole Toggle Switch
2. 3-Way - Three-Way Toggle Switch
3. 4-Way - Four-Way Toggle Switch
4. W/Pilo - Single-Pole Toggle Switch with Pilot Light

C. Must be back and side wired, and have color-coded covers, Brass terminal screws, back wire ground clamp, and self-grounding clip.

2.3 RECEPTACLES:

A. Provide duplex receptacles from one of the following manufacturers:

<u>Manufacturer</u>	<u>CO</u>	<u>GFCI</u>	<u>IG</u>
Hubbell	5362	GF5362	5362IG
Pass & Seymour	5362	2091-S	IG6300
Leviton	5362	8899	5362-IG
Cooper	5362	VGF20	IG5362
Bryant	5362	GFR53FT	5362IG

B. Abbreviations are defined as follows:

1. CO- Convenience Outlet Duplex Receptacle
2. GFCI- Ground Fault Circuit Interrupter duplex Receptacle
3. IG- Isolated Ground Duplex Receptacle

2.4 FLOOR SERVICE OUTLETS:

A. Provide all receptacles and special purpose outlets required in floor boxes. See Section 26135 - Electrical Boxes and Fittings. Provide coverplates, carpet flanges, etc. in finishes or colors selected by Architect/Engineer.

2.5 POKE-THROUGH ASSEMBLIES:

A. Provide factory-assembled, poke-through assemblies equipped with wiring devices as specified herein. Construct of materials to maintain fire rating of suspended slab with pre-

wired conduit, fire barriers, toggle arm assemblies, service fittings, integral junction box, etc. Provide coverplates, carpet flanges, etc. in finishes or colors selected by Architect/Engineer. Provide Poke-through assemblies of one of the following:

1. Hubbell
2. Thomas&Betts
3. Wiremold

## 2.6 DIMMERS:

- A. Incandescent: Provide solid state, linear slide preset dimmers of voltage and wattage ratings to suit respective application. Provide dimmers that are UL listed for required loads (i.e., incandescent, magnetic low voltage transformer, electronic low voltage transformer). Where applicable, insure that dimmers are compatible with lamps and ballasts provided. Provide dimmers from one of the following:

1. Lutron (Nova T Series)
2. Prescolite (Horizon Series)
3. Lightolier (Neptune Momentum Series)
4. Leviton (IllumaTech Series)

- B. Fluorescent: Provide single-pole, AC dimmers for fluorescent fixtures, 60 hertz, 120 or 277 volt as applicable, with slide-to-off continuously adjustable slider control. Construct with continuously adjustable trim potentiometer for adjustment of low end dimming. Dimmers to be an integral part of a fluorescent dimming system consisting of dimming ballast and lighting controls made by the same manufacturer. Refer to Section 26510 - Interior and Exterior Building Lighting. Provide dimmers from one of the following:

1. Lutron (Nova T Series)
2. Leviton (IllumaTech Series)

## 2.7 SPECIAL PURPOSE OUTLETS:

- A. Provide special purpose outlets of voltage and ampere ratings, and NEMA configurations to suit respective application. Refer to drawings for NEMA configuration. Provide special purpose outlets in amperages at least as large as the overcurrent protective device from which they are served.

## 2.8 MULTI-OUTLET ASSEMBLIES:

- A. Provide multi-outlet assemblies with 15A, grounding-type, receptacle outlets spaced at 6" on centers and in colors selected by Architect/Engineer or as otherwise noted on drawings. Provide multi-outlet assemblies of one of the following:

1. Wiremold
2. Thomas&Betts
3. Hubbell

## 2.9 CORD CAPS AND CONNECTORS:

- A. Provide cord caps and connectors of voltage and ampere ratings, and NEMA configurations which mate and match with outlets specified as required for final connections for equipment.

Provide cord caps and connectors of one of the following:

1. Hubbell
2. Pass & Seymour
3. Leviton
4. Cooper
5. Bryant

2.10 COVERPLATES:

- A. Wall Plates: Provide coverplates for all wiring devices. In all finished areas, provide stainless steel coverplates. Provide red coverplates for all receptacle outlets and toggle switches that are circuited to emergency power. Provide orange coverplates for all isolated ground receptacle outlets. Provide stainless steel coverplates in commercial kitchens and food preparation areas. Provide ganged coverplates for all switches and/or dimmers. Provide pre-marked coverplates for special purpose outlet indicating voltage, amperages, and phase. Provide raised stamped, galvanized, steel plates in all unfinished areas. Provide weather-proof coverplates for outlets exposed to weather and moisture.
- B. Weather-Protecting Device Enclosure: Where required for compliance with NEC 410-67 (receptacles installed outdoors for use other than with portable tools or equipment), provide weather-tight device covers which provide complete protection with the cord and cap inserted into the wiring device. Provide units which mount on either single or double gang devices. Provide device enclosures manufactured by one of the following:
1. Intermatic WP1020 or WP1030
  2. Hubbell WP826MP
  3. Pass & Seymore

2.11 OCCUPANCY SENSORS:

- A. General: Provide self-contained, ultrasonic motion detectors providing volumetric coverage without gaps within the detection area. Provide sensors in voltage and wattage ratings required to suit application. Provide sensors from one of the following manufacturers:
1. Lithonia
  2. Novitas
  3. The Watt Stopper
  4. Hubbell
  5. Leviton
- B. Ceilings-Type Occupancy Sensors :
1. One-way Sensors: Pattern shall cover 900 sq. ft minimum of ½ step motion and 670 sq. ft minimum working-at-desk motion.
  2. Two-way Sensors: Pattern shall cover 1,800 sq. ft. minimum of ½ step motion and 1,344 sq. ft minimum working-at-desk motion.
  3. Corridor and Warehouse Sensors: Sensors shall detect motion in a corridor 14' wide and 80' long, with one sensor mounted 10' above the floor. Sensors shall detect motion in a warehouse aisle 10' wide and 60' long (walking motion) or 100' long (forklift motion ) when mounted 22 feet above the floor.
  4. Sensors shall contain timing circuiting to provide user adjustable "time to light off" delay

- of 30 seconds to 12 minutes.
5. A manual override switch in the sensor shall allow the load to be turned on without tools in the event of sensor failure.
  6. Switchpack: Provide switchpack for 15 VDC power to sensors for relay switching of load. Relay contact shall be isolated and shall be operable on either 120 or 277 VAC circuits. Relay contacts shall have ratings as follows:
    - a. 10A - 120 VAC Tungsten
    - b. 20A - 120 VAC Ballast
    - c. 20A - 277 VAC Ballast

C. Wall-Type Occupancy Sensors:

1. The wall switch shall be designed to cover areas up to 300 sq. ft. in one direction.
2. The unit shall require a pushbutton to be pressed to turn lights on. Lights may also be turned off with the same pushbutton, or lights shall automatically be turned off after the pre-set period of time elapses.
3. There shall be a 10 second "grace" period after the unit turns itself off (because of lack of motion) during which a new motion will automatically turn light on without the pushbutton having to be pressed.
4. Sensitivity and time-on after activation shall be user adjustable through concealed controls to minimize tampering. Time-on shall be adjustable between 90 seconds and 30 minutes.
5. Override capability, for use in emergency or during lamp changes, shall be provided by a three-position switch which allows selection of positive on, off, and automatic operation.

PART 3 – EXECUTION

3.1 GENERAL:

- A. Install wiring devices and accessories in accordance with manufacturer's written instruction, applicable requirements of the NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to insure that products fulfill requirements.

3.2 METHODS:

- A. Install wiring devices only in electrical boxes which are clean and free from excess building materials, dirt, and debris. Do not install wiring devices until painting work is completed.
- B. Replace receptacles and/or coverplates which are damaged, stained, or burned.

3.3 GFCI RECEPTACLES:

- A. Provide separate neutral conductor from panel to each GFCI receptacle circuits.
- B. Install GFCI receptacles for all receptacles installed in restrooms, outdoors, or within six feet of any sink. All receptacles in kitchens shall be GFCI protected.
- C. Do not wire standard receptacles on the load side of GFCI receptacle - Install GFCI

receptacles.

3.4 DIMMERS:

- A. Provide separate neutral conductor for each phase of the branch circuit on which dimmers are installed.
- B. Provide dimmers in wattage ratings that will support the maximum potential wattage of the fixtures that are being dimmed. Do not size dimmers based on actual lamps installed in light fixtures, but on maximum lamp wattage ratings of light fixtures on that particular circuit.

3.5 SURFACE RACEWAYS:

- A. Provide all receptacles and special purpose outlets required in surface raceways. See Sections 2601 10 – Conduit Raceways, and 2601 35 – Electrical Boxes and Fittings.

3.6 OCCUPANCY SENSORS:

- A. Do not locate immediately adjacent to air diffusers. Coordinate exact placement with Divisions 21, 22, and 23.

3.7 GROUNDING:

- A. Provide electrical continuous, tight, grounding connections for wiring devices.

3.8 TESTING:

- A. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

3.9 IDENTIFICATION:

- A. All devices shall be identified on the coverplate with panelboard name and circuit number.
- B. In each outlet, tag each wire to identify the circuit it serves.
- C. Identification labels shall be as follows:

Normal Power	Black with White letters
Emergency Power	Red with White Letters
UPS	Orange with White Letters
Isolated ground	White with Orange Letters

END OF SECTION 2601 40

SECTION 260155 - MOTOR STARTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to motor starters.

1.2 DESCRIPTION OF WORK:

- A. Extent of motor starter work is indicated by drawings and schedules.
- B. Type of motor starters in this section include the following:
  - 1. Fractional Horsepower Manual Starters
  - 2. Integral Horsepower Manual Starters
  - 3. Non-Reversing Magnetic Starters
  - 4. Two-Speed Non-Reversing Magnetic Starters
  - 5. Combination Non-Reversing Magnetic Starters

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.
- B. SUBMITTALS:
  - 1. Shop Drawings: Submit manufacturer's data and dimensional details on motor starters including voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
  - 2. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Manufacturers: Subject to compliance with all requirements, provide products of on of the following:
  - 1. Allen Bradley
  - 2. Cutler-Hammer
  - 3. General Electric

4. Siemens
5. Square D

- B. Maintenance, Stock, Fuses: For types and ratings required, furnish additional fuses, amounting to one unit for every 10 installed units, but not less than 3 units of each, for both power and control circuit fuses.

## 2.2 THERMAL OVERLOAD UNITS:

- A. Provide metal alloy, thermal overload units for all motor starters. Size to actual running full load current, not to motor plate current, after air and water balancing are completed.

## 2.3 FRACTIONAL HORSEPOWER MANUAL STARTERS:

- A. Provide fractional horsepower manual starters for single-phase fractional horsepower motors up to and including 1 horsepower, equivalent to Square D Class 2510, Type F, of types, sizes, and electrical characteristics required to suit applications or as otherwise indicated on drawings. Provide NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage starter, with thermal overload units, red pilot light, and toggle operator with handle guard/lock-off. Provide ANSI/NEMA ICS 6, Type 1 enclosures, or where subject to weather or moisture, Type 3R.

## 2.4 INTEGRAL HORSEPOWER MANUAL STARTERS:

- A. Provide integral horsepower manual starters for single-phase and three-phase motors in excess of 1 horsepower, equivalent to Square D Class 2510, Type M, of types, sizes, and electrical characteristics required to suit applications or as otherwise indicated on drawings. Provide NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage starter, with thermal overload units, low voltage protection, red pilot light, and push button with mechanism lock off. Provide ANSI/NEMA ICS 6, Type 1 enclosures, or where subject to weather or moisture, Type 3R.

## 2.5 NON-REVERSING MAGNETIC STARTERS:

- A. Provide non-reversing magnetic starters equivalent to Square D Class 8536, Type S, of types, sizes, and electrical characteristics as required to suit applications or as otherwise indicated on drawings. Provide NEMA ICS 2, AC general-purpose Class A magnetic starter for induction motors. Provide encapsulated coil with operating voltage compatible with control system (coordinate with Divisions 21, 22, and 23). Provide totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring. Provide straight-through wiring with all terminals clearly marked. Provide NEMA ICS, melting alloy, interchangeable, overload relays with one-piece thermal unit construction and under voltage protection in all phases. Provide replaceable overload relay control circuit contacts. Thermal units shall be required for starter to operate. Provide NEMA ICS 2, 2 each normally open and closed, field convertible, auxiliary contacts in addition to seal-in contact. Provide rotary-type, hand-off-auto and reset switches, recessed pushbutton control. Provide red pilot light. Provide control power transformer in each motor starter with fused primary and secondary. Provide each magnetic starter with integral phase failure protection that will protect against phase loss, phase unbalance, phase reversal, and undervoltage. Provide ANSI/NEMA ICS 6, Type 1 enclosures, or where subject to weather or moisture, Type 3R.

## 2.6 TWO-SPEED NON-REVERSING MAGNETIC STARTERS:

- A. Provide two-speed, non-reversing magnetic starters equivalent to Square D 8810, of types, sizes, and electrical characteristics as required to suit applications or as otherwise indicated on drawings. Provide non-reversing magnetic starters with features as noted above in the description for "NON-REVERSING MAGNETIC STARTERS" with the following exceptions: Provide high/low pushbutton switches to select motor speed when operating in the hand mode. Provide green high speed and red low speed pilot lights. Label lights appropriately. Provide separate overload units for high and low speed windings. Provide consequent pole and/or separate winding starters as required to coordinate with motors provided. Coordinate all work with Divisions 21, 22, and 23.

#### 2.7 COMBINATION NON-REVERSING MAGNETIC STARTERS:

- A. Provide combination, non-reversing magnetic starters equivalent to Square D 8538, Type S (non-fusible and fusible disconnect switch type) and Square D 8539, Type S (motor circuit protector type), of types, sizes, and electrical characteristics as required to suit applications or as otherwise indicated on drawings. Provide non-reversing magnetic starters and/or two-speed non-reversing magnetic starters with features as noted above in the descriptions for "NON-REVERSING MAGNETIC STARTERS" and "TWO-SPEED NON-REVERSING MAGNETIC STARTERS".
- B. Where Combination Magnetic Starter/Motor Circuit Protector switches are specified, provide NEMA AB 1, circuit breakers with integral instantaneous magnetic trip in each pole. Provide circuit breakers with externally operable handles that give positive visual indication of ON-OFF positions with red and black color coding.
- C. Where Combination Magnetic Starter/Nonfusible Disconnect Switches are specified, provide NEMA KS 1, enclosed knife switch with externally operable handle and visible blades. Provide disconnects with externally operable handles that give positive visual indication of ON-OFF positions with red and black color coding.
- D. Where Combination Magnetic Starter/Fusible Disconnect Switches are specified, provide NEMA KS 1, enclosed knife switch with externally operable handle and visible blades. Provide switches with Fuse clips to accommodate Class J fuses. Provide fuses in accordance with Section 26180 - Overcurrent Protective Devices. Provide disconnects with externally operable handles that give positive visual indication of ON-OFF positions with red and black color coding.

### PART 3 – EXECUTION

#### 3.1 GENERAL:

- A. Install motor starters in accordance with manufacturer's written instructions, applicable requirements of the NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices.

#### 3.2 METHODS:

- A. Install overload units so catalog number is visible. Mount chart inside each starter indicating heater type, size, and ampere ratings available.

- B. Where sizes of starters, disconnect, fuses, motor circuit protectors, heaters, etc. are not indicated on drawings, size all equipment in accordance with manufacturer's written instructions.
  - C. Submit with the record drawings a record of the motor amperage readings of each electrically-driven unit; show horsepower, full-load amps and service factor.
- 

3.3 IDENTIFICATION:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each starter cabinet. Provide red plastic laminate label for starter supplied by emergency power. Include mechanical equipment designation, horsepower, voltage, full-load amps, and service factor of motor. Mark on interior cover the source of power by indicating the panel and circuit number.

3.4 MOTOR CONNECTIONS:

- A. Each motor shall be connected to the conduit with a length of flexible, seal-tight conduit (minimum of 18"), with proper type fittings. All motor supply circuits shall include a green ground conductor. Check for proper motor rotation on all motors or equipment.

END OF SECTION 260155

SECTION 260156 - VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of this contract, including general and supplementary conditions and division 1 specification sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to variable frequency drives.
- C. Information contained on the drawings and/or schedules shall detail the additional specific requirements for the Variable Frequency Drive (VFD) system equipment.

1.2 SCOPE OF WORK:

- A. It is the intent of this specification to set the minimum acceptable requirements for the design, construction, installation, commissioning and vendor support requirements for the VFD systems herein specified.
- B. The VFD installation, harmonic mitigation, and associated equipment coordination and interface shall be provided by the electrical contractor.

1.3 CODES AND STANDARDS:

- A. The equipment supplied under this specification shall conform to the latest applicable codes and standards of the following:
  - 1. NEC - (NFPA 70) - National Electric Code.
  - 2. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
  - 3. NEMA AB 1 - Molded Case Circuit Breakers.
  - 4. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
  - 5. IEEE Standard 519-1992 - Recommended Practices for Harmonic Control in Electrical Power Systems.
  - 6. ANSI C37 - Standards for Circuit Breakers, Switchgear, Relays, Substations and Fuses.
  - 7. ANSI C57 - Distribution, Power, and Regulating Transformers. (includes Reactors)
- B. The fully assembled VFD system shall carry the UL label certifying UL-508 standards. An equivalent safety labeling program by ETL or CSA documenting compliance with these industry standards shall be acceptable.

1.4 VENDOR QUALIFICATIONS:

- A. All vendors supplying equipment and/or services under this specification, shall pre-qualify and be listed in section 1.5.
- B. The electrical contractor shall coordinate and assume system responsibility and compatibility between the various approved supplier's equipment and services required to meet these specifications.

C. The electrical contractor shall be responsible for the coordination with qualified vendors of equipment and services outside the scope of this specification (but required for the proper operation of the system) as listed in section 4.1.

D. Suppliers of VFD systems shall have a minimum of five (5) years of experience supplying and maintaining VFDs. Suppliers must have a local service center with a factory spare parts inventory and factory-authorized service technicians available twenty-four hours a day.

1.5 ACCEPTABLE SUPPLIERS:

A. The following VFD manufacturer's equipment have been pre-approved to meet the products section of this specification:

1. Energy Management Corp. (Mitsubishi)
2. Long Building Environments (Yaskawa)
3. Midgely-Huben (ABB)
4. TMS (Danfoss)

B. The following companies have been pre-approved to meet the harmonic testing and documentation section of this specification.

1. Energy Management Corporation
2. Power Quality Consultants

C. Vendors wishing to quote other VFD/filter manufacturers and/or service companies must have prior written approval from the engineer. If not listed above, the vendor must apply to the engineer for approval 10 days prior to bid date showing a point by point compliance with the intention of this specification including actual test and documentation reports from previous projects for all services required on this project.

1.6 MATERIAL BOND:

A. A material supply bond is required covering the VFD system equipment and services provided by the vendor on this project. The bond shall assure that all requirements and provisions of this VFD specification are complied with.

1.7 SUBMITTALS:

A. The following information shall be included with the bid package:

1. VFD system and services bid bond.
2. Description of equipment and tests included in bid to meet power quality requirements of section 3.1.
3. Qualifications and name of engineering and technical persons responsible for support and warranty on this project.
4. Extended warranty/service contract bid per section above.

B. The following shall be included in the submittal package in the quantities required under the general provisions of this project:

1. Completed Data Sheet.
  2. Set of outline drawings giving complete mounting and conduit entry and exit dimensions.
  3. Set of complete electrical drawings for power and control wiring.
  4. Detailed drawings of filter equipment and sample graphs and data to meet IEEE 519-1992 compliance for voltage and current distortion.
  5. Manufactures literature giving detailed information of equipment being supplied including part numbers, model numbers and ratings.
- C. The following compliance and approval forms shall be submitted for approval:
1. Sample installation approval form to comply with section 4.1.
  2. Sample VFD system commissioning approval form to comply with 4.2A.
  3. Sample VFD system training approval form to comply with 4.2B.
  4. Sample VFD quality assurance program and sample factory test and certification report forms as required to meet section 2.5.
- D. The following shall be included in the Operations and Maintenance Manual(s):
1. All information required under paragraph 1.7B.
  2. Test certificates.
  3. Warranty information.
  4. A listing of service personnel responsible for warranty repairs.

## PART 2 - PRODUCTS

### 2.1 GENERAL:

- A. This portion of the specification outlines the overall fabrication, performance and functional requirements of VFDs supplied for positive speed control of standard NEMA design B induction motors.
- B. It is the intent of this section to specify non-proprietary designs and hardware that assure modern "state of the art" equipment which provides a high level of performance and reliability for the greatest long term, total value to the owner.
- C. Provide VFD systems compatible in every respect with motor it controls. Coordinate work with Divisions 21, 22, and 23.

### 2.2 SYSTEM DESCRIPTION:

- A. The VFD system shall be supplied as a complete, pre-integrated, stand-alone package produced by a single manufacturer regularly engaged in the production of same and who maintains full system support responsibility.
  1. The VFD system manufacturer shall integrate all components and equipment required to meet these specification features and functions as a single UL (or equivalent) labeled system. Vendors providing equipment requiring panel shop or job site modifications or additions that would not be valid under the original equipment manufacturer's (OEM's) safety labeling will not be acceptable.
  2. Pre-integrated equipment shall include but not be limited to incoming line filters, rectifier

units, inverter units, control circuitry, operator interfaces, protective equipment, and other accessories and auxiliary items necessary to meet the highest standards for the type of service specified herein.

## 2.3 CONSTRUCTION:

### A. SPACE and ENVIRONMENT:

1. All VFD system components shall be housed in a grounded, dead front, free-standing, or wall mounted NEMA 1 enclosure. The variable frequency drive inverter unit shall be mounted on a removable panel to facilitate maintenance. The VFD system size shall not exceed the size allotments specified on the drawings nor shall any portion of the system exceed a height of 90 inches. Entry shall be provided for incoming line and load cables as required or as shown on the drawings.
2. VFD systems mounted indoors shall be properly ventilated and sized to operate continuously at the job site elevation in an ambient environment of 0°C to 40°C, 0-90% RH. VFD systems mounted outdoors shall include environment control provisions as required (or as shown on the plans) to operate in an ambient of -30°C to 50°C, 0-100% RH.
3. Provide cooling fans and filters in all variable frequency drive enclosures.

## 2.4 SUPPLY POWER:

- A. All components of the VFD system shall be selected to operate continuously without any system trip or damage based on the nominal power specifications and requirements shown on the drawings or schedules. The above conditions must be maintained under the following expected variations:
1. Plus or minus 10% voltage fluctuation.
  2. Plus or minus 3% frequency variation (5% if served by a back-up generator).
  3. Distorted voltage waveform with up to 7% total voltage harmonic distortion.
- B. The VFD system shall employ voltage sag ride-through coordination under normal operating (average load) conditions to prevent nuisance trips with the following utility interruptions (based on preliminary IEEE working group P1346 data):
1. 0% voltage for 1 cycle.
  2. 60% voltage for 10 cycles.
  3. 87% voltage continuous.
- C. DEVICES and WIRING:
1. The VFD system shall employ door mounted industrial control operator devices, programming unit, and other devices per the layout shown on the drawings and as required to meet all functional and feature requirements of this specification. Operator pilot lights, switches and pushbuttons (if required) shall be industrial oil tight industry standard devices.
  2. Control voltages shall be 120 volts or less supplied by machine tool type transformers employing both primary and secondary fusing. VFD control transformer VA sizes shall be increased by 10% or as necessary to accommodate external impedances when plans show connections to external safety interlocks or other control devices.
  3. The VFD system factory wiring shall be permanently marked with hot emboss stamping

or an equivalent marking system. All devices shall be labeled and identified with correct setting selections. All component identification and wiring shall be documented in the operation and maintenance manual.

D. LOAD:

1. The VFD system shall be capable of starting and continuously driving the specified maximum motor load as identified on the drawings and schedules.
2. VFDs driving variable torque loads shall be programmed to optimize load patterns which maximize system efficiency and minimize motor heating and stresses. VFDs driving constant torque or other loads shall be programmed to optimize load patterns for system or process performance as required.
3. All VFD systems shall have an overload capacity of a minimum of 120% for one minute.

E. EFFICIENCY and POWER FACTOR :

1. The VFD solid state converter and inverter power switching components and control shall be selected to achieve a 95% efficiency or better at full load and speed. Other auxiliary devices required on the drawings or in these specifications including filters, line reactors, cooling or heating devices etc. shall be of a design to optimize efficiency as intended under this specification.
2. The entire true system power factor (as measured at the input to the VFD system) shall be 95% or better across the operational speed range. Power factor that becomes leading under light load conditions (due to PF correction) is acceptable only if voltage rise is prevented from backfeeding to the rest of the system (meaning PF correction must act like a synchronous condenser). The voltage tolerance at the main VFD system input terminals (as specified in section 2.3 B1a.) shall not be compromised as a result of power factor correction techniques.

F. PROTECTION :

1. Short circuit protection shall be provided to the VFD system through an externally operated, door interlocked fused disconnect, circuit breaker or motor circuit protector (MCP) rated at 65,000 AIC minimum. The door interlocked handle must be capable of being locked off to meet NEC.
2. Each VFD is to be supplied with an input disconnect motor circuit protector (MCP). The MCP shall allow trip adjustment sufficient to start the motor across the line in the bypass mode, and normally will be set at a minimum setting for maximum protection in the VFD mode. The door-mounted handle shall be lockable in the "Off" position. Each VFD is to be supplied with an isolation input disconnect witch on the line side of the inverter to disconnect all power from the inverter during maintenance operations. The inverter isolating switch operator shall be door-mounted and shall be lockable in the off position.
3. Overcurrent protection shall be provided in the VFD system through electronic motor overload (MOL) circuits with instantaneous trip, inverse time trip, and current limit functions. These shall be adjustable and optimized for the application. Multi-motor units shall have separate overload protection for every motor.
4. In addition to the overcurrent protection above, the VFD system shall provide over and under voltage protection, overtemperature protection, ground fault protection, and control or microprocessor fault protection. These protective circuits shall cause an orderly shutdown of the VFD, provide indication of the fault condition, and require a

- manual reset (except undervoltage) before restart. Undervoltage from a power loss shall be set to automatically restart after return to normal. The history of the previous three faults shall remain in memory for future review.
5. External protective faults including safeties or motor overtemperature may be interfaced to the VFD system and annunciated if shown on the drawings.
  6. Provide a Category A TVSS at the line-side conductors feeding each variable frequency drive. Refer to the Division 26 section, "Transient Voltage Protection."
  7. Provide reactive filters for the load-side conductors feeding each variable drive.

G. SYSTEM CONTROLS AND INTERFACE TERMINATIONS:

1. If shown on the drawings, the VFD system may require integrated transducers, controllers, sequencers, bypass methods, filters and communication interfaces among others. Such devices (shown on the drawings as part of the VFD system) shall be completely pre-integrated requiring the contractor to make only the typical field connections required as customer connections.
2. Items shown on the drawings or schedules as "future" shall be available from the VFD system manufacturer in kit form for future owner integration into the VFD system.
3. The VFD system customer terminations shall be clearly identified with terminal numbers and a permanent wiring diagram located in the VFD system enclosure.
4. The VFD shall be controlled with 0-10V dc (0 – 100% speed) and 4-20 ma ( 20 – 100% speed) signals. Coordinate all control work with Divisions 21, 22, and 23.

2.5 FEATURES:

- A. The following operator control and indication features shall be provided standard (unless shown differently on the drawings) as part of each VFD system:
1. Hand-Off-Auto (local start at VFD, remote start with contact closure).
  2. Local-Remote speed control (local speed control at VFD, remote speed control through speed reference signal).
  3. Frequency (speed) indication.
  4. Motor voltage indication.
  5. Motor current indication.
  6. VFD run indication.
  7. VFD fault and diagnostic indication.
  8. External fault light (safeties interlock).
  9. Bypass switch.
- B. The inverter shall be specified with a minimum of the following protective features and an alarm display indication:
1. Overcurrent Shut-off
  2. Regenerative Overvoltage
  3. Electronic Thermal Protector
  4. Heatsink Overheat
  5. Instantaneous Power Failure
  6. Ground Fault
- C. The following customer connections and interface terminations shall be provided standard (unless shown differently on the drawings) as part of each ASD system:

1. VFD remote start/stop connection.
2. External safeties connection.
3. VFD run annunciation.
4. VFD fault annunciation.
5. VFD speed reference input connection (4-20mA or as shown on drawings).
6. Safeties Interlock (N.C. contacts-located remote)
7. Remote Start/Stop Contact (N.O. contacts-located remote)
8. Remote VFD Fault Contacts (N.C.)
9. Remote VFD/Bypass Enable Contacts (N.O.)
10. Remote Electronic Signal Input

D. The following parameter adjustments shall be available to tune the VFD system:

1. Minimum and maximum speeds.
2. Acceleration and deceleration times.
3. Overcurrent trip point.
4. Current limit response to overload.
5. Maximum base motor voltage.
6. Input speed reference signal gain and bias.
7. Output speed reference signal gain and bias.

E. The VFD shall be capable of starting into a rotating motor at any speed.

F. The VFD shall auto restart after a power failure.

Auto Restart is to be initiated by means of an automatic time delay restart after recovering from undervoltage or loss of power. The inverter shall not automatically restart after overcurrent, overvoltage, overtemperature, or any other damaging condition, instead requiring a manual restart.

G. For maintenance purposes, the VFD system shall be capable of starting, stopping, and running with stable operation with the motor completely disconnected (no load).

H. Variable frequency drives shall be specified as a complete system, and shall include an enclosure and a manually-selected, motor-rated, contactor-type maintenance bypass arrangement. The bypass shall include a minimum of two (2) contactors (mechanically interlocked). The system shall be assembled in a single enclosure. The enclosure shall be suitable for the conditions in which the unit is located. No louvered cans shall be allowed unless protected by filters and fans. The maintenance bypass shall allow maintenance operations to be safely performed while the system is operating in the bypass mode. Each mechanical system driven by a VFD shall be specified to be designed and constructed to operate at specified conditions and safely at full capacity in the bypass mode during maintenance operations. Variable frequency drives shall be UL or ETL labeled as a complete system and not merely contain UL- or ETL-labeled components. Provide this Classic Bypass Package consisting of the following equipment:

1. Extended enclosure.
2. Door interlocked motor circuit protector.
3. One motor overload relay.
4. 2 contactor bypass (output and bypass).
5. Operator control panel with drive-off bypass selector.
6. 115 VAC control transformer.

7. 3 pilot lights (drive, bypass, external fault).
8. Fast acting drive input fuses.

## 2.6 QUALITY ASSURANCE:

- A. The VFD system manufacturer shall have a quality assurance program acceptable to the engineer. An outline of this program shall be submitted for approval as noted in 1.7.
- B. Prior to shipping any equipment, the manufacturer shall individually test and certify each unit to document compliance. This certification report shall be submitted as part of the operation and maintenance manual and include the following minimum testing:
  1. A visual inspection shall be made consisting of all system components, wiring connections, and safety mechanisms.
  2. High pot testing shall be conducted on the completed VFD system including all accessory power components as a complete package. This test shall be conducted per UL 508 (two times the rated voltage plus 1000 volts AC for 60 seconds) using regularly calibrated high pot test equipment.
  3. A system run test shall be conducted using an actual motor accelerated and decelerated through the entire speed range.
  4. All control panel devices, including switches, pilot lamps, keypad and special control devices shall be functional tested.
  5. Special tests shown on the drawings or schedules or as later required by the engineer to demonstrate compliance with any specification herein shall be conducted upon request (either witnessed or not) at no additional cost.

## PART 3 – POWER QUALITY REQUIREMENTS

### 3.1 IEEE STD. 519-1992 COMPLIANCE:

- A. Compliance with IEEE STD. 519-1992 (Recommended Practices for Harmonic Control in Electrical Power Systems) shall be a requirement of this project. Harmonic filters (passive or active), phase multiplication devices, or any other components required to mitigate harmonic voltage and current to IEEE std. 519-1992 published levels shall be an integral part of the VFD system. Designs which are not pre-integrated and factory wired as part of the UL (or equal) labeled VFD system shall not be acceptable under this specification.
  1. Designs which employ shunt tuned filters must be designed to prevent the importation of outside harmonics which could cause system resonance or filter failure. Calculations supporting the design, including a system harmonic flow analysis, must be provided as part of shunt tuned filter design documentation.
  2. Designs which cause voltage rise at the VFD terminals must document coordination with the total system voltage variation to eliminate nuisance tripping.
  3. Designs which do not provide both true and displacement power factor (measured at the VFD system input terminals) of at least 95% or better at full load are not acceptable. Designs that allow leading power factor at minimum loads which create voltage rise on the line side of the VFD system are not acceptable (see 2.3 E2).
- B. Relevant data for VFD system vendor calculations to meet IEEE Std. 519-1992 requirements are

as follows:

1. For the purpose of this specification, the Point of Common Coupling (PCC) as identified in IEEE Std. 519-1992, shall be the connection at which each individual VFD system (the offending non-linear load) is connected to the electrical distribution system (linear loads). Required voltage and current harmonic distortion measurements shall be taken at each individual VFD system PCC.
2. The load current ( $I_L$ ) is used to calculate the IEEE Std. 519-1992  $I_{SC}/I_L$  ratio required for determining acceptable maximum harmonic current distortion table values as reproduced in 3.1B4. For the purposes of this specification, this calculated current ( $I_L$ ) shall be the total combined full load current of each VFD system supplied as part of this project or the total combined amperage of loads designated as "non-linear" on the drawings or schedules.
3. The VFD system vendor is responsible to determine the short circuit current ( $I_{SC}$ ) available at the PCC through the drawings, through coordination with other equipment suppliers, from the electric utility, and/or from actual job site electrical equipment nameplate or measurement data.
4. As a convenience, the IEEE Std. 519-1992 table of current distortion limits for general distribution systems (120 V through 69,000 V) is given below:

Current Distortion Limits for General Distribution Systems  
 (120 V through 69,000 V)

**Maximum Harmonic Current Distortion in percent of  $I_L$**

Individual Harmonic Order (Odd Harmonics)

$I_{SC}/I_L$	$<11$	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h$	TDD
$<20$	4.0	2.0	1.5	0.6	0.3	5.0
$20 < 50$	7.0	3.5	2.5	1.0	0.5	8.0
$50 < 100$	10.0	4.5	4.0	1.5	0.7	12.0
$100 < 1000$	12.0	5.5	5.0	2.0	1.0	15.0
$>1000$	15.0	7.0	6.0	2.5	1.4	20.0

**Even harmonics are limited to 25% of the odd harmonic limits above.**

- C. Documentation of IEEE Std. 519-1992 compliance shall be part of the commissioning required by the VFD supplier. Actual job site measurement testing shall be conducted at one half and full load and documented in the operation and maintenance manuals. Reports shall include the following data:
  1. Data (text and graphical) shall be supplied showing voltage and current waveforms, THD (or TDD) and individual harmonic spectrum analysis in compliance with the above standards.
  2. Power quality reports including transformer de-rate analysis, telephone influence factor, true and displacement power factor, and voltage and current imbalance reports shall also be supplied.

- D. All VFD suppliers shall obtain pre-approval based on satisfactory completion of previous VFD projects meeting the above requirements. Pre-approval requests to bid shall include calculations, test reports and other sufficient data to show the owner/engineer how compliance to IEEE Std. 519-1992 requirements have been met on previous projects and how compliance will be accomplished on this project.

#### PART 4 - EXECUTION

##### 4.1 INSTALLATION:

- A. The electrical contractor shall be responsible for mounting the VFD.
- B. The VFD system equipment shall be installed and tested under the direction of factory trained personnel as specified in 1.2B & 4.2. The installation shall be certified based on the approval form submitted as part of section 1.7.
- C. Protect stored VFD systems during construction. Storage must be in areas free of dirt, dust, vibration, and moisture. VFDs shall not be exposed to excessive heat or cold. Install new filters in VFD units just prior to substantial completion, when system maintenance will become the owner's responsibility.

##### 4.2 SYSTEM COMMISSIONING AND CERTIFICATION:

- A. The VFD system start-up shall be performed by a service technician or engineer certified by the manufacturer. The following adjustments and tests shall be performed as a minimum with certified copies included in the maintenance and operation manual:
  - 1. Verify that the input voltage is within the manufacturer's specification tolerances.
  - 2. Verify that the motor rotation is correct in all modes of operation.
  - 3. Verify all operator devices, programming and monitoring functions to be fully operational.
  - 4. Verify operation of all field signal control connections.
  - 5. Measure and record system output voltage and current at 50% and 100% speed. Tune the output voltage to correspond to motor nameplate rating at full speed. Check full load current measurements against nameplate data.
  - 6. Make all parameter adjustments to tune and optimize the VFD system to the application. Record all configuration values as part of this report.
  - 7. Conduct harmonic tests as identified in 3.01C. Measurements shall be recorded for each unit with the VFD system off, running at 50% speed, and running at full speed and load.
- B. Owner training shall be provided for each model and type of VFD system provided. Training shall consist of both classroom and actual equipment hands-on training. The training shall be certified on the approved form (submittal required in section above) and included in the operation and maintenance manuals.

##### 4.3 DOCUMENTATION:

- A. The VFD system vendor shall supply certified as-built drawings based on the required

drawings and approved drawing formats included as part of the submittal process (see section above).

1. The drawings shall be included as part of the operation and maintenance manual and be of a reproducible quality.
2. Autocad format files of each drawing shall also be included on a floppy disk.

B. The operation and maintenance manuals shall consist of the following instructions and information:

1. Unloading, handling, installation, and special consideration instructions.
2. Operating functional descriptions and operating instructions.
3. Bill of materials with all spare parts ordering information and availability.
4. Factory test reports per 2.5.
5. Start-up and system commissioning reports per 4.2A.
6. Training certification per 4.2B.
7. Power quality and harmonic test reports per 3.1C.

#### 4.4 WARRANTY:

A. The VFD system vendor shall supply a complete parts and labor warranty (including travel expenses) for 1 year from the date of substantial completion.

1. The warranty shall cover the entire VFD system including power devices, controllers, filters etc. enclosed as part of the system package.

B. In place of the one year warranty, a two year warranty/service contract shall be quoted as an option at bid time. This service contract shall be renewable in two year increments thereafter. The service contract shall be executable by the owner at the fixed bid price anytime during the first 6 months of operation from date of substantial completion.

1. The extended warranty/service contract shall include necessary repairs or loaner replacement assuring complete restoration of operation within 24 hours from the time a service call is requested. A \$200.00 per day penalty shall be applied for failure to comply after the acknowledged service request.
2. The extended warranty/service contract shall include job site visits twice yearly to inspect, clean, tune (optimize parameters) and repair (if necessary) each ASD system supplied under this contract.
3. The extended warranty/service contract shall include basic orientation and operator training review with the owner's designated personal as part of this visit.
4. The extended warranty/service contract shall include a 200% performance bond in the owner's favor for the term of the service contract.

#### 4.5 SOURCE QUALITY CONTROL:

- A. All materials and equipment provided shall be new and unused.
- B. All components shall be UL listed and labeled.
- C. ASD shipped directly from the manufacturer shall have a UL label.
- D. ASD packages assembled from components by suppliers shall be UL labeled or ETL approved.

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END OF SECTION 260156

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SECTION 260160 – PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to panelboards.

1.2 DESCRIPTION OF WORK:

- A. Extent of panelboard work is indicated by drawings and schedules and is specified herein.
- B. Type of panelboards in this section include the following:
  - 1. Lighting and Appliance Panelboards
  - 2. Power Distribution Panelboards

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.
- B. SUBMITTALS:
  - 1. Shop Drawings: Submit dimensioned drawings of panelboards and enclosures showing accurately scaled layouts of enclosures. Include schedule of devices, including, but not necessarily limited to, circuit breakers, fusible switches, fuses, ground-fault circuit interrupters, and accessories.
  - 2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

- A. Subject to compliance with all requirements, provide products from one of the follows:
  - 1. Cutler-Hammer, Eaton Corp.
  - 2. General Electric Co.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D Co.

2.2 GENERAL:

- A. Provide panelboards, enclosures, and ancillary components, of types, sizes, and ratings indicated. Provide overcurrent protective devices, etc. as indicated on drawings for a complete installation.
- B. Where "Spaces" or "Blanks" are indicated on panelboard schedules, provide drilled bus and mounting hardware ready to receive breaker or fusible switch of size indicated on panelboard schedule.

### 2.3 PANELBOARD ENCLOSURES:

- A. Provide Code gauge, galvanized or rust-resistant sheet steel enclosures in sizes and NEMA types to suit respective applications. The size of the wiring gutters and gauge of steel shall be in accordance with the latest NEMA Standards Publication and latest UL standards for panelboards. Flush locks shall not protrude beyond the front of the door. Key all enclosures alike and provide three keys at completion of the project. Fronts shall have adjustable indicating trim clamps, which shall be completely concealed when the doors are closed. Doors shall be mounted by completely concealed steel hinges. A circuit directory frame and card, with clear plastic covering shall be provided on the inside of the door. The directory cards shall be typewritten to identify each circuit service. Provide panel enclosures with doors hinged to enclosures. Provide ANSI-61 painted finish.

### 2.4 LIGHTING AND APPLIANCE PANELBOARDS:

- A. Provide dead-front, safety-type lighting and appliance panelboards of types and electrical characteristic indicated. Provide Copper bus bars, full-sized neutral bus, and ground bus. Provide insulated/isolated ground buses where indicated. Include overcurrent protective devices and switches in quantities, ratings, types, and arrangements shown. See Section 260180 - Overcurrent Protective Devices.
- B. Rate devices, bussing, supports, etc. equal to or greater than the short circuit current rating indicated. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.
- C. Rate devices, bussing, supports, etc. equal to or greater than the short circuit current rating indicated. Series-rated systems are acceptable.

### 2.5 POWER DISTRIBUTION PANELBOARDS:

- A. Provide dead-front, safety-type lighting and appliance panelboards of types and electrical characteristic indicated. Provide wall-mounted or floor-standing power distribution panelboards as indicated. Provide panelboards suitable for use as service equipment where required. Provide Copper bus bars, full-sized neutral bus, and ground bus. Provide insulated/isolated ground buses where indicated. Include overcurrent protective devices and switches in quantities, ratings, types, and arrangements shown. See Section 260180 - Overcurrent Protective Devices.
- B. Rate devices, bussing, supports, etc. equal to or greater than the short circuit current rating indicated. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

## PART 3 - EXECUTION

3.1 GENERAL:

- A. Install panelboards in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 IDENTIFICATION:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on both the interior and exterior of each panelboard enclosure indicating name of panelboard. Bolt and nut or rivet labels to enclosure. (Sheet metal screws are not acceptable).

- 1. This label shall also indicate the feeder circuit. Mark on interior cover the source of power by indicating the panel and circuit number.

- B. All subpanels shall be labeled to identify the main panel that supplies the feeder circuit.

- C. Provide red plastic laminate label for panelboards supplied by emergency power.

- D. Provide orange plastic laminate label for panelboards supplied by UPS power.

3.3 MOUNTING:

- A. Mount panelboards as indicated, but in no case higher than 6'-6" from finished floor to top of panel. Anchor enclosures firmly to walls and structural surfaces.

- B. Provide 4" high concrete pad under floor-standing power distribution panelboards.

3.4 CIRCUIT DIRECTORIES:

- A. For lighting and appliance panelboards, provide typed panelboard circuit directories. Indicate load description or name and location. Utilize actual building room numbers, not architectural room numbers used on drawings. Label the panel and circuit that feed this panel.

- B. For power distribution panelboards, provide 1/16" thick black plastic laminate labels with 1/4" high lettering for each load served.

- 1. Provide red plastic laminate label for emergency loads.
- 2. If circuits are changed in a panel, type the new circuit designation and glue on existing circuit directory. Do not discard existing panelboard schedule unless all circuits have been changed.

3.5 WIRING METHODS:

- A. Arrange conductors neatly within enclosure, and secure with suitable nylon ties.

- B. Panelboards shall not be used for junction or splicing boxes or as a raceway.

3.6 ARRANGEMENT OF OVERCURRENT PROTECTIVE DEVICES:

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- A. The overcurrent protective devices shall be in the same sequence and labeled as the panel schedule on the drawings.

END OF SECTION 260160

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SECTION 260162 – POWER MODULE SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Architectural, Structural, Mechanical and other applicable documents also apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Provide elevator power module switches, fuses and accessories as required and specified on Contract Drawings to distribute electrical power to each elevator.

1.3 RELATED SYSTEMS:

- A. Other Divisions relating to electrical work, apply to the work of this section. See other applicable Divisions including, but not necessarily limited to:

- 1. Division 1 - General and Supplementary Conditions
- 2. Division 2 - Existing Conditions
- 3. Division 3 - Concrete
- 4. Division 5 - Metals
- 5. Division 6 - Wood, Plastics, and Composites
- 6. Division 7 - Thermal and Moisture Protection
- 7. Division 8 - Openings
- 8. Division 9 - Finishes
- 9. Division 21 - Fire Suppression
- 10. Division 22 - Plumbing
- 11. Division 23 - Heating Ventilating and Air Conditioning
- 12. Division 27 - Communications
- 13. Division 28 - Electronic Safety and Security

1.4 CODES:

- A. All work shall be performed in accordance with the latest edition of applicable standards, codes and laws.

- 1. NFPA 70-1999 Sections 620-51 (A)-(B), 620-62, 648-10, 700-25 (FPN)
- 2. ANSI/ASME A17-1 – Section 102.2(4)
- 3. BOCA 3006.2.3

1.5 STANDARDS:

- A. Except as modified by governing codes, all equipment shall be manufactured in accordance with the latest applicable standards:

1. Enclosed switches, U.L. 98 and CSA-C22.2 No. 4.

1.6 SUBSTITUTIONS:

- A. Substitutions shall comply with the requirements of the General Conditions and General Requirements. The names of manufactures and model numbers have been used to establish types of equipment and standards of quality. A submittal shall contain sufficient information to prove compliance with Contract Documents. This includes compliance with all pertinent sections of codes and standards as specified above.

1.7 SUBMITTALS:

- A. Submit shop drawings and product data under the provisions of the General Conditions.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, configurations, and methods of mounting and installation.
- C. Submit listing of all types, sizes and quantity of fuses which will be installed including the location of each.
- D. Spare fuses shall be supplied as required by Section 260180 – Overcurrent Protective Devices.
- E. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spacial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

- A. Bussmann® Power Module™ Switch – PS
- B. Little Fuse

2.2 GENERAL CONDITIONS & REQUIREMENTS:

- A. Provide power Module Switch in a single NEMA enclosure with all necessary relay(s), control transformer and other options (as listed below), and as shown on drawings. The Power Module Switch shall have an ampere rating as shown on the contract drawings, and shall include a horsepower rated fusible switch with shunt trip capabilities. The ampere rating of the switch shall be based upon elevator manufacturer requirements and utilize Class J fuses (provided separately). It shall include as an accessory, a 100VA control power transformer with primary and secondary fuses. The primary voltage rating shall be 480 volts with a 120 volt secondary. It shall also contain an isolation relay (3PDT, 10amp, 120V). The coil of the isolation relay shall be 120 Vac. A 5A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid (140VA inrush at 120V). (Note: If 24 Vdc coil is selected, a separate 24 Vdc source and contact must be provided by the Fire Alarm Safety System.)
- B. The module shall contain the following options:

1. Key to Test Switch
  2. Pilot Light (Green, Red or White) – "ON"
  3. (1 NO & 1 NC or 2 NO & 2 NC) Mechanical Interlock Auxiliary Contact (required for hydraulic elevators with automatic recall).
  4. NEMA 1 Enclosure
- C. The module shall have been successfully tested to a short-circuit rating with Bussmann LOW-PEAK Class J fuses at 200,000 amps RMS Symmetrical. All switches shall have shunt trip capabilities at 120 Vac from remote fire safety signal. Branch feeders shall be selectively coordinated and fed with an upstream supply overcurrent protective device at a minimum of 2:1 size ration utilizing LOW-PEAK (Class J, RK1, or L) fuses.

### PART 3 - EXECUTION

#### 3.1 GENERAL:

- A. Install power module switches in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

#### 3.2 IDENTIFICATION:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on both the interior and exterior of each panelboard enclosure indicating name of panelboard. Bolt and nut or rivet labels to enclosure. (Sheet metal screws are not acceptable).
- B. All panels shall be labeled to identify the main panel that supplies the feeder circuit.
- C. Provide red plastic laminate label for panels supplied by emergency power.

#### 3.3 MOUNTING:

- A. Mount panelboards as indicated, but in no case higher than 6'-6" from finished floor to top of panel. Anchor enclosures firmly to walls and structural surfaces.

#### 3.4 CIRCUIT DIRECTORIES:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering for each load served.
1. Provide red plastic laminate label for emergency loads.

#### 3.5 WIRING METHODS:

- A. Arrange conductors neatly within enclosure, and secure with suitable nylon ties.

END OF SECTION 260162



SECTION 260170 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to disconnect switches.

1.2 DESCRIPTION OF WORK:

- A. Extent of disconnect switch work is indicated by drawings and schedules and is specified herein.
- B. Type of disconnects in this section include the following:
  - 1. General Duty Disconnect Switches
  - 2. Heavy Duty Disconnect Switches
  - 3. Fusible Switches

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.
- B. SUBMITTALS:
  - 1. Product Data: Submit manufacturer's data on disconnect switches including specifications, installation instructions, etc.
  - 2. Shop Drawings: Submit dimensioned drawings of disconnects showing accurately scaled layouts of disconnects and enclosures.
  - 3. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

- A. Subject to compliance with all requirements, provide disconnect switches (fusible and non-fusible) and fusible switches (in power panels) from one of the following:
  - 1. Cutler-Hammer
  - 2. General Electric
  - 3. Siemens
  - 4. Square D

2.2 GENERAL:

- A. Provide fusible and/or non-fusible disconnect switches and ancillary components of types, sizes, ratings, and electrical characteristics as indicated. Provide enclosures in NEMA ratings suitable for applications. Provide fuses as indicated; See Section 26180 - Overcurrent Protective Devices.

2.3 GENERAL DUTY DISCONNECT SWITCHES:

- A. Provide 240 volt rated, general duty switches in sheet steel enclosures as indicated of types, sizes, ratings, and electrical characteristics indicated and as required to suit respective application. Provide general duty switches for circuits rated 240 volts or less. Construct of spring-assisted, quick-make, quick-break mechanisms. Provide solid neutral as required by application. Equip with operating handle capable of being locked in the OFF position. Provide Class R rejection fuse clips for fusible-type switches.

2.4 HEAVY DUTY DISCONNECT SWITCHES:

- A. Provide 600 volt rated, heavy duty switches in sheet steel enclosures as indicated of types, sizes, ratings, and electrical characteristics indicated and as required to suit respective application. Provide heavy duty switches for circuits rated greater than 240 volts, but less than 600 volts. Construct of spring-assisted, quick-make, quick-break mechanisms. Provide solid neutral as required by application. Equip with operating handle capable of being locked in the OFF position. Provide Class R rejection fuse clips for fusible-type switches.

2.5 FUSIBLE SWITCHES:

- A. Provide factory-assembled, fusible switch units as integral components of distribution power panels and switchboards of types, sizes, ratings, and electrical characteristics indicated and as required to suit respective application. Provide quick-make quick-break mechanisms and visible blades. Equip with handle capable of being locked in the OFF position. Provide dual fuse door interlocks. Provide switch with Class R rejection fuse clips. Include copper lugs to accommodate conductors specified.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Install disconnects in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 IDENTIFICATION:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each disconnect indicating name of disconnect or load served. Bolt labels to enclosure. Mark on interior cover the source of power by indicating the panel and circuit number.

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- B. Provide red plastic laminate label for disconnects supplied by emergency power

3.3 MOUNTING:

- A. Mount disconnects as indicated, but in no case higher than 6'-6" from finished floor to top of disconnect. Anchor enclosures firmly to walls and structural surfaces.
- B. Provide 4" high concrete pad under floor-standing disconnects.

END OF SECTION 260170



SECTION 260180 - OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to overcurrent protective devices.

1.2 DESCRIPTION OF WORK:

- A. Extent of overcurrent protective devices is indicated by drawings and schedules and is specified herein.
- B. Type of overcurrent protective devices in this section include the following:
  - 1. Molded Case Circuit Breakers
  - 2. Electronic Circuit Breakers
  - 3. Fuses
  - 4. Ground Fault Protection

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.
- B. SUBMITTALS:
  - 1. SHOP DRAWINGS: Submit manufacturer's data on overcurrent protective devices including specifications, time-current trip characteristics curves, mounting requirements, installation instructions, etc. Submit dimensioned drawings of overcurrent protective devices.
  - 2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. Provide overcurrent protective devices and ancillary components of types, sizes, ratings, and electrical characteristics indicated. Provide enclosures in NEMA ratings as indicated and suitable for applications.

2.2 MOLDED CASE CIRCUIT BREAKERS:

A. MANUFACTURERS:

Subject to compliance with all requirements, provide molded case circuit breakers from one of the following:

1. Cutler-Hammer
2. General Electric
3. Siemens
4. Square D

B. MOLDED CASE CIRCUIT BREAKERS:

1. Provide factory-assembled, molded case circuit breakers as integral components of lighting and appliance panelboards, power panelboards, switchboards, and for individual mounting as indicated. Provide thermal magnetic, molded case circuit breakers of amperages, voltages, types, and short circuit current ratings indicated. Provide bolt-on type breakers only. Construct with quick-break, quick-break mechanism with inverse-time delay and instantaneous trip protection for each pole. Provide breakers rated for ambient temperatures to suit respective applications. Provide mechanical screw type removable copper connector lugs of size to accommodate conductors specified.
2. Provide breakers that have interrupting ratings greater than or equal to the specified fault current. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

2.3 ELECTRONIC CIRCUIT BREAKERS:

A. VENDORS:

Subject to compliance with all requirements, provide electronic circuit breakers from one of the following:

1. Cutler-Hammer
2. General Electric
3. Siemens
4. Square D

B. ELECTRONIC CIRCUIT BREAKERS:

1. Provide factory-assembled, electric circuit breakers as integral components of power panelboards and switchboards. Unless noted otherwise on drawings, provide electronic circuit breakers in accordance with requirements as set forth in "MOLDED CASE CIRCUIT BREAKERS" above and with features as follows:
2. Provide electronic circuit breakers having the following selectable settings:
  - a) Long time pickup and delay.
  - b) Short time pickup and delay with I<sup>2</sup>T In and I<sup>2</sup>T Out features.
  - c) Instantaneous.
  - d) Ground fault pickup and delay with I<sup>2</sup>T In and I<sup>2</sup>T Out features.
3. Provide electronic circuit breakers having the following additional features:
  - a) 80% rated. (\*\* Alternate – 100% rated. \*\*)
  - b) True RMS sensing.

- c) Interchangeable rating plugs.
- d) Thermal and magnetic backup protection.
- e) Long time and ground fault memory.

2.4 FUSES:

A. VENDORS:

Subject to compliance with all requirements, provide fuses from one of the following:

- 1. Bussmann
- 2. Gould Shawmut
- 3. Reliance
- 4. Littlefuse

B. FUSES:

General: Provide fuses as integral components of disconnects, fusible switches, and bolted pressure switches. Provide fuses in types and sizes as recommended by manufacturer's written instructions. Provide fuses for mains, feeders, and branch circuits as follows:

- 1. Circuits 601 to 6000 amperes: Shall be protected by current limiting Bussmann Low-Peak Time-Delay Fuses KRP-C or equivalent. Fuses shall be UL Class L with an interrupting rating of 200,000 amperes r.m.s. symmetrical.
- 2. Motor and Transformer Circuits 0 to 600 amperes: Shall be protected by current-limiting Bussmann Low-Peak Dual Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts) or equivalent. Fuses shall be UL Class RK1 with an interrupting rating of 200,000 amperes r.m.s. symmetrical.
- 3. Feeders to Circuit Breaker Panels 0 to 600 amperes: Shall be protected by current-limiting Bussmann Low-Peak Time Delay fuses LPJ or equivalent. Fuses shall be UL Class RK1 with an interrupting rating of 200,000 amperes r.m.s. symmetrical.

C. FUSE CABINETS:

- 1. Furnish and install fuse cabinet(s) equivalent to Bussmann SFC-FUSE-CAB.

2.5 GROUND FAULT PROTECTION:

A. VENDORS:

Subject to compliance with all requirements, provide ground fault protection equipment from one of the following:

- 1. Cutler-Hammer
- 2. General Electric
- 3. Pringle Electric
- 4. Siemens
- 5. Square D

B. GROUND FAULT PROTECTION:

1. Provide ground fault protection systems to operate shunt trip or electric trip of thermal magnetic circuit breakers or bolted pressure switches and/or as integral components of electronic circuit breakers where indicated on drawings and as required to meet all the requirements as set forth in the NEC. Provide ground fault protection by means of a zero sequence ground fault sensor and ground fault relay. Provide power for ground fault relay through output of current sensor. Provide relay with current settings from 100 through 1200 amperes and time delay of .1 through 1 second. Provide cover that inhibits tampering with settings after installation. Provide means of testing the ground fault system without tripping the breaker or switch to meet the on-site testing requirements of the NEC. Provide visual trip indication for ground fault trip occurrences. Provide all interconnecting wiring as required.

### PART 3 - EXECUTION

#### 3.1 GENERAL:

- A. Install overcurrent protective devices in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

#### 3.2 SIZING FUSES:

- A. Size all fuses in accordance with manufacturer's written recommendations, whether fuse size is indicated on drawings or not. If nuisance tripping occurs, increase fuse size and disconnect if necessary as required to provide nuisance-free tripping. Adjust fuse size for proper ambient temperature, frequent starting and stopping of motor loads, and for loads with long start times.

#### 3.3 IDENTIFICATION:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each disconnect indicating name of disconnect or load served. Bolt labels to enclosure. Mark on interior cover the source of power by indicating the panel and circuit number.
- B. Provide red plastic laminate label for disconnects supplied by emergency power.

#### 3.4 MOUNTING:

- A. Mount disconnects as indicated, but in no case higher than 6'-6" from finished floor to top of disconnect. Anchor enclosures firmly to walls and structural surfaces.
- B. Provide 4" high concrete pad under floor-standing disconnects.

#### 3.5 SETTINGS:

- A. Adjust settings of overcurrent protective devices as directed by engineer.

#### 3.6 TESTING OF GROUND FAULT PROTECTION:

- A. Have all ground fault protection systems tested by authorized factory representative for proper operation. Replace all malfunctioning units. A complete record of current trip level and time

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required to trip the disconnecting device shall be submitted to the owner.

3.7 SPARE PARTS:

- A. Spare Fuses: For each type and ampere rating, furnish one spare fuse for every 5 provided, but not less than three total.
- B. Fuse Cabinets: Furnish and install fuse cabinet(s) in quantities as required, but in no case less than one, to house the spare fuses indicated above. Locate in main electrical room as directed by the Electrical Engineer.

END OF SECTION 260180



SECTION 260181 – DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to transformers.

1.2 DESCRIPTION OF WORK:

- A. Extent of transformer work is indicated by drawings and schedules and is specified herein.
- B. Type of transformers in this section include the following:
  - 1. Dry-type transformers

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.
- B. SUBMITTALS:
  - 1. SHOP DRAWINGS: Submit dimensioned drawings of transformers and enclosures showing accurately scaled layouts of enclosures. Provide product data including certification of transformer performance efficiency, percent regulation at 100 percent and 80 percent power factor, no-load and full load losses in watts, percent impedance at 75 degree C broken down into resistance and reactance, hot-spot and average temperature rise above 40 degree C ambient, sound level in decibels, and standard published data.
  - 2. EQUIPMENT ROOM LAYOUTS: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

- A. Subject to compliance with all requirements, provide products from one of the follows:
  - 1. Cutler Hammer
  - 2. General Electric
  - 3. Siemens
  - 4. Square D
  - 5. Federal Pacific Transformers Co.
  - 6. Cooper Power Systems

7. Powersmiths

2.2 GENERAL:

- A. Provide transformers, enclosures, and ancillary components, of types, sizes, and ratings indicated.

2.3 DRY-TYPE TRANSFORMERS:

- A. Taps: Provide primary windings with minimum of 4 full capacity taps; each 2-1/2 percent, two above and two below full-rated voltage for de-energized tap-changing operation.
- B. Windings: All windings to be copper.
- C. Insulation: Insulate with Class 220 insulation and rate for continuous operation at KVA.
- D. Temperature Rise: Limit temperature rise to 150 (\*\* **Alternate** - 115 or 80 \*\*) degree C.
- E. Sound Levels: Sound level rating not to exceed 45 db in accordance with ANSI/NEMA standards.
- F. Efficiency: All transformers 15 KVA and larger shall meet the NEMA TP-1-2002 standard for energy efficiency.
- G. Enclosure: Provide ventilated, heavy-gauge, steel, painted enclosure.
- H. Electrostatic shield: Where indicated on drawings, provide shielded isolation type transformers for attenuation of source line interference.
- I. K-Factor Ratings: Where noted on drawings, provide K-factor rated transformers to serve harmonic loads equivalent to Square D NL (UL K-4 rated) or Square D NLP (UL K-13 rated) as indicated.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Install transformers in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 MOUNTING:

- A. Unless noted otherwise, mount transformers on 4" concrete house-keeping pad. Concrete pad to be furnished and installed under division 26. Anchor transformer enclosures firmly to concrete pad. See Section 260072 – Electrical Support and Seismic Restraints. Maintain adequate clearance from combustible surfaces in accordance with the NEC. Locate transformers a sufficient distance from walls and adjacent equipment to allow for adequate ventilation in accordance with all manufacturer's instructions. Lay-out electrical rooms and spaces prior to rough-in to insure proper ventilation and to maintain code required clearances.

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3.3 LABELS:

- A. For transformers, provide 1/16" thick black plastic laminate labels with 1/4" high lettering for each load served.
  - B. Provide red plastic laminate label for emergency loads.
- 

END OF SECTION 260181



SECTION 260182 – SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to switchboards.

1.2 DESCRIPTION OF WORK:

- A. Extent of switchboards is indicated by drawings and schedules and is specified herein.

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.
- B. SUBMITTALS:
  - 1. Shop Drawings: Submit dimensioned drawings of switchboards and enclosures showing accurately scaled layouts of enclosures. Include schedule of devices, including, but not necessarily limited to, circuit breakers, fusible switches, fuses, and accessories.
  - 2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 VENDORS:

- A. Subject to compliance with all requirements, provide products from one of the follows:
  - 1. Cutler-Hammer
  - 2. General Electric
  - 3. Siemens
  - 4. Square D

2.2 GENERAL:

- A. Provide switchboards, enclosures, and ancillary components, of types, sizes, and ratings indicated. Provide overcurrent protective devices, etc. as indicated on drawings for a complete installation. See Section 260180 - Overcurrent Protective Devices.
- B. Rate devices, etc. equal to or greater than the short circuit current rating indicated. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted

otherwise.

### 2.3 AC DEAD-FRONT SWITCHBOARDS:

- A. Provide factory assembled, front accessible, dead-front, floor-standing switchboards in NEMA types to suit respective applications. Construct bus bars of silver-plated copper, braced to withstand RMS symmetrical fault current indicated. Provide ground bus in each section. Provide ANSI-61 painted finish.
- B. Lugs shall be copper only.

## PART 3 - EXECUTION

### 3.1 GENERAL:

- A. Install switchboards in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

### 3.2 IDENTIFICATION:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on exterior of each enclosure indicating name of switchboard. Bolt labels to enclosure. Mark on enclosure the source of power by indicating the panel and circuit number.
- B. Provide red plastic laminate label for emergency loads.

### 3.3 MOUNTING:

- A. Provide 4" high concrete pad. Mount switchboard as indicated, but in no case higher than 6'-6" from finished floor to top of switchboard including concrete pad. Bolt switchboard to concrete pad in accordance with Section 260072 – Electrical Support and Seismic Restraints
- B. .

### 3.4 CIRCUIT DIRECTORIES:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering for each load served.
- B. Provide red plastic laminate label for emergency loads.

### 3.5 WIRING METHODS:

- A. Arrange conductors neatly within enclosure, and secure with suitable nylon ties.

END OF SECTION 260182

## SECTION 260183 - MOTOR CONTROL CENTERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to Motor Control Centers.

#### 1.2 DESCRIPTION OF WORK:

- A. Extent of motor control center work is indicated by drawings and schedules and is specified herein.

#### 1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.
- B. SUBMITTALS:
  - 1. Shop Drawings: Submit dimensioned drawings of motor control centers and enclosures showing accurately scaled layouts of enclosures. Include schedule of devices, including, but not necessarily limited to, motor starters, circuit breakers, and accessories.
  - 2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

### PART 2 – PRODUCTS

#### 2.1 MANUFACTURERS:

- A. Subject to compliance with all requirements, provide products from one of the follows:
  - 1. Cutler-Hammer
  - 2. General Electric
  - 3. Siemens
  - 4. Square D

#### 2.2 GENERAL:

- A. Provide motor control centers, enclosures, and ancillary components, of types, sizes, and ratings indicated. Provide motor starters, overcurrent protective devices, power factor correction capacitors, etc. as indicated on drawings for a complete installation. See Section 26155 - Motor Starters, Section 260180 - Overcurrent Protective Devices, and Section 260184 - Power Factor Correction.

- B. Power control circuits from individual starter or breaker switch such that opening switch or breaker de-energizes control circuit. Provide individual fusing for all control circuits. Lugs shall be rated copper only.

- C. Rate devices, etc. equal to or greater than the short circuit current rating indicated. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

### 2.3 MOTOR CONTROL CENTER ENCLOSURES:

- A. Provide factory assembled, front accessible, free-standing enclosures in NEMA types to suit respective applications. Standard sections shall have a top horizontal wire trough with an opening between sections. Provide ANSI-61 painted finish.

### 2.4 BUSSING SYSTEM:

- A. Construct bus bars of silver-plated copper, braced to withstand RMS symmetrical fault current indicated. Provide ground bus in each section.

### 2.5 DISCONNECT OPERATORS:

- A. Provide external operator handles for switches and circuit breakers capable of being locked in the OFF position.

## PART 3 - EXECUTION

### 3.1 GENERAL:

- A. Install motor control centers in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

### 3.2 IDENTIFICATION:

- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on exterior of each enclosure indicating name of motor control center. Bolt labels to enclosure. Mark on enclosure the source of power by indicating the panel and circuit number.
- B. Provide red plastic laminate label for emergency loads.

### 3.3 MOUNTING:

- A. Housekeeping Pad: Provide 4" high concrete pad. Mount motor control centers as indicated, but in no case higher than 6'-6" from finished floor to top of motor control center including concrete pad. Bolt motor control centers to concrete pad in accordance with Section 260072 – Electrical Support and Seismic Restraints.

### 3.4 CIRCUIT DIRECTORIES:

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- A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering for each load served.
- B. Provide red plastic laminate label for emergency loads.

3.5 WIRING METHODS:

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- A. Arrange conductors neatly within enclosure, and secure with suitable nylon ties.

END OF SECTION 260183



SECTION 260184 - POWER FACTOR CORRECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to power factor correction.

1.2 DESCRIPTION OF WORK:

- A. Extent of power factor correction is indicated by drawings and schedules and is specified herein.

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.

1.4 SUBMITTALS:

- A. Shop Drawings: Submit dimensioned drawings of power factor correction equipment and enclosures showing accurately scaled layouts of enclosures and all components. Submit manufacturer's data on all equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Subject to compliance with all requirements, provide products from one of the follows:
  - 1. Cutler-Hammer
  - 2. General Electric
  - 3. Siemens
  - 4. Square D

2.2 GENERAL:

- A. Provide power factor correction equipment and ancillary components in sizes and characteristics to suit respective applications and as indicated on drawings.

2.3 CAPACITORS:

- A. Provide factory-assembled power factor correction capacitors in types, sizes, ratings, and electrical characteristics indicated. Provide industrial-grade capacitors with metal encased dielectric systems possessing self-clearing characteristics. Provide capacitors with discharge

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resistors to drop residual voltage to 50 Volts, or less, within one minute after the cell is disconnected from power source. Provide capacitors cell capable of operating in an ambient temperature range of -40 Degrees C. to 50 Degree C. and capable of operating at 135% of their rated capacitive reactive power due to the combined effects of frequency variation, overvoltages and/or harmonics. Provide current limiting protective fusing and blown fuse indicators. Rate enclosures to suit respective application.

### PART 3 - EXECUTION

#### 3.1 GENERAL:

- A. Install Power factor correction equipment in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

#### 3.2 MOUNTING:

- A. Mount capacitors in motor control centers or adjacent to motors as indicated. Provide all necessary connectors, frames, racks, etc. necessary for a complete system. See Section 26072 – Electrical Support and Seismic Restraints as applicable.

END OF SECTION 260184

SECTION 260289 - TRANSIENT VOLTAGE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes TVSSs for low-voltage power.
- B. Related Sections include the following:
1. Division 26 Section "Switchboards" for factory-installed TVSSs.
  2. Division 26 Section "Panelboards" for factory-installed TVSSs.
  3. Division 26 Section "Motor Control Centers" for factory-installed TVSSs.

1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. SVR: Suppressed voltage rating.
- C. TVSS: Transient Voltage Surge Suppressor.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.
- B. Product Certificates: For transient voltage suppression devices, signed by product manufacturer certifying compliance with the following standards:
1. UL 1283.
  2. UL 1449 2<sup>nd</sup> Edition.
  3. UL 281-1 (fuse)
  4. CSA 22.2.
  5. NEMA LS-1
- C. Manufacturer Seismic Qualification Certification: Submit certification that transient voltage suppression devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Electrical Supports and Seismic Restraints." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Products Testing: For transient voltage suppression devices, provide the following product test data:
1. Provide actual let through voltage test data in the form of oscillograph results for the ANSA/IEEE C62.41 Category C3 & C1 (combination wave) and B3 (ringwave) tested in accordance with ANSI/IEEE C62.45.
  2. Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying the device noise attenuation equal or exceeds 50 db at 100 kHz.
  3. Provide test report in compliance with NEMA LS1 from a recognized independent testing laboratory verifying that suppressor components can survive published surge current rating on both a per mode and per phase basis using the IEEE C62.41, 8 x 20 microsecond current wave. Note that test data on individual module is not accepted.
- E. Field quality-control test reports, including the following:
1. Test procedures used.
  2. Test results that comply with requirements.
  3. Failed test results and corrective action taken to achieve requirements.
- F. Operation and Maintenance Data: For transient voltage suppression devices to include in emergency, operation, and maintenance manuals.
- G. Warranties: Special warranties specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with ANSI/IEEE C62.41.1-2002, "IEEE Guide for Surge Environment in Low Voltage (1000 V and Less) AC Power Circuits," IEEE C62.41.2-2002, "IEEE Recommended Practice on Characterization of Surges in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45-2002, "IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."
- C. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."
- D. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449 2<sup>nd</sup> Edition, "Transient Voltage Surge Suppressors."
- E. The manufacturer shall be ISO 9000 certified.
- F. Comply with Military Standards MIL-STD220A.
- G. Comply with FIPS Pub 94.

- H. Comply with NEC 2002, Article 285, "Transient Voltage Surge Suppression TVSSs".

#### 1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

- B. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: -40 to 140 deg F (-40 to 60 deg C).
3. Humidity: 5 to 95 percent, non-condensing.
4. Altitude: Up to 20,000 feet (6090 m) above sea level.

#### 1.7 COORDINATION

- A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance. Coordinate placement of breakers in electrical panelboards feeding field-mounted surge suppressors so that conductor leads are kept to an absolute minimum.
- B. Coordinate surge protection devices with Division 26 Section "Electrical Power Monitoring and Control."

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Current Technology, Inc.
2. Cutler-Hammer, Inc.; Eaton Corporation.
3. EFI Electronics
4. General Electric Company.
5. LEA International.
6. Leviton Mfg. Company Inc.
7. Liebert Corporation; a division of Emerson.

8. Siemens Energy & Automation, Inc.
9. Square D; Schneider Electric.
10. United Power Corporation.

## 2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

### A. Electrical Requirements:

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall be greater than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge suppressor for the service entrance and other distribution level. The system shall not utilize silicon avalanche diodes, selenium cell, air gaps or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – For a wye-configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta-configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).
5. UL 1449 2<sup>nd</sup> Edition Suppressed Voltage Rating (SVR) – The maximum UL 1449 2<sup>nd</sup> Edition SVR for the device must not exceed the following:
  - a. 208Y/120 V:
    - 1) L-N; L-G; N-G: 400 V.
    - 2) L-L: 800 V.
  - b. 480Y/277 V:
    - 1) L-N; L-G; N-G: 800 V.
    - 2) L-L: 1800 V.
6. ANSI/IEEE Cat. C3 Let Through Voltage – The let through voltage based on IEEE C62.41 and C62.45 recommended procedures for Category C3 surges (20 kV, 10 kA) shall be less than:
  - a. 208Y/120 V L-N: 560 V.
  - b. 480Y/277 V L-N: 960 V.
7. ANSI/IEEE Cat. B3 Let Through Voltage – Let through voltage based on IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. B3 ringwave (6 kV, 500 amps) shall be less than:
  - a. 208Y/120 V L-N: 160 V.
  - b. 480Y/277 V L-N: 165 V.

### B. TVSS Design

1. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating TVSS modules shall not be acceptable.
2. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHz using the MIL-STD-220A insertion loss test method. Products not able to demonstrate noise attenuation of 50 dB @ 100 kHz shall be rejected.
3. Extended Range Filter – The Surge Protective Device shall have a High Frequency Extended Range Tracking Filter in each Line to Neutral mode with compliance to UL 1283 and NEMA LS1. The filter shall have published high frequency attenuation rating in

the attenuation frequencies:

- a. Insertion Loss (ratio):
    - 1) 50kHz: 40
    - 2) 100kHz: 316
    - 3) 500kHz: 316
    - 4) 1MHz: 89
    - 5) 10MHz: 200
    - 6) 100MHz: 79
  - b. Insertion Loss (dB):
    - 1) 50kHz: 32
    - 2) 100kHz: 50
    - 3) 500kHz: 50
    - 4) 1MHz: 39
    - 5) 10MHz: 46
    - 6) 100MHz: 38
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.
5. Standard Monitoring Diagnostics – Each TVSS shall provide integral monitoring options:
- a. Each unit shall provide a green / red solid state indicator light shall be provided on each phase. The absence of a green light and the presence of a red light shall indicate which phase(s) have been damaged.
  - b. Contacts for Remote Status Monitoring – The TVSS device must include form C dry contacts (one NO and one NC) for remote annunciation of unit status. The remote alarm shall change state if any of the three phases detect a fault condition.
6. **(Optional) Monitoring Diagnostics:**
- a. **[Audible Alarm** – The TVSS shall provide an audible alarm with a reset pushbutton that will be activated under any fault condition.]
  - b. **[Event Counter** – The TVSS shall be equipped with a LCD display system designed to indicate to the user how many surges, sags, swells and outages have occurred at the location. The event counter triggers each time under each respective category after significant even occurs. A reset pushbutton shall also be standard allowing all counters to be zeroed.]
  - c. **[Push to Test** – The TVSS shall be equipped with push-to-test feature, designed to provide users with real time testing of the suppressor's monitoring and diagnostic system. By depressing the test button, the diagnostic system initiates a self test procedure. If the system is fully operational, the self test will activate all indicator lights.]
  - d. **[Voltage Monitoring** – The TVSS shall display true Root Mean Square (RMS) on three L-N voltage protection mode on Wye configuration and three L-L voltage on delta configuration.]
  - e. **[Non Volatile Memory** – The TVSS shall at least be able to save the last 1000 events.]
  - f. **[Network Communication** – The TVSS shall have the ability to communicate via Ethernet 10BaseT port or Modbus to provide information to the network master drive.]
  - g. **[Security** – The TVSS monitoring diagnostics shall be password protected.]
  - h. **[Protection Remaining** – The TVSS shall indicate the level of protection remaining.]
  - i. **[Total Harmonic Distortion (%THD)** – The TVSS shall display Total Harmonic

Distortion.]

7. Overcurrent Protection Fusing: In order to isolate the TVSS under any fault condition, the manufacturer shall provide:
    - a. Individual Fusing: MOV's shall be individually fused via Copper Fuse Trace. The Copper Fuse shall allow protection during high surge (kA) events. TVSS shall safely reach an end-of-life condition when subjected to fault current levels between 0 and 200 kA, including low level fault currents from 5 to 5000 amperes.
    - b. Thermal Protection: MOV's shall be equipped with Thermal Fuse Spring (TFS) technology which allows disconnection of the suppression component at the overheated stage common during temporary over voltage condition. For small fault currents between 100mA to 30Amp, or if the occurrence is over a longer period of time, the TFS will disconnect first. Manufacturers that utilize fuse trace only shall not be approved since there is no fault current protection between 100mA to 30A.
    - c. All overcurrent protection components shall be tested in compliance with UL 1449-Limited Current Test and AIC rating test.
- C. Minimum Repetitive Surge Current Capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 2002:
1. The suppression filter system shall be repetitive surge tested in every mode utilizing a 1.2 x 50 microseconds, 20kV open circuit voltage. 8 x 20 microsecond, 10kA short circuit current Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current. The minimum repetitive surge current capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992 shall be:
    - a. Service Entrance: 5000 impulse per mode.
    - b. Distribution Locations: 5000 impulse per mode.
    - c. Branch Locations: 5000 impulse per mode.

## 2.3 SYSTEM APPLICATION

- A. Locations – Electrical drawings indicate the location and IEEE Category requirements of all required TVSS's.
- B. Surge Current Capacity – The minimum total surge current 8 x 20 microsecond waveform that the device is capable of withstanding shall be as follows:
  1. IEEE Category "C" Locations:
    - a. Per Phase: 240kA.
    - b. Per Mode: 120kA.
  2. IEEE Category "B" Locations:
    - a. Per Phase: 150kA.
    - b. Per Mode: 80kA.
  3. IEEE Category "A" Locations:
    - a. Per Phase: 100kA.
    - b. Per Mode: 60kA.
- C. Lighting and Appliance Panelboard Requirements – Any one of the following options are acceptable:

1. Factory-Installed TVSS Option:
  - a. The TVSS shall not limit the use of Through-feed lugs, Sub-feed lugs and Sub-feed breaker options.
  - b. The TVSS shall be immediately installed on the load side of the main breaker or main lugs.
  - c. The panelboard shall be capable of re-energizing upon removal of the TVSS.
  - d. A direct bus bar connection shall be used to mount the TVSS component to the panelboard bus bar to reduce the impedance of the shunt path.
  - e. The TVSS panelboard shall be constructed using a direct bus bar connection (cable connection between bus bar and TVSS device is not acceptable). TVSS units that use a cable connection do not meet the intent of this specification. For this option, the breaker shown on the electrical drawings shall be deleted.
  - f. The TVSS shall be included and mounted within the panelboard by the manufacturer of the panelboard.
  - g. The TVSS shall be of the same manufacturer as the panelboard.
  - h. The complete panelboard including the TVSS shall be UL67 listed.
2. Electronic grade Panelboard Extension Option:
  - a. The TVSS shall not limit the use of Through-feed lugs, Sub-feed lugs and Sub-feed breaker options.
  - b. The TVSS shall be installed in an panelboard extension consisting of a box and trim as follows:
    - 1) Box: The unit's box shall be formed of galvanized and chemically cleansed metal and all breaks in galvanizing shall be painted with metallic paint. Minimum size shall be 16" (406 mm) high and in width and depth to match the panelboard dimensions. It shall have removable top and bottom end-plates to facilitate attachment to the top of bottom of a panelboard (also with removable end-plates) in order to provide a continuous barrier-free volume for routing feeder or branch wiring through the extension box. Collar hardware shall be provided to mate the panelboard and the box.
    - 2) Trim: The unit shall be constructed with gray baked enamel sheet metal trim suitable for attachment to the panelboard. Trim shall be flush- or surface mounted to match panelboard trim requirements. Refer to panelboard schedules.
  - c. Provide a multi-pole circuit breaker in the panelboard in size as recommended by the manufacturer to feed the surge suppressor. The size of the breaker shall supersede the size of the breaker shown on the electrical drawings.
  - d. Provide copper conductors in size as recommended by the manufacturer for connecting the phases, neutral, and ground between the surge suppressor and the circuit breaker in the panelboard. The size of the conductor shall supersede the size of the conductors shown on the electrical drawings.
3. Wall-Mounted and/or Retrofit Application Option:
  - a. The TVSS shall be wall-mounted immediately adjacent to the panelboard. Conform to all NEC clearance requirements.
  - b. Provide a multi-pole circuit breaker in the panelboard in size as recommended by the manufacturer to feed the surge suppressor. The size of the breaker shall supersede the size of the breaker shown on the electrical drawings.
  - c. Provide copper conductors in size as recommended by the manufacturer for connecting the phases, neutral, and ground between the surge suppressor and the circuit breaker in the panelboard. The size of the conductor shall supersede the size of the conductors shown on the electrical drawings. Route conductors in conduit sized in accordance with all NEC requirements.

D. Power Distribution Panelboard, Motor Control Center, and Switchboard Requirements – Any one of the following options are acceptable:

1. Factory-Installed TVSS Option:
  - a. The TVSS shall be of the same manufacturer as the power distribution panelboard, motor control center, or switchboard.
  - b. The TVSS shall be factory installed inside the power distribution panelboard, motor control center, or switchboard at the assembly point by the original equipment manufacturer.
  - c. Locate suppressor on load side of main disconnect device or main lugs, as close as possible to the phase conductors and ground/neutral bar.
  - d. Provide a disconnect sized in accordance with all manufacturer's recommendations. The disconnect shall be directly integrated to the suppressor and assembly bus by using bolted bus bar connections. The disconnect is the preferred method. If otherwise recommended by the manufacturer, provide a multi-pole circuit breaker in the panelboard in size as recommended by the manufacturer to feed the surge suppressor. The size of the breaker shall supersede the size of the breaker shown on the electrical drawings. Provide copper conductors in size as recommended by the manufacturer for connecting the phases, neutral, and ground between the surge suppressor and the circuit breaker in the panelboard. The size of the conductor shall supersede the size of the conductors shown on the electrical drawings.
  - e. The TVSS shall be integral to power distribution panelboard, motor control center, or switchboard as factory standardized design.
  - f. All monitoring diagnostics features shall be visible from the front of the equipment.
2. Wall-Mounted and/or Retrofit Applications Option:
  - a. The TVSS shall be wall-mounted immediately adjacent to the panelboard. Conform to all NEC clearance requirements.
  - b. Provide a multi-pole circuit breaker in the panelboard in size as recommended by the manufacturer to feed the surge suppressor. The size of the breaker shall supersede the size of the breaker shown on the electrical drawings.
  - c. Provide copper conductors in size as recommended by the manufacturer for connecting the phases, neutral, and ground between the surge suppressor and the circuit breaker in the panelboard. The size of the conductor shall supersede the size of the conductors shown on the electrical drawings. Route conductors in conduit sized in accordance with all NEC requirements.

## 2.4 ENCLOSURES

- A. Provide enclosures suitable for locations as indicated on the drawings or as described below:
1. NEMA 1/3R rainproof enclosures intended for outdoor use primarily to provide protection against rain, sleet and damage from external ice formation.
  2. NEMA 12 dust-tight enclosures intended for indoor use primarily to provide protection against circulating dust, falling dirt and dripping non-corrosive liquids. (Panelboards Only)
  3. NEMA 4 watertight stainless steel intended for indoor or outdoor use primarily to provide protection against windblown dust and rain, splashing rain, hose-directed water, and damage from external ice formation. (Side Mounted Units Only)

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF SURGE PROTECTION DEVICES

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install devices for panelboard and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground at TVSS.

### 3.2 PLACING SYSTEM INTO SERVICE

- A. Do not energize or connect electrical equipment to their sources until surge protection devices are installed and connected.

### 3.3 FIELD QUALITY CONTROL

- A. Testing: Perform the following field tests and inspections and prepare test reports:
  - 1. After installing surge protection devices, but before electrical circuitry has been energized, test for compliance with requirements.
  - 2. Complete startup checks according to manufacturer's written instructions.
  - 3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
- B. Remove and replace malfunctioning units and retest as specified above.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transient voltage suppression devices. Refer to Division 1 Section "Closeout Procedures" or "Demonstration and Training" as may be applicable.

END OF SECTION 260289



SECTION 260420 - SERVICE ENTRANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to service entrances.

1.2 DESCRIPTION OF WORK:

- A. Extent of service entrance work is indicated by drawings and schedules and is specified herein.
- B. Work under this section includes the following:
  - 1. Power Company Coordination and Fees
  - 2. Power Company Transformer Pads
  - 3. Raceways and Conductors
  - 4. CT Enclosures
  - 5. Metering
  - 6. Service Entrance Switchboards and/or Panelboards
  - 7. Overcurrent Protective Devices and/or disconnects

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.
- B. SUBMITTALS:
  - 1. Shop Drawings: Submit manufacturer's data on service entrance equipment and accessories. Submit dimensioned drawings of service entrance equipment.
  - 2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms containing service entrance equipment indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Provide service entrance equipment and accessories of types, sizes, ratings, and electrical characteristics indicated or as otherwise required to provide a complete system. See other applicable sections.

2.2 POWER COMPANY COORDINATION AND FEES:

- A. Coordinate and comply with all power company requirements. Verify all costs for line extensions (both high voltage and low voltage conductors), underground service fees, etc. with Power Company prior to bid. Include all costs in bid. Confirm location of point of service before bidding.

2.3 POWER COMPANY TRANSFORMER PADS AND VAULTS:

- A. Provide steel reinforced, concrete transformer pads and/or vaults of sizes and with openings in accordance with the latest standards and requirements of the local power company. Verify all requirements with Power Company prior to installation.

2.4 RACEWAYS AND CONDUCTORS:

- A. Provide service entrance raceways and conductors in accordance with Section 260110 - Conduit Raceways, and Section 261020 - Conductors and Cables.

2.5 CT ENCLOSURES:

- A. Provide CT enclosures complete with meter bases of types and sizes in accordance with all power company requirements. Provide steel reinforced, concrete pads with openings in accordance with same. Refer to "Concrete Bases" under Section 26001 - Electrical General Provisions. Verify and comply with all power company requirements prior to installation.

2.6 METERING:

- A. Meter Bases: Provide meter bases in accordance with all power company requirements. Extend 1" empty conduit from meter bases to secondary compartment of power company transformer. Verify exact location of meter bases prior to installations.

- B. Power Meters:

1. Provide Square D Power Logic Circuit Monitor, Class 3020, Model CM-3250, or equivalent, integrally mounted in service switchboard, completely wired with current transformers, potential transformers, control power transformer, and fusing.
2. Provide meter with the following features:
  - a. Front panel features:
    - 1) Six-digit LED display
    - 2) Kilo/Mega units LEDs
    - 3) Meter indication LEDs
    - 4) Setup/rest parameters
    - 5) Phase indication LEDs
    - 6) Phase select button
    - 7) Select meter buttons
    - 8) Mode indication LEDs
    - 9) Mode select button
    - 10) Optical communications port
  - b. True RMS Metering
  - c. Accepts standard CT and PT inputs
  - d. 0.2% accuracy, current and voltage
  - e. Min/Max displays for metered data
  - f. On-board clock/calendar
  - g. RS-485 Communications standard
  - h. Setpoint controlled alarm/relay functions

- i. On-board event and data logging
  - j. Waveform capture
  - k. High-speed, triggered 12-cycle event capture
  - l. Downloadable firmware
  - m. Date/time for each Min/Max
  - n. Optional voltage/power module, where required, for direct connection to 480Y/277 V systems.
3. Provide meter with instrumentation to displaying the following information:
- a. Real-time readings:
    - 1) Current (per phase, N, G, 3 phase)
    - 2) Voltage, per phase (L-L, L-N), and 3 phase average.
    - 3) Apparent RMS Current
    - 4) Real power (per phase, 3 phase)
    - 5) Reactive Power (per phase, 3 phase)
    - 6) Apparent power (per phase, 3 phase)
    - 7) Power factor (per phase, 3 phase)
    - 8) Frequency
    - 9) THD (current and voltage)
    - 10) K-factor (per phase)
  - b. Demand Readings:
    - 1) Demand current (per-phase present, peak)
    - 2) Average demand current (per phase present, peak)
    - 3) Peak demand current (per phase)
    - 4) Average power factor (3 phase total)
    - 5) Demand real power (3 phase total)
    - 6) Average demand peak power (3 phase total)
    - 7) Predicted demand real power
    - 8) Peak demand real power
    - 9) Demand apparent power (3 phase total)
  - c. Energy Readings:
    - 1) Accumulated energy, real
    - 2) Accumulated energy, reactive
  - d. Power Analysis Values:
    - 1) Crest factor (per phase)
    - 2) K-factor demand (per phase)
    - 3) Displacement power factor (per phase, 3 phase)
    - 4) Fundamental voltages (per phase)
    - 5) Fundamental currents (per phase)
    - 6) Fundamental real power (per phase)
    - 7) Harmonic power
    - 8) Unbalance (current and voltage)
4. Phase rotation
- 2.7 SERVICE ENTRANCE SWITCHBOARDS AND/OR PANELBOARDS:
- A. Provide service entrance switchboards and/or panelboards in accordance with Section 260182 - Switchboards, and Section 260160 - Panelboards. Rate all service switchboards and/or panelboards as service entrance equipment.
- 2.8 OVERCURRENT PROTECTIVE DEVICES AND/OR DISCONNECTS:
- A. Provide overcurrent protective devices and/or disconnects in service switchboards and/or

panelboards in accordance with Section 260180 - Overcurrent Protective Devices, and Section 260170 - Disconnect Switches.

### PART 3 - EXECUTION

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#### 3.1 GENERAL:

- A. Install service entrance equipment and accessories in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

#### 3.2 TRANSFORMER LOCATIONS:

- A. Verify and coordinate exact placement of concrete pad with local power company prior to installation. Strictly maintain sufficient distances from door, window, building walls and overhangs, gas meters, fuel tanks, etc. in accordance with all power company requirements. Field-verify placement of transformer pad in company with the local power company representative.

#### 3.3 COORDINATION:

- A. Coordinate all service entrance work with other trades.
- B. Power Company Coordination: Coordinate installation of service entrance equipment with Power Company and insure that power to building is ready when needed. After the contract has been signed, immediately notify the engineer that the project is underway and indicated when power to the building/project is needed. It is the engineer's responsibility to complete and submit the power company service request form.

END OF SECTION 260420

SECTION 260435 - PROTECTIVE DEVICE STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Section 26001, "Electrical General Provisions," section applies to work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Protective device studies in this section include the following:
  - 1. Fault Current Study
  - 2. Protective Device Coordination Study

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest issue of the publications shall be used.
  - 1. American National Standards Institute (ANSI) Publications:
    - a. C37.5 Protective Device Coordination
  - 2. Institute of Electrical and Electronic Engineers (IEEE)
  - 3. American Society for Testing and Materials (ASTM) Publications:
    - a. 399 Protective Device Coordination
    - b. STD-141 Protective Device Coordination

1.4 QUALITY ASSURANCE

- A. Studies shall be performed by qualified engineers of the equipment manufacturer or an approved consultant. Studies shall bear the professional engineer's stamp of the engineer in responsible charge of the studies. Perform all work in accordance with latest IEEE and ANSI standards.

1.5 SUBMITTALS

- A. All submittals will be submitted to the Resident Engineer for review and recommendation of acceptance, change, or rejection to the Project Engineer.
- B. The studies shall be submitted to the Electrical Engineer prior to submittal of shop drawings. Shop drawings shall not be reviewed by the Electrical Engineer until the studies are submitted.

PART 2 - PRODUCTS

## 2.1 FAULT CURRENT STUDY

- A. A fault current analysis shall be performed with the aid of a computer and appropriate software.
1. Include as input data the maximum available short circuit contribution, resistance and reactance components of the branch impedances, the X/R ratios, base quantities selected, and other source impedance.
  2. Calculate fault current close and latch duty values and interrupting duty values on the basis of assumed three-phase bolted short circuits at each switchgear bus, medium voltage controller, switchboard, low voltage motor control center, distribution panelboard, branch circuit panelboard and other significant locations throughout the system. Include symmetrical fault currents, and X/R ratios in the fault current tabulations. For each fault location, list the total duty on the bus, as well as the individual contribution from each connected branch, with its respective X/R ratio. Calculate ground fault currents at each bus. Incorporate major motor contributions in determining momentary and interrupting ratings of protective devices.
  3. Perform an evaluation to determine the adequacy of circuit breakers, molded case switches, automatic transfer switches, and fuses, by tabulating and comparing the short circuit rating of these devices with the calculated fault currents. Apply appropriate multiplying factors based on system X/R ratios and protective device rating standards. Report problem areas of inadequacies in the equipment due to short circuit currents.

## 2.2 PROTECTIVE DEVICE COORDINATION STUDY

- A. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage breaker trip characteristics and settings. The objective of the study is to obtain optimum protective and coordination performance from these devices.
1. The coordination study shall include all voltage classes of equipment from the utility's incoming line protective device down to and including the largest rated device in each motor control center and panelboard. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices.
  2. The time-current characteristics of the specified protective devices shall be drawn on log-log paper. The plots shall include complete titles, representative one-line diagram and legends, associated power company's relays or fuse characteristics, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. All restrictions of the National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a system basis. A sufficient number of separate curves shall be used to clearly indicate the coordination achieved.
  3. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identifications, IEEE device number, current transformer ratios and connection, manufacturer and types, range of adjustment and

recommended settings. A tabulation of the recommended power fuse selection shall be provided for all fused in the system. Any discrepancies, problem areas, or inadequacies shall be promptly brought to the Engineer's attention.

2.3 ARC FLASH

2.4 REPORT

- A. The results of the power system study shall be summarized in a final report. Six (6) bound copies of the final report shall be submitted. The report shall include the following sections:
1. Description, purpose, basis and scope of the study and a single diagram of the portion of the power system which is included within the scope of the study.
  2. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties and commentary regarding same. Include formulas and description of methods used.
  3. Fault current calculations including a definition of terms and guide for interpretation of computer printout.
  4. Tabulations of circuit breaker, fuse and other protective device ratings.
  5. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

PART 3 - INSTALLATION

3.1 GENERAL

- A. Subject to Engineer's approval, all overcurrent protective devices shall be selected on the basis of adequate trip coordination.

3.2 PROTECTIVE DEVICE TESTING, CALIBRATION AND ADJUSTMENT:

- A. The equipment manufacturer shall provide the services of a qualified field engineer and necessary tools and equipment to test, calibrate, and adjust the protective relays and circuit breaker trip devices as recommended in the power system study.

END OF SECTION 260435



SECTION 260452 – GROUNDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to grounding.

1.2 DESCRIPTION OF WORK:

- A. Extent of grounding work is indicated by drawings and schedules and is specified herein.
- B. Ground the complete electrical installation including the system neutral, metallic conduits and raceways, boxes, fittings, devices, cabinets, equipment, and separately derived systems in accordance with the NEC and all other applicable codes to provide a permanent, continuous, low impedance, grounding system.
- C. Provide grounding system such that the resistance from the service entrance ground bus, through the grounding electrode to earth is not greater than 5 ohms.

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.
- B. TESTING: Submit results of ground resistance testing as specified in this section. Include name of testing agency with report. Include test results in operation and maintenance manuals.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. Provide grounding equipment and accessories of types, sizes, ratings, and electrical characteristics indicated or as otherwise required to provide a complete system.

2.2 GROUNDING CONDUCTORS:

- A. Unless noted otherwise, provide grounding conductors with stranding and insulation types to match phase conductors. Provide conductors with green insulation if possible; otherwise wrap with green tape. Size ground conductors as indicated on drawings. Do not size ground conductors smaller than that allowable by NEC.

2.3 GROUND RODS:

- A. Provide copper clad, steel, 3/4" diameter by 10' long, ground rods ( Weaver, Cadweld, or

equivalent).

2.4 TEST WELLS:

- A. Provide precast concrete box 9-1/2" W. x 16" L. x 18" D. with light duty concrete cover for non-traffic areas or rated steel plate for traffic areas. Provide covers with lifting holes. Engrave cover with "Ground Rod".

2.5 CONCRETE ENCASED GROUNDING ELECTRODE (UFER GROUND):

- A. Provide a bare copper conductor encased along the bottom of concrete foundation or footing that is in direct contact with the earth and where there is no impervious water-proofing membrane between the footing and the soil. Size UFER ground conductor in accordance with the NEC. Extend conductor through a horizontal length of 30' minimum and encase with not less than 2 nor more than 5 inches of concrete separating it from surrounding soils.

2.6 INSULATED GROUNDING BUSHINGS:

- A. Provide plated malleable iron body with 150 degree Centigrade molded plastic insulating throat, lay-in grounding lug with hardened stainless steel fasteners (OZ Gedney BLG or equivalent).

2.7 CONNECTION TO PIPES:

- A. Provide heavy duty, cast bronze, ground clamp systems with silicon bronze bolts and nuts (OZ Gedney G Series - B or equivalent).

2.8 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES:

- A. Provide exothermic welds. (Cadweld or equivalent)

2.9 BONDING JUMPERS:

- A. Provide bonding jumpers with hot dip galvanized malleable or ductile iron clamps, hot dip galvanized steel U-bolts, and tinned copper braids (OZ Gedney BJ Series or equivalent).

2.10 GROUND BUS:

- A. Provide 1/4" x 4", copper ground bus complete with insulators and brackets in lengths and at mounting heights as indicated on drawings. Furnish complete with drilled holes and lugs to accommodate grounding conductors.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Install grounding systems in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 CLEANING:

- A. Thoroughly clean all metal contact surfaces prior to installation of clamp-on connectors.

3.3 SEPARATELY DERIVED SYSTEMS:

- A. Ground each separately derived system in accordance with NEC Section 250-16 unless otherwise indicated on drawings.

3.4 SERVICE ENTRANCE GROUNDING:

- A. Connect the following items using NEC sized copper grounding conductors (in NEC sized, conduits if concealment is required) to lugs on the service ground bus:
  - 1. Conductor from the UFER ground.
  - 2. Conductor from two ground rods driven exterior to building at not less than 10' apart.
  - 3. Conductor from main incoming cold water piping system.
  - 4. Conductor from building structural steel.
  - 5. Conductor from separately derived systems.
  - 6. Conductor from insulated ground bushings on service entrance conduits.
  - 7. Additional ground rods as required to achieve resistance value specified.
  - 8. Additional items indicated on drawings.

3.5 EQUIPMENT BONDING AND GROUNDING:

- A. Provide an NEC sized conductor, whether indicated or not on the drawings, in raceways as follows:
  - 1. Non-metallic conduits and ducts.
  - 2. Distribution feeders.
  - 3. Motor and equipment branch circuits.
  - 4. Device and lighting branch circuits.
  - 5. Full length of all multi-outlet assemblies and other surface wireways.

3.6 ADDITIONAL GROUNDING INSTALLATION REQUIREMENTS:

- A. Provide grounding bushings on all service conduit and conduits installed in concentric/eccentric knock-outs or reducing washer at panelboards, cabinets, and gutters.
- B. Provide bonding jumpers across expansion and deflection couplings in conduit runs, across pipe connections at water meters, and across dielectric couplings in metallic cold water piping system. Connection to water piping system shall be made electrically continuous by connecting to the street side of the water main valve and/or installing additional bonding jumpers across the meter, valves or service unions that might be disconnected.
- C. Provide bonding wire in all flexible conduits.
- D. Isolated Ground Circuits: Circuits used for isolated ground outlets shall be run in separate raceways or shall have a separate green insulated ground conductor installed and tagged for identification at all outlet and junction boxes.

3.7 TEST WELLS:

USTAR Building #2  
Utah State University  
Life Sciences Research Center  
Logan, Utah

- A. All ground rods shall be driven external to building and shall be located in ground well boxes. Locate in landscaped areas where possible.

3.8 TESTING:

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- A. Obtain and record ground resistance measurements both from service entrance ground bus to the ground electrode and from the ground electrode to earth. Install additional bonding and grounding electrodes as required to comply with resistance limits specified under this Section. Use independent testing agency for all testing.

END OF SECTION 260452

SECTION 260510 - INTERIOR AND EXTERIOR BUILDING LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to interior and exterior building lighting.

1.2 DESCRIPTION OF WORK:

- A. Extent of interior and exterior building lighting work is indicated by drawings and schedules and is specified herein.
- B. Type of lighting fixtures in this section include the following:
  - 1. Fluorescent
  - 2. Incandescent / Halogen
  - 3. High Intensity Discharge (HID)

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable. Provide fluorescent-lamp ballasts which comply with Certified Ballast Manufacturer's Association standards and carry the CBM label.
- B. SHOP DRAWINGS: Submit manufacturer's data on interior and exterior building lighting fixtures. Submit dimensioned drawings of all lighting fixtures. Identify light fixtures by type and submit in alphabetical order.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Provide light fixtures of types as indicated on drawings or as approved by addenda. Provide light fixtures complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, starters, wiring, etc. Provide all light fixtures with safety latches where applicable.
- B. Provide all detachable fixture parts, luminous ceiling accessories, louvers, diffusers, lenses, and reflectors with locking catches, screws, safety chains, or safety cables.
- C. Provide all exterior fixtures with damp or wet location labels as required by application.
- D. Provide all light fixtures and support accessories as required for a complete system.

- E. Consult architectural drawings for louvers (if any) to be provided by Division 26.

## 2.2 FLUORESCENT LIGHT FIXTURES:

### A. FLUORESCENT BALLASTS:

1. Electronic:
  - a. Manufacturers: Provide electronic ballasts from manufacturers specified as an integral part of light fixtures on the light fixture schedule. Where "generic" electronic ballasts are specified, provide products of one of the following for each fixture type:
    - 1) Advance Transformer
    - 2) Magnetek
    - 3) Motorola
    - 4) Osram Sylvania
  - b. Electronic Ballasts: Whether specified specifically or generically, provide electronic, fluorescent lamp ballasts for each type of fluorescent fixture capable of operating lamps indicated. Provide high power factor (97% or greater), Class P, sound-rated A, and internally thermally protected ballasts. Provide ballasts with input third harmonic content not exceeding 10% for 120V ballasts and less than 15% for 277V ballasts, average lamp current crest factor of 1.7, frequency of operation 20 KHz or greater, and non-PCB capacitors. Unless specifically noted otherwise, provide all interior light fixtures, with full light output electronic ballasts. Equip all exterior light fixtures with low temperature starting ballasts. Comply with all manufacturer's written recommendations for all lamp-ballast combinations.
  - c. Programmed Start Electronic Ballasts: Electronic ballasts shall be programmed start for maximum lamp life on shorter start cycles. Filament voltage shall be applied prior to the application of open circuit voltage to allow adequate heating of the filaments and then open circuit voltage is applied to start the lamps. Ballasts shall provide for a minimum lamp starting temperature of 0 Degrees F.
  - d. End-of-Life Circuitry: Ballasts for lamps of T5 and smaller including T5, T4, and T2 diameter shall contain end-of-life sensing circuitry to prevent lamp bulb, lamp base, or socket damage at lamp end-of-life.
2. Dimming:
  - a. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
    - 1) Lutron
    - 2) Dimming Ballasts:
  - b. Dimming ballasts shall be provided as part of a fluorescent dimming system where ballasts and controls are made by the same manufacturer. Refer to Fluorescent Lamp Dimmers Section 140 - Wiring Devices.
  - c. Ballasts shall be UL listed, Class P thermally protected and meet ANSI C62.41 (IEEE Publication 587, category A for surge protection).
  - d. Dimming shall be smooth and continuous without flicker down to 1% light levels for T-12, and T-8 lamps (5% for T-5 lamps).
  - e. Ballasts shall have a power factor greater than .95, ballast factor equal to .93, total harmonic distortion less than 10%, and lamp current crest factor less than or equal to 1.6.
  - f. Ballasts shall be inaudible in a 27dB ambient throughout the dimming range.
  - g. Ballasts shall be capable of striking lamps at any light level without first flashing to full light.

- h. Ballasts shall comply with FCC Part 18 regulations and shall not interfere with other properly installed electrical equipment,
  - i. Ballasts shall have a minimum starting temperature of 10 Degrees C.
  - j. Ballasts shall be free of Polychlorinated Biphenyls (PCB's).
3. Ballast Disconnect:
- a. Fluorescent fixtures that can be serviced-in-place shall come equipped with a disconnecting means that allows the ballast to be disconnected simultaneously from all conductors during maintenance and repair. The means of disconnect shall be placed so that it is accessible to all individuals before service of the fixture or ballast is initiated.
  - b. The line-side terminals of the ballast disconnect shall also be guarded.
  - c. The ballast disconnect shall adhere to the requirements outlined in the code, NEC 2005 410.73(G).
4. Ballast Fusing: All ballasts shall be externally and individually fused.

B. FLUORESCENT LAMPS:

- 1. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
  - a. General Electric
  - b. Phillips
  - c. Osram Sylvania
- 2. Lamps: Provide fluorescent lamps in types, wattages, and sizes as indicated on fixture schedule. Unless specifically noted otherwise, equip interior light fixtures with full light output, energy-conserving, fluorescent lamps.
- 3. T-8 Lamps: Where T-8 lamps are specified, provide General Electric "Trimline", Sylvania "Octron", or Phillips only with initial lumens outputs of 2950 minimum.
- 4. Provide TCLP-compliant lamps where available from the manufacturer.

- C. DIFFUSERS: Where acrylic diffusers are specified, provide 100 percent virgin acrylic compound with minimum thickness of .125 inches.

2.3 INCANDESCENT / HALOGEN LIGHT FIXTURES

- A. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
- 1. General Electric
  - 2. Phillips
  - 3. Osram Sylvania
- B. Incandescent Lamps: Provide incandescent lamps in types, wattages, and sizes as indicated on the light fixture schedule.
- C. Halogen Lamps: Provide halogen lamps with increased LPW (IR technology) or improved optics in types, wattages, and sizes as indicated on the light fixture schedule.

2.4 HIGH INTENSITY DISCHARGE (HID) LIGHT FIXTURES:

- A. HID BALLASTS:

1. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
  - a. Advance Transformer
  - b. General Electric
  - c. Universal
2. Ballasts: Provide electromagnetic, constant wattage, HID lamp ballasts for each type of HID fixture capable of operating lamps indicated. Provide high power factor (90% of greater) ballasts. Provide HID ballasts for each HID fixture with features in accordance with all manufacturer's written recommendations. Equip all exterior light fixtures with low temperature (-10 degree F.) starting ballasts. Comply with all manufacturer's written recommendations for all lamp-ballast combinations.

B. HID LAMPS:

1. Manufacturers: Subject to compliance with all requirements, provide products of one of the following for each fixture type:
  - a. General Electric
  - b. Phillips
  - c. Osram Sylvania
  - d. Venture
2. Lamps: Provide HID lamps in types, wattages, and sizes as indicated on fixture schedule.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Install interior and exterior light fixtures in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 SUPPORT REQUIREMENTS:

A. RECESSED LIGHT FIXTURES:

1. Lay-in Ceilings: Support all light fixtures in lay-in ceilings independent from the ceiling system. Support each recessed light fixture from the building structure with #12 gauge steel wire attached to each corner. Provide clips to securely fasten lay-in light fixtures to Tee-Bars. Provide suspension bars for downlight fixtures in lay-in ceilings.
2. Gypsum Board, Plaster, or Similar Ceilings: Support all light fixtures in hard ceilings independent from the ceiling system. Support each recessed light fixture from the building structure with #12 gauge steel wire attached to each corner. Provide backing supports and all mounting accessories as required.
3. Fire Ratings: Provide gypsum board protection for each light fixture recessed in fire-rated ceiling as required to maintain fire rating of penetrated ceiling.

- B. SURFACE MOUNTED LIGHT FIXTURES: Support all surface mounted fixtures from a 4" square octagonal outlet box connected to a standard 3/8" stud or box hangar where applicable. Include backing and supports as required to support weight of light fixture.

- C. PENDANT AND STEM MOUNTED LIGHT FIXTURES: Provide pendants, rigid conduit stems, and flexible ball joint hangers for all pendant and stem hung fixtures.

### 3.3 PROTECTION AND CLEANING:

- A. Protect installed and non-installed fixtures from damage during construction period.
- B. Thoroughly clean all interior and exterior light fixtures. Do not mar or scar reflectors or diffusers. Repair all nicks and scratches to appearance of original finish. Remove protective plastic coverings on light fixtures at completion of project.

### 3.4 WIRING METHODS:

- A. Route a minimum of 36" of 3/8" flexible conduit to each lay-in light fixture directly from an outlet box. Unless specified otherwise, flexible conduit shall not exceed 72" in length. Do not loop flexible conduit from fixture to fixture.
- B. Grounding: Provide equipment grounding connections for each lighting fixture.

### 3.5 COORDINATION:

- A. Refer to architectural reflected ceiling drawings for exact location and quantities of light fixtures, and ceiling types. Where conflicts occur between the architectural and electrical drawings, or where fixtures types do not coordinate with ceiling systems, notify architect/engineer prior to bid. After bid and award of contract, provide all light fixtures as required to meet the intent of the construction documents. Coordinate fixture layouts and installations with ceiling installer prior to submitting shop drawings and during construction. Fluorescent light fixtures shall be not less than 1/2" from combustible materials.

### 3.6 SPARE PARTS:

- A. LAMPS: Provide 15% spare lamps, but in no case less than one, of each type, wattage, and size used for the project.
- B. ACRYLIC DIFFUSERS: Provide a spare acrylic diffusers and/or glass for each light fixture type and one for each additional unit for each ten fixtures. The quantity of any single type need not exceed 10.
- C. ELECTRONIC BALLASTS: Provide 2% spare electronic ballasts.

### 3.7 WARRANTY:

- A. LAMPS: Warranty incandescent and fluorescent lamps for a period of two months from substantial completion.
- B. ELECTRONIC BALLASTS: Warranty electronic ballasts for parts and labor for complete replacement for a period of five years. Warranty shall include an allowance for nominal replacement labor and replacement of defective product.

END OF SECTION 260510



SECTION 260551 - EXTERIOR AREA LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to exterior area lighting.

1.2 DESCRIPTION OF WORK:

- A. Extent of exterior area lighting work is indicated by drawings and schedules and is specified herein.

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions and other sections as applicable.
- B. SHOP DRAWINGS: Submit manufacturer's data on exterior area lighting items including but not necessarily limited to poles, brackets, light fixtures, fuse, fuseblocks, etc. Submit dimensioned drawings of all pole and lighting fixtures. Include information with interior and exterior building lighting fixtures.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Provide exterior lighting fixtures of types as indicated on drawings or as approved by addenda.

2.2 LIGHT FIXTURES:

- A. Refer to Section 260510 - Interior and Exterior Building Lighting for requirements for exterior light fixtures, lamps, ballasts, etc.

2.3 POLES:

- A. Provide poles and all accessories including but not necessarily limited to anchor bolts, templates for anchor bolt pattern, brackets, bolts, etc. Provide handhole and cover at base of each pole. Provide poles which have been primed and painted at the factory. Provide poles, anchor bolts, etc. in sizes as recommended by manufacturer to withstand windloadings.

2.4 CONCRETE BASES:

- A. Provide 3000 psi class concrete, forms, steel reinforcement, tie wires, etc. as required. See

drawings for details.

2.5 GROUND RODS:

- A. See Section 260452 - Grounding for ground rod requirements.

2.6 FUSEHOLDER, FUSES, AND BREAK-A-WAY RECEPTACLES:

- A. Provide fuseholders with break-a-way receptacles equivalent to Bussmann Tron Waterproof Fuseholders and Break-A-Way Receptacles in the base for all phase conductors and materials. Neutral fuse holder will use a shorting fuse insert. Provide Bussmann KTK-R fuses in ratings to suit respective applications and sized in accordance with all manufacturer's recommendations.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Install exterior area lighting in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 INSTALLATION METHODS:

- A. Set all poles plumb. Use belt slings or ropes to raise and set poles to protect finish. Repair nicks and scratches to match original surface.
- B. Locate fuseholder at handhole. Provide fuse blanks in all neutral conductors.
- C. Grounding: Provide one ground rod for each light pole. Connect ground rod to pole by means of an NEC-sized grounding conductor and all additional grounding as required.

3.3 CONCRETE BASES:

- A. Provide concrete bases for light poles in accordance with details on drawings. Grout and hand-rub all concrete to a uniform smooth finish.

3.4 SPARE PARTS:

- A. FUSES: Provide three spare fuses for each type and size used.

3.5 WIRING METHODS:

- A. No common neutral multi-wire circuits will be used to feed area lighting. Provide dedicated neutral wire for each circuit indicated.

END OF SECTION 260551

SECTION 260560 - LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to lighting control equipment.

1.2 SYSTEM DESCRIPTION

- A. Install a Low Voltage Switching System consisting of relay panels and intelligent switches and/or photocells connected together by a dataline, as well as all associated wiring.
- B. The system includes a DIN rail mounted timeclock, photosensor control module and/or other low voltage control devices. These devices are totally compatible with the manual operation of the softwired switches.
- C. Requirements are indicated elsewhere in the specifications for work including, but not limited to, raceways and electrical boxes and fitting required for installation of control equipment and wiring.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Component Pre-testing: All components and assemblies are to be factory pre-tested prior to installation.
- C. System Support: Factory applications engineers shall be available for telephone support.
- D. NEC Compliance: Comply with NEC as applicable to electrical wiring work.
- E. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
- F. UL Approvals: Remote panels are to be UL listed under UL 916 Energy Management Equipment.
- G. CSA Approvals: Remote panels are to be CSA listed.
- H. FCC Emissions: All assemblies are to be in compliance with FCC emissions Standards specified in Part 15 Subpart J for Class A application.

1.4 SUBMITTALS

- A. Shop Drawings: Submit dimensional drawings of all lighting control system components and accessories.
- B. One Line Diagram: Submit a one line diagram of the system configuration proposed if it differs from that illustrated in the riser diagram included in the contract drawings.
- C. Typical Wiring Diagrams: Submit typical wiring diagrams for all components including, but not limited to, relay panels, relays, dataline low voltage switches, occupancy sensors and daylighting controls.

#### 1.5 MANUFACTURERS

- A. Douglas
- B. Next Light
- C. Hubbell

### PART 2 – PRODUCTS

#### 2.1 PROSYS II RELAY PANELS

##### A. Description

1. Modular Relay Panels shall be UL listed and consist of the following:
  - a. Tub: Empty NEMA 1 enclosure that can accept an interior sized to accept up to 12, 24, or 48 GE RR7P or RR9P relays.
  - b. Power Supply: Transformer assembly with two 40VA transformers with separate secondaries. Transformers include internal overcurrent protection with automatic reset and metal oxide varistor protection against power line spikes. **Specify:** (120) or (277) VAC, 50/60 Hz. +/- 10%.
  - c. Cover: **Specify:** (Surface) or (Flush) with captive screws in a hinged, lockable configuration. A wiring schedule directory card shall be affixed to the cover's back.
  - d. Interior: Bracket and intelligence board backplane with pre-mounted relays. Interiors shall be provided with up to 12, 24, or 48 installed and tested relays.
2. Panel shall be provided with an integral DIN rail mounting bar for easy installation of other system components (such as ProSys clock). Terminals shall be included in the interior to accept a dataline for the connection of softwired dataline switches to the system, or to allow a dataline to be run between multiple panels for network communications between the panels.
3. Panel shall be provided with individual ON/OFF switches for both panel and dataline power.
4. Eight channels shall be provided in each interior regardless of size, each with an associated pushbutton to toggle the channel ON/OFF, and a terminal block for a separate dry contact input. Any number of relays in the panel can be assigned to each channel, with overlapping allowed. Channels shall be set up via "Softwiring", i.e. no hand held programmer or keypad is required. Systems that require programmers or keypads, or that change relay states during set up are not acceptable. Each channel pushbutton shall provide LED state indication - RED shall indicate that all of the relays within the

channel group are ON; NO LED shall indicate that all of the relays within the group are OFF, and GREEN shall indicate the channel's relays are in a MIXED state.

\*\*\* OPTIONAL \*\*\*

5. Each channel pushbutton shall provide LED **status** indication - RED shall indicate that all of the relays within the channel group are ON; NO LED shall indicate that all of the relays within the group are OFF, and GREEN shall indicate the channel's relays are in a MIXED **status**. (Note: requires use of RR9P relays.)
6. System shall accept future functionality upgrades without removal of the panel.

B. Features

1. Relays shall be momentary-pulsed mechanically latching contactors rated at 20 amps, 120 - 277 VAC. They shall attach to the Interior by a single plug-in connector.
2. Next to each relay shall be an individual override button and an LED to indicate state. LED shall indicate RELAY ON, RELAY OFF.

\*\*\* OPTIONAL \*\*\*

3. Next to each relay shall be an individual override button and an LED to indicate **status**. LED shall indicate RELAY ON, RELAY OFF, **RELAY FAILURE**.
4. Captive screw terminations will be provided for all wiring connections.
5. Each channel button's dry control contact input terminal shall accept either 2 or 3-wire, maintained or momentary inputs. They shall also accept a 2-wire toggling input.
6. Each channel shall also have an associated 1 amp, 30 VDC isolated contact which may be used for status feedback or pilot light control.
7. The Relay Panel shall use an EEPROM to record the channel softwiring assignments and the current status of all relays, thus insuring a 40-year backup of information in the event of a power failure. Systems that require a chargeable battery with less than 10 year's life shall not be allowed.
8. The unit shall provide LED status indication of the power supply status. Access to 24VAC and 24V rectified power for accessory devices shall be provided within the panel.

\*\*\* OPTIONAL \*\*\*

9. Interior shall use relays with an optional pilot contact to provide individual relay feedback to other control systems. Also, terminal blocks will be located next to each relay to allow standard low voltage switching devices to control the relay state. Devices can be either 2 or 3-wire, maintained or momentary inputs. They shall also accept a 2-wire toggling input.

\*\*\* OPTIONAL \*\*\*

10. System shall comply with the LonMark® lighting controller profile and provide capability for network binding to LonMark compliant building automation system components without the use of dry contacts, gateways, protocol converters or additional systems devices.

2.2 NETWORK DATALINE

A. Description

1. The intelligence in multiple panels shall be linked over a single dataline that uses the open Echelon/LonTalk™ protocol for communications, and be fully LonMark® and LNS (LonWorks® Network Services) compliant. The dataline shall provide a highly reliable communications bus for transferring control and status between the relay panels. The dataline shall be self-powering at each relay panel and not require any ancillary equipment to function properly.
2. The dataline, in addition to linking together multiple relay panels, shall be capable of extending out from the electrical closet, and provide a single communications bus to allow softwired dataline switches to communicate with the panels.
3. The dataline can also connect to a single softwired dataline timeclock mounted in the interior of a relay panel or a separate enclosure at another location.

B. Features

1. Dataline shall be 18/4 twisted conductor with shield meeting Class 2P NEC code requirements. The dataline can be run in a loop, serial, or star configuration. Minimum 1 turn per 3 inches; 50 pf/ft. max.
2. Maximum length for all dataline wire in the system is 1,500 feet.
3. Maximum number of devices (panels/switch modules/timeclocks) on a dataline is 127.

\*\*\* OPTIONAL \*\*\*

4. The system shall be expandable to 32,000 nodes worldwide with the use of LonWorks® routers and repeaters.

2.3 SOFTWIRED DATALINE SWITCHES

A. Description

1. To allow individual overrides, dataline switches shall be terminated to each panel's 4 wire "Local Dataline". Switches shall be available in either single, dual, quad, or octal (1 button, 2 button, 4 button, or 8 button) designs. The single, dual, and quad devices mount in a standard single gang box, while the octal version mounts in a two gang box.
2. Each button in a switch module can be individually programmed. Programming is done by a "Softwiring Sequence" rather than with a handheld keypad or laptop. Each button can be assigned to any one of the following four functions:
  - a. Control any individual relay in any single panel
  - b. Control any group of relays in any single panel
  - c. Control any of the eight channels (A-H) in a single panel
  - d. Control the same channel letter (A-H) in any chosen group of panels in the system.
3. For applications that require pattern switching, any button can perform its function using an "ON/OFF/Not Controlled" pattern of relays instead of the normal All ON/All OFF.

B. Features

1. Switches shall have a non-breakable Lexan body and a matching screwless Lexan wallplate.
2. Each switch module shall use a bi-color LED pilot light for the individual buttons to indicate status of the controlled relay or group of relays. LED indications are Red for All

ON, Green for Mixed State (some relays in the group ON and others OFF), and No LED for All OFF.

3. Switch shall also include a locator light.
4. Individual buttons shall have a removable clear cover to allow standard 3/8 inch tape to use for labeling the controlled loads.
5. The dual, quad, and octal switches shall all include a single master button that will override all relays controlled by the individual buttons OFF, or Restore them to their original state. Each switch unit's master button function can be configured to perform a "Master On/Off", "OFF Only", or "Disabled" function if desired.
6. Dip switches on the back of the module shall allow switch units to be designated for "Cleaning Crew" Control. This prevents the switch from turning off the occupant's lights accidentally.
7. Each switch module is available in a Smart Keylock version. Once a key is inserted, the individual buttons will function for five minutes.

## 2.4 SOFTWIRED CLOCK

### A. Description

1. Using the same dataline as mentioned above, provide a softwired timeclock. From any plug-in point on the dataline, timeclock can be used to: (1) schedule any of the 8 channel groups (A-H) in the relay panel network and (2) program softwired dataline switches. Schedules are defined using "Occupied vs. Unoccupied" times to simplify data entry.
2. Timeclock shall include user-selectable intelligent scenarios to handle standard lighting control functions for each channel independently. Selectable scenarios shall include:
  - a. Scheduled ON / Scheduled OFF
  - b. Manual ON / Scheduled OFF
  - c. Astronomical ON / Astronomical OFF (with optional offset)
  - d. Astronomical ON / Scheduled OFF (with optional offset)
3. Each channel can be assigned a standard time delay from 1-256 minutes. During "Occupied" hours, the time delays do not take effect. During "Unoccupied" hours, the time delays will ensure that overridden lights are automatically turned off.
4. Each channel can be assigned an automatic "blinking" of the lights before they are turned off to allow occupants the opportunity to enter an override without being put in the dark. The time interval between the blink warn and "off" operation shall be user configurable between 1 and 15 minutes.

### B. Features

1. The timeclock will provide a clear 9-line, 22-character per line display and a simple user interface. A single button can be used to bring up a context sensitive help screen to assist the user.
2. Timeclock to take into account leap year, daylight savings dates, holidays, and be certified as "Year 2000 Approved".

## 2.5 (OPTIONAL) SOFTWARE

- A. Manufacturer shall provide Windows®-based configuration "plug-ins" for system commissioning, programming, monitoring and control. Software shall be capable of functioning with any available LNS network tool.

- B. Once the system parameters have been programmed, system shall allow any user-definable feature (schedules, relay groups, switch assignments) to be field modified without the need for configuration software or systems integration expertise.

## 2.6 (OPTIONAL) BAS INTEGRATION

- A. In addition to hardwired channel inputs, system shall provide for integration to building automation system components including, but not limited to, photocell controllers, HVAC controllers, security, access and fire safety systems without the use of dry contact, gateways or protocol converters. This integration shall be accomplished via network binding of LonMark variables for LNS compliant devices.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Install lighting control equipment in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

### 3.2 INSTALLATION

- A. Softwired Switches and/or photocells shall be mounted in the spaces as indicated on the Reflected Ceiling Plans. Each low voltage wire shall be labeled clearly indicating which relay panel it connects to. Use only properly color coded, stranded #18 AWG (or larger) wire as indicated on the drawings. All relays and switches shall be tested after installation to confirm proper operation and the loads recorded on the directory card in each panel.
- B. The relay panels shall be mounted in electrical closets as indicated on the drawings. The numbered relays in the panel shall be wired to control the power to each load as indicated on the Panel Wiring Schedules included in the drawings. All power wiring will be identified with the circuit breaker number controlling the load. If multiple circuit breaker panels are feeding into a relay panel, wires shall clearly indicate the originating panel's designation.

### 3.3 (OPTION) SYSTEM STARTUP

- A. Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of all system components.

### 3.4 (OPTION) TRAINING

- A. Manufacturer shall provide factory authorized application engineer to train owner personnel in the operation and programming of the lighting control system.

### 3.5 (OPTION) DOCUMENTATION

- A. Manufacturer shall provide system documentation including:
  - 1. System 1-line showing all panels, number and type of switches, dataline, and network timeclock.

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2. Drawings for each panel showing hardware configuration and numbering.
3. Panel wiring schedules
4. Typical wiring diagrams for each component.

3.6 (OPTION) EXTENDED WARRANTY

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- A. Manufacturer shall provide a (specify) \_\_\_ year extended warranty in addition to a required one year warranty for all system components.

END OF SECTION 260560



SECTION 260610 - EMERGENCY ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to emergency electrical systems.

1.2 DESCRIPTION OF WORK:

- A. Types of emergency system components specified in this section include the following:
  - 1. Emergency Diesel Generator Sets
  - 2. Automatic Transfer Switches
  - 3. Exhaust and Fuel Systems
  - 4. Weather Protective Enclosure
  - 5. Remote Annunciator Panel

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.
- B. REQUIREMENTS OF REGULATORY AGENCIES:
  - 1. The electric generating system consists of a prime mover, generator, governor, coupling and all controls which must have been tested as a complete unit on a representative engineering model as required by NFPA 110-1985. The tests, being potentially damaging to the equipment tested, must not be performed on the equipment to be sold, but on a separate prototype model.
  - 2. Conform to N.E.C. and applicable inspection authorities.
  - 3. Transfer switches to be labeled under UL 1008.
- C. SHOP DRAWINGS: Submit dimensioned shop drawings of all emergency electrical system components and accessories including but not necessarily limited to emergency generator, protective enclosure, fuel tank, automatic transfer switch, battery charger, all instruments and accessories, and fuel piping requirements. Show accurately scaled layouts of system components. Submittals shall include complete system interconnection wiring diagrams and manufacturer's warranty form indicating compliance with these specifications.
- D. OWNER'S MANUALS: Four (4) sets of owner's manuals specific to the product supplied must accompany delivery of the equipment. General operating instruction, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Engine Generator Sets: This engine generator sets and equipment from one of the following:
1. Caterpillar
  2. Onan
  3. Kohler
  4. Smith Detroit Diesel
- B. Automatic Transfer Switches: Provide automatic transfer switches and accessories from one of the following manufacturers:
1. ASCO
  2. Onan
  3. Russelectric
  4. Zenith
  5. Kohler

2.2 GENERAL:

- A. Provide emergency electrical system components and specified herein and as shown on the drawings. Provide systems and components capable of start and load transfer within 10 seconds of power outages.
- B. Please note that the generator is to deliver the specified KW rating as indicated on the drawings. Increase rating of generator as required for altitude and temperature ratings as follows:
1. Altitude: 5500 Feet Above Sea Level
  2. Maximum Ambient Temperature: 50 Degrees C.
  3. Minimum Ambient Temperature: 0 Degrees C.

2.3 ENGINE-GENERATOR SET:

- A. Engine: Provide 60 hertz alternating-current standby diesel engine driven generator units of voltage, phase, and capacities indicated. Base rating of electric sets upon operation after deducting power required for output for all necessary operating accessories including radiator fans, fuel pumps, etc. and under environmental conditions specified. Provide electric sets rated and capable of producing KW specified at 0.8 power factor. Certify performance of the electric set series by means of independent testing laboratory tests for full power rating stability, and voltage and frequency regulation. Provide stationary, water-cooled, full diesel, compression ignition, four stroke cycle, multi-cylinder or single cylinder, in-line or V-type engine. Arrange engine for direct connection to an alternator current generator; do not exceed engine speed of 1800 RPM at full rated load.
- B. Alternator: Provide direct connected, engine driven, single bearing, synchronous type alternator with electrical characteristics indicated.
1. Instantaneous Voltage Dip: Limit voltage dip of engine generator set to less than 30 percent upon application of full rated power. Accomplish voltage regulation by means

of a solid state voltage regulator. Inherently regulated machines are acceptable in sizes under 6 KW.

- a. Stability: 1 percent of its mean value at any constant load from no load to full load for solid state regulators.
  - b. Regulation: Plus or minus 2 percent maximum so load to full load for solid state regulators.
2. Where more than 40 percent of the load is comprised of rectifiers and/or thyristors, provide power to voltage regulator by means of ceramic type permanent magnet pilot excitor, capable or 80 percent automatic controlled SCR/Thyristor loading.
- C. Lubrication System: Equip engine with a pressure lubricated system. Provide spin-on type full flow lubricating oil filter. Equip filters with bypass valve to insure oil circulation if filters are clogged. Include dipstick oil level indicator.
- D. Air Cleaner: Provide reusable element air cleaner of size and type recommended by the engine manufacturer.
- E. Starting: Equip engine with a 12 volt electric starting motor of sufficient capacity to crank the engine at a speed which will allow full diesel starting of the engine. Disengage starter automatically when engine starts.
- F. Batteries: Provide rack-mounted, heavy duty, lead acid battery set of adequate voltage and amperage capacity to start and operate the engine. Provide sufficient capacity for cranking the engine for at least 30 seconds at firing speed with capacity for starting the diesel engine a minimum of four times. Provide capacity and voltage recommended by engine manufacturer. Provide all intercell and connecting battery cables as required.
- G. Battery Charger: Provide an automatic dual rate battery charger manufactured by the engine-generator set supplier. The automatic equalizer system shall monitor and limit the charge current to 10 amps. The output voltage is to be determined by the charge current rate. The charger must have a maximum open circuit voltage of 35 volts and be protected against a reverse polarity connection. The battery charger is to be factory installed on the generator set. Due to line voltage drop concerns, a battery charger mounted in the transfer switch will be unacceptable.
- H. Water Jacket Heater: Equip engine with thermostatically controlled water jacket heater. The heater voltage shall be 120 volt single phase for smaller units or 480 volt single-phase for larger units in KW rating as recommended by the manufacturer. Make all connections to water jacket heaters.
- I. Engine Instruments: Provide a unit mounted console with the following gauges:
1. Run-stop-remote switch
  2. Remote starting, 12-volt, 2 wire
  3. Coolant temperature gauge
  4. Field circuit breaker
  5. DC voltmeter
  6. Running time meter
  7. Lamp test switch
  8. Engine preheat switch
  9. Oil pressure gauge

10. Fault reset switch
11. Cycle cranking
12. Time delay start/stop
13. 7-Light engine monitor with individual 1/2 amp relay signals and a common alarm contact for each of the following conditions:
  - a. Run
  - b. Pre-warning for low oil pressure
  - c. Pre-warning for high coolant temp
  - d. Low oil pressure shutdown
  - e. High coolant temperature shutdown
  - f. Overcrank shutdown
  - g. Overspeed shutdown

**\*\* OPTION \*\***

14. AC Voltmeter (dual range)
  15. AC Ammeter (dual range)
  16. Voltmeter/ammeter phase selector switch with an off position
  17. Frequency meter
  18. AC Rheostat (panel mounted) for plus or minus 5% voltage adjust
- J. Exhaust System: An exhaust silencer shall be provided of the size as recommended by the manufacturer and shall be of critical grade. Wrap the entire exhaust system, from manifold to roof or wall penetration with exhaust insulation. The silencer(s) shall be mounted on the weather protective enclosure with the use of a flexible, seamless, stainless steel exhaust connection and rain cap. All components must be properly sized to assure operation without excessive back pressure when installed.
- K. Engine Protection Devices: Provide the following engine protection devices with indicating light annunciation for each device:
1. Low-Oil pressure cut-out
  2. High air temperature cut-out
  3. Overspeed Cut-out
- L. Mounting: Equip electric set with a suitable base for mounting on a level surface.
- M. Isolators: Provide spring isolators between the electric set and base. Spring isolators between the engine and the base are acceptable if in accordance with manufacturer's recommendations.
- N. Fuel: Provide engine capable of satisfactory performance on commercial grade diesel fuel as recommended by the manufacturer.
- O. Governor: Equip engine with an electronic governor to maintain frequency within the limits as required to properly serve computer and electronic equipment.
- P. Fuel System:
1. Equip engine with primary and secondary fuel filters with replaceable elements, and an engine driven fuel pump, all mounted on the engine. Provide fuel system piping of size and type recommended by the engine manufacturer.

2. The fuel system shall include a base-mounted fuel tank sized for 24 hours of run time at full load. It shall have the structural integrity to support the engine-generator set. Minimum features shall include all welded double-wall construction, a lockable fuel filler cap, fuel gauge, fuel line check valve and fittings for fuel supply, return, fill and vent. This tank must be supplied and warranted by the engine-generator set manufacturer and be factory installed. The tank shall be provided with a complete leak detection system and control panel.

- Q. Weather Protective Enclosure: The engine-generator set shall be factory enclosed in a heavy gauge steel enclosure constructed with corner posts, coated with electro statically applied zinc and finished with baked enamel paint. The enclosure is to have large, hinged doors to allow access to the engine, alternator and control panel. Each door is to be fitted with stainless steel, lockable hardware with identical keys. Padlocks do not meet this specification.
- R. Main Line Circuit Breaker: Provide a main line circuit breaker in rating as indicated on the drawings, but in no case greater than that recommended by the generator manufacturer. Provide a breaker with AIC rating as required to safely interrupt and clear the maximum available fault current of the alternator to meet all NEC requirements.

#### 2.4 AUTOMATIC TRANSFER SWITCHES

- A. General: Automatic transfer switches shall be furnished by the manufacturer of the engine-generator set so as to maintain system compatibility and local service responsibility for the complete emergency power system. It shall be listed by Underwriter's Laboratory, Standard 1008 with circuit breaker protection. Representative production samples of the transfer switch supplied shall have demonstrated through tests the ability to withstand at least 10,000 mechanical operation cycles. One operation cycle is the electrically operated transfer from normal to emergency and back to normal. Wiring must comply with NEC table 373-6(b).
- B. Ratings & Performance: Refer to electrical drawings for switch rating requirements. When transfer switch is fed from an upstream overcurrent protection device having ground fault protection, provide a four pole unit with switched neutral.
- C. Construction:
1. The transfer switch shall be double throw construction, positively electrically and mechanically interlocked to prevent simultaneous closing and mechanically held in both normal and emergency positions. Independent break before make action shall be used to positively prevent dangerous source to source connections. When switching the neutral, this action prevents the objectionable ground currents and nuisance ground fault tripping that can result from overlapping designs. The transfer switch shall be approved for manual operation. The electrical operating means shall be by electric solenoid. Every portion of the contactor is to be positively mechanically connected. No clutch or friction drive mechanism is allowed, and parts are to be kept to a minimum. This transfer switch shall not contain integral overcurrent devices in the main power circuit, including molded case circuit breakers or fuses.
  2. The transfer switch electrical actuator shall have an independent disconnect means to disable the electrical operation during manual switching. Maximum electrical transfer time in either direction shall be 160 milliseconds, exclusive of time delays. Main switch contacts shall be high pressure silver alloy contacts to resist burning and pitting for long life operation.
  3. There shall be one SPDT, 10 ampere, 250 volt auxiliary switch on both normal and

emergency sides, operated by the transfer switch. Full rated neutral bar with lugs for normal, emergency and load conductors shall be provided inside the cabinet.

D. Controls:

1. All control equipment shall be mounted on the inside of the cabinet door in a metal lockable enclosure with transparent safety shield to protect all solid state circuit boards. This will allow for ease of service access when main cabinet lockable door is open, but to prevent access by unauthorized personnel. Control boards shall have installed cover plates to avoid shock hazard while making control adjustments. The solid state voltage sensors and time delay modules shall be plug-in circuit boards with silver or gold contacts for ease of service.
2. A solid state undervoltage sensor shall monitor all phases of the normal source and provide adjustable ranges for field adjustments for specific applications needs. Pick-up and drop-out settings shall be adjustable from a minimum of 70% to a maximum of 95% of nominal voltage. A utility sensing interface shall be used, stepping down line voltage to 24VAC, helping to protecting the printed circuit board from voltage spikes and increasing personnel safety when troubleshooting.
3. Signal the engine-generator set to start in the event of a power interruption. A set of contacts shall close to start the engine and open for engine shutdown. A solid state time delay start (adjustable, .1 to 10 seconds) shall delay this signal to avoid nuisance start-ups on momentary voltage dips or power outages.
4. Transfer the load to the engine-generator set after it reached proper voltage (adjustable, 70% to 90%) and frequency (adjustable, 80% to 90%). A solid state time delay (adjustable, 5 seconds to 3 minutes) shall delay this transfer to allow the engine-generator to warm-up before application of load. There shall be a switch to bypass this warm-up timer when immediate transfer is required.
5. Retransfer the load to the line after normal power restoration. A return to utility timer (adjustable, 1 to 30 minutes) shall delay this transfer to avoid short term normal power restoration.
6. The operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred. Controls shall provide an automatic retransfer of the load from emergency to normal if the emergency source fails with the normal source available.
7. Signal the engine-generator to stop after the load retransfers to normal. A solid state engine cool down timer (adjustable, 1 to 30 minutes) shall permit the engine to run unloaded to cool down before shutdown.
8. Provide an engine minimum run timer (adjustable, 5 to 30 minutes) to ensure an adequate engine run period.
9. Provide a solid state plant exercise clock to set the day and time of generator set exercise period. Actual time of day and exercise time shall be displayed. The clock shall have a one week cycle and be powered by the load side of the transfer switch. A battery must be supplied to maintain the circuit board energized when the load side of the transfer switch is de-energized. Include a switch to select if the load will transfer to the engine-generator set during the exercise period.
10. The transfer switch shall have a time delay neutral feature to provide a time delay (adjustable, .1 to 10 seconds) during the transfer in either direction, during which time the load is isolated from both power sources. This allows residual voltage components of motors or other inductive loads (such as transformers) to decay before completing the switching cycle. A switch will be provided to bypass this feature when immediate transfer is required.
11. Front mounted controls shall include a selector switch to provide for a NORMAL TEST

mode with full use of time delays, FAST TEST mode which bypasses all time delays to allow for testing the entire system in less than one minute, or AUTOMATIC mode to set the system for normal operation.

12. Provide bright lamps to indicate the transfer switch position in either UTILITY (white) or EMERGENCY (red). A third lamp is needed to indicate STANDBY OPERATING (amber). These lights must be energized from utility or the engine-generator set.
13. Provide manual operating handle to allow for manual transfer. This handle must be mounted inside the lockable enclosure so accessible only by authorized personnel.
14. Provide a safety disconnect switch to prevent load transfer and automatic engine start while performing maintenance. This switch will also be used for manual transfer switch operation.
15. Provide LED status lights to give a visual readout of the operating sequence. This shall include utility on, engine warm-up, engine warm-up bypass, standby voltage "ready", standby frequency "ready", standby on, transfer to standby, return to utility, engine cool down, engine minimum run and fast test mode.

## 2.5 REMOTE ANNUNCIATOR PANEL:

A. General: Provide remote annunciator panel with the following features:

1. Provide visual indication of 20 separate alarm conditions. The panels shall monitor and be labeled as follows:
  - a. GENSET RUNNING (Green)
  - b. HIGH TEMP (Amber)
  - c. LOW OIL PRESS (Amber)
  - d. LOW TEMP (Amber)
  - e. LOW FUEL (Amber)
  - f. HIGH TEMP (Red)
  - g. LOW OIL PRESS (Red)
  - h. OVERCRANK (Red)
  - i. OVERSPEED (Red)
  - j. NOT IN AUTO (Red-flashing)
  - k. BLANK (Red)
  - l. BLANK (Red)
2. Switchable lenses and alarm horn function.
3. Removable legend plates for engraving alarm or status labels.
4. Alarm silence button on annunciator resets circuit for any subsequent fault condition whether or not initial fault has been cleared.
5. Designed for operation at 24 VDC, with negative ground signals.
6. Stainless steel front panel for flush or surface mounting. Refer to drawings for mounting requirements.
7. Knockouts for conduit connections.
8. Replaceable 25,000 hour high intensity lamps for easy readability, high reliability, and low power consumption.
9. Lamp Test/Alarm silence switch.

## PART 3 - EXECUTION

### 3.1 GENERAL:

- A. Install emergency electrical systems in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

### 3.2 MOUNTING:

#### A. Generator Sets:

1. Housekeeping Pads: Unless noted otherwise, provide 6" high steel reinforced concrete pad for generator sets. Adjust height of pad and steel reinforce in accordance with all manufacturer's recommendations - verify prior to installation. Refer to "Concrete Bases" under Section 26001 - Electrical General Provisions.

#### B. Transfer Switches:

1. Anchor switches firmly to walls and structural surfaces.
2. Housekeeping Pads: Provide housekeeping pads in accordance with "Concrete Bases" under Section 260010 - Electrical General Provisions.

### 3.3 FACTORY TESTING:

- A. Before shipment of the equipment, the engine-generator set shall be tested under rated load and power factor for performance and proper functioning of control and interfacing circuits. Tests shall include:

1. Verifying all safety shutdowns are functioning properly.
2. Single step load pick-up per NFPA 110-1985, Paragraph 5-13.2.6.
3. Transient and voltage dip responses and steady state voltage and speed (frequency) checks.

### 3.4 SERVICE:

- A. Supplier of the electric set and associated items shall have permanent service facilities in this trade area. These facilities shall comprise a permanent force of factory trained service personnel on 24 hour call, experienced in servicing this type of equipment, providing warranty and routine maintenance service to afford the owner maximum protection. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. Service contracts shall also be available.

### 3.5 WARRANTY:

- A. The standby electric generating system components, complete engine-generator, instrumentation panel, and automatic transfer switch shall be warranted by the manufacturer against defective materials and factory workmanship for a period of one year. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge for travel and labor. The warranty period shall commence when the standby power system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the financial strength and technical expertise with all components supplied to provide adequate warranty support.

3.6 CHECKOUT & STARTUP:

- A. The supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to checkout the completed installation and to perform an initial startup inspection to include:

1. Ensuring the engine starts (both hot and cold) within the specified time.
2. Verification of engine parameters within specification.
3. Set no load frequency and voltage.
4. Test all automatic shutdowns of the engine-generator.

3.7 LOAD BANK TEST:

- A. Conduct a load bank test to the rated KW of the generator for a minimum of four hours.

3.8 MISCELLANEOUS:

- A. Provide engine lubricating oil, fuel, engine coolant, filters, etc. for system testing. After testing, refill all fluids to capacity for final acceptance.
- B. Provide line voltage wiring for battery chargers, heaters, and leak detection system.
- C. Provide low voltage control and monitoring wiring for all transfer switches and remote annunciators as may be specified.

END OF SECTION 260610



SECTION 260611 - UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SUMMARY:

- A. These specifications describe requirements for an Uninterruptible Power Supply System (UPS). The UPS shall automatically maintain AC power within specified tolerances to the critical load, without interruption, during failure or deterioration of the normal or emergency power source.
- B. The manufacturer shall design and furnish all materials and equipment to be fully compatible with electrical, environmental, and space conditions at the site. It shall include all equipment to properly interface the AC power source to the intended load and be designed for unattended operation.

1.2 STANDARDS:

- A. The UPS and all associated equipment shall be manufactured in accordance with the following applicable standards:
  - 1. CSA 22.2, No. 107.1
  - 2. IEEE 587, Category B (ANSI C62.41)
  - 3. National Electrical Code (NFPA 70)
  - 4. NEMA PE-1
  - 5. OSHA
  - 6. UL Standard 1778
- B. The UPS shall be ETL listed per UL Standard 1778 Uninterruptible Power Supplies, and shall be CSA certified.
- C. The Quality System for the engineering and manufacturing facility shall be certificated to conform to Quality System Standard ISO 9001 for the design and manufacture of power protection systems for computers and other sensitive electronics.

1.3 SYSTEM DESCRIPTION:

- A. Design Requirements:
  - 1. The UPS shall be sized for the KVA and KW output ratings as indicated on the drawings.
  - 2. Load voltage and bypass line voltage will be 480 VAC, three phase 3-wire. Input voltage will be 480 VAC, three-phase, 3-wire.
  - 3. The battery shall be rated to support full load for a minimum of 10 minutes at 25E C.
- B. Modes of Operation:
  - 1. The UPS shall operate as an on-line reverse transfer system in the following modes:
    - a. Normal: The critical AC load is continuously powered by the UPS inverter. The rectifier/charger derives power from the utility or emergency generator AC source and supplies DC power to the inverter, while simultaneously float charging the battery.

- b. Emergency: Upon failure of utility AC power, the critical AC load is powered by the inverter which, without any switching, obtains its power from the battery plant. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.
- c. Recharge: Upon restoration of the utility AC source, the rectifier/charger powers the inverter and simultaneously recharges the battery. This shall be an automatic function and shall cause no interruption to the critical AC load. The unit shall have the capability to recharge only on utility power rather than on generator power.
- d. Bypass: If the UPS must be taken out of service for maintenance or repair, the static transfer switch shall transfer the load to the bypass source. The transfer process shall cause no interruption in power to the critical AC load.
- e. Off-Battery: If the battery is only taken out of service for maintenance, it is disconnected from the rectifier/charger and inverter by means of (an) external disconnect breaker(s). The UPS shall continue to function and meet all of the specified steady-state performance criteria, except for the power outage back-up time capability.

C. Performance Requirements:

1. The maximum working voltage, current, and di/dt of all solid-state power components and electronic devices shall not exceed 75% of the ratings established by their manufacturer. The operating temperature of solid-state component sub-assemblies shall not be greater than 75% of their ratings. Electrolytic capacitors shall be computer grade and be operated at no more than 95% of their voltage rating at the maximum rectifier charging voltage.
  - a. Input:
    - 1) Voltage Range: +10%, -15% of nominal (no battery discharge at -20%).
    - 2) Frequency Range: +/- 5%.
    - 3) Inrush Current Limiting: 20% to 100% of full rated load over 15 seconds.
    - 4) Sub-cycle Magnetizing Inrush: Not to exceed 5-8 times normal full load input current with input filter.
    - 5) Power Factor: Minimum 0.92 lagging at full load and 0.97 at half load.
    - 6) 2-Step Input Current Limit: Maximum of 125% normal full load input current. (Factory set at 115% for normal operation, 100% for generator operation)
    - 7) 2-Step Battery Charge Current Limit:
      - a) Step 1 - Factory set at 10% (adjustable 1-25%).
      - b) Step 2 - Factory set at 1% (adjustable 1-25%).
    - 8) Current Distortion: Total reflected input current distortion shall be Less than 7% THD at full load and less than 10% THD at half load.
    - 9) Surge Protection: Sustains input surges without damage per criteria listed in ANSI C62.41-1980.
  - b. AC Output
    - 1) Load Rating: 104% continuous load rating at 40 degrees C for any combination of linear and non-linear loads.
    - 2) Voltage Regulation: +/- 0.5% for balanced load, +/- 2% for 50% unbalanced load.
    - 3) Voltage Adjustment Range: +/- 5% manually.
    - 4) Automatic Line Drop Compensation: Adjustable 0 to +5% of nominal voltage.
    - 5) Frequency Regulation: 0.1%.
    - 6) Efficiency: Defined as output kW/input kW at a load power factor of 0.8 lagging.

- 7) Not less than 94% for 480/480 VAC.
  - 8) Phase Imbalance:
    - a) Balanced loads 120 deg +/- 1 deg
    - b) 50% unbalanced loads 120 deg +/- 3 deg.
  - 9) Unbalanced Voltage Regulation:
    - a) Balanced Load, +/- 1% from the arithmetic average of the 3 phases.
    - b) 20% Unbalanced Load, +/- 1% from the arithmetic average of the 3 phases.
    - c) 50% Unbalanced Load, +/- 2% from the arithmetic average of the 3 phases.
  - 10) Voltage Transients:
    - a) 20% Load Step +/-4%
    - b) 50% Load Step +/-5%
    - c) 100% Load Step +/-7%
    - d) Loss of/return to AC input power +/-1%
    - e) Transfer to/from Bypass +/-4%
  - 11) Voltage Transient Recovery Time:
    - a) To within 1% of output voltage within 50 milliseconds.
  - 12) Harmonic Content:
    - a) Maximum 4% RMS total (non-linear load). Maximum 2% any single harmonic (linear load).
    - b) Maximum 5% RMS total for up to 100% non-linear load.
  - 13) Overload at full Output Voltage: 104% continuously. 125% of full load for 10 minutes. 150% of full load for a minimum of 30 seconds with +/-2% voltage regulation.
  - 14) Current Limit: 155% full load current.
  - 15) Fault Clearing: Sub-cycle current of at least 300% but not more than 500% of normal full load current (when bypass is not available).
- c. Grounding:
- 1) The AC output neutral shall be electrically isolated from the UPS chassis where applicable. The UPS chassis shall have an equipment ground terminal. Provisions for local bonding are provided.

#### 1.4 ENVIRONMENTAL CONDITIONS:

- A. The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:
1. Operating Ambient Temperature
    - a. UPS 32 degrees F to 104 degrees F (0 degrees C to 40 degrees C) without de-rating. (Consult factory for performance de-rating over 40 degrees C.
    - b. Battery 77 degrees F (25 degrees C), +/- 5 degrees F.
  2. Storage/Transport Ambient Temperature
    - a. -4 degrees F to 158 degrees F (-20 degrees C to 70 degrees C).
  3. Relative Humidity
    - a. 0 to 95%, non-condensing.
  4. Altitude
    - a. Operating - To 6000 ft. above Mean Sea Level.
    - b. Storage/Transport - To 40,000 ft. above Mean Sea Level.
  5. Audible Noise

- a. Noise generated under any normal condition shall not exceed 69 dBA measured 5 feet from the UPS.

## 1.5 SUBMITTALS:

### A. Proposal Submittals. Submittals with the proposal shall include:

1. System configuration with single-line diagrams.
2. Functional relationship of equipment including weights, dimensions, and heat dissipation.
3. Descriptions of equipment to be furnished, including deviations from these specifications.
4. Size and weight of shipping units to be handled by contractor.
5. Detailed layouts of customer power and control connections.

### B. 60 Day Submittals. Submittals 60 days prior to UPS delivery shall include:

1. Detailed installation drawings including all terminal locations.
2. Interconnect wiring diagrams showing conduit wiring with terminal numbers for each wire.

### C. UPS Delivery Submittals. Submittals upon UPS delivery shall include:

1. Eight (8) complete set of submittal drawings.
2. Four (4) sets of instruction manuals. Manuals shall include a functional description of the equipment, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

## 1.6 WARRANTY

### A. UPS Warranty

1. The UPS manufacturer shall warrant the unit against defects in workmanship and materials for 12 months after initial start-up or 18 months after ship date, whichever comes first.

### B. Battery

1. The battery manufacturer's standard warranty shall be passed through to the end user.

## 1.7 QUALITY ASSURANCE

### A. Manufacturer Qualifications

1. A minimum of five years' experience in the design, manufacture, and testing of solid-state UPS systems is required.

### B. Factory and Certification Testing

1. Before shipment, the manufacturer shall provide testing by an independent testing agency to verify that each UPS system complies in every respect with the specifications indicated herein. Testing as a minimum shall include reflected harmonic current

distortion, current inrush, and power factor on the input side and load rating, voltage regulation, frequency regulation, efficiency, voltage transient, harmonic content, and overload on the output side at 25%, 50%, 75%, and 100% loading conditions. A load bank shall be provided by the manufacturer for testing purposes. These tests shall include operational discharge and recharge tests to ensure guaranteed rated performance. Batteries shall also be tested in accordance with all manufacturers' written instructions. All certification testing shall be at the expense of the UPS manufacturer. A report with the required test data shall be submitted to the Electrical Engineer prior to shipment. UPS systems not meeting the specifications shall be rejected.

## PART 2 - PRODUCT

### 2.1 FABRICATION

#### A. Materials

1. All materials of the UPS shall be new, of current manufacture, high grade and shall not have been in prior service except as required during factory testing. All active electronic devices shall be solid-state. All power semi-conductors shall be hermetically sealed. Control logic and fuses shall be physically isolated from power train components to ensure operator safety and protection from heat. All electronic components shall be accessible from the front without removing sub-assemblies for service access.

#### B. Wiring

1. Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code, OSHA, and applicable local codes and standards. All bolted connections of bus bars, lugs, and cables shall be in accordance with requirements of the National Electric Code and other applicable standards. All electrical power connections shall be torqued to the required value and marked with a visual indicator.
2. Provisions shall be made in the cabinets to permit installation of input, output, and external control cabling, using raceway or conduit. Provision shall be made for either top or bottom access to input and output connection cabinets without requiring additional cabinetry. In conformance with NEC, connection cabinets shall provide for adequate wire bend radius. All copper bus bars shall be tin plated for connection integrity.

#### C. Construction and Mounting

1. The UPS shall be in NEMA Type 1 enclosures, designed for floor mounting. The UPS shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling. Maximum cabinet height shall be 79 inches.

#### D. Cooling

1. Adequate ventilation shall be provided to ensure that all components are operated well within temperature ratings. The fans shall be redundant so that a single fan failure will not cause temperatures to increase beyond acceptable limits.
2. Temperature sensors shall be provided to monitor UPS internal temperature. Upon

detection of temperatures in excess of manufacturer's recommendations, the sensors shall cause audible and visual alarms to be sounded on the UPS control panel. A separate room ambient temperature sensor shall be provided to give an alarm if the temperature of the inlet air to the UPS is above specified limits. Air filters shall be located at the point of air inlet and be changeable without opening cabinet doors. No service clearance or ventilation shall be required in the rear of the system.

## 2.2 EQUIPMENT

### A. UPS System

1. The UPS module shall consist of a rectifier/charger and three-phase inverter, static transfer switch with bypass switch, synchronizing equipment, protective devices, and accessories as specified. The specified system shall also include a battery disconnect breaker and battery system.

### B. System Protection

1. The UPS shall have built-in protection against: surges, sags, and over-current from the AC source, overvoltage and voltage surges from output terminals of paralleled sources, and load switching and circuit breaker operation in the distribution system.
2. The UPS shall be protected against sudden changes in output load and short circuits at the output terminals. The UPS shall have built-in protection against permanent damage to itself and the connected load for all predictable types of malfunctions. Fast-acting current limiting devices shall be used to protect against cascading failure of solid-state devices. Internal UPS malfunctions shall cause the module to trip off-line with minimum damage to the module and provide maximum information to maintenance personnel regarding the reason for tripping off line. The load shall be automatically transferred to the bypass line uninterrupted for an internal UPS malfunction. The status of protective devices shall be indicated on a graphic display screen on the front of the unit.

## 2.3 COMPONENTS

### A. Rectifier/Charger: The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert AC to regulated DC for input to the inverter and for charging the battery.

1. Input Current Total Harmonic Distortion: Input current THD shall be less than 7% THD at full load and less than 10% THD at half load.
2. AC Input Current Limiting: The rectifier/charger shall include a circuit to limit AC input current to an adjustable level of 100% to 125% of the full input current rating. A second circuit shall provide greater limiting (85% to 125%) when signaled by an external contact (i.e., operation of generator). AC input current limit is to be factory set at 115% for normal operation and 100% for generator operation.
3. Battery Charge Current Limiting: The rectifier/charger shall include a circuit to limit battery charging current to an adjustable level of 1% to 25% of maximum battery discharge current. A second circuit shall provide greater limiting when signaled by an external contact (i.e., operation of generator). Battery charge current limit is to be factory set at 10% for normal operation and 1% for generator operation.
4. Input Current Walk-In: The rectifier/charger shall provide a feature that limits the total initial power requirement at the input terminals to 20% of rated load, and gradually increases power to 100% of full rating over the 15-second time interval. This walk-in shall

- be graphically displayed on the front of the unit during start-up.
5. Input Circuit Breaker: The rectifier/charger shall have an input circuit breaker. The circuit breaker shall be of the frame size and trip rating to supply full rated load and recharge the battery at the same time and shall be rated 65,000 A.I.C.
  6. Minimum: The circuit breaker shall have an under-voltage release to open automatically when the control voltage is lost.
  7. Fuse Protection: Each AC phase shall be individually fused with fast-acting fuses so that loss of any semi-conductor shall not cause cascading failures. Fuses shall be bolted to bus bars at both ends to ensure mechanical and electrical integrity. The display panel on the front of the unit shall indicate a blown fuse occurring on any phase of the rectifier.
  8. DC Filter: The rectifier/charger shall have an output filter to minimize ripple current into the battery. The AC ripple voltage of the rectifier DC output shall not exceed 0.5% RMS of the float voltage. The AC ripple current in the battery during float operation shall not exceed 2% RMS of the inverter full load DC current. The filter shall be adequate to ensure that the DC output of the rectifier/charger will meet the input requirements of the inverter without the battery connected.
  9. Battery Recharge: In addition to supplying power for the load, the rectifier/charger shall be capable of producing battery charging current sufficient to replace 95% of the battery discharge power within ten (10) times the discharge time. After the battery is recharged, the rectifier/charger shall maintain the battery at full charge until the next emergency operation.
  10. Battery Equalize Charge: An automatic equalize charge timer feature shall be provided to automatically apply an equalize voltage to the battery after a 30 second or longer utility outage. The duration of equalize charge time shall be adjustable from 0-72 hours. Manual override shall be provided for the automatic equalize circuit.
  11. Overvoltage Protection: There shall be DC over-voltage protection so that if the DC voltage rises to the pre-set limit, the UPS shall shut down automatically and initiate an uninterrupted load transfer to bypass.
- B. Inverter: The term inverter shall denote the equipment and controls to convert DC from the rectifier/charger or battery to precise AC to power the load. The inverter shall be solid-state, capable of providing rated output power, and for increased performance the inverter shall be a pulse-width-modulated 6-step design and utilize insulated gate bipolar transistors (IGBTs).
1. Overload Capability: The inverter shall be able to sustain an overload across its output terminals up to 150% with +/- 2% output voltage regulation. The inverter shall be capable of at least 300% current for short circuit conditions. If the short circuit is sustained, the load shall be transferred to the bypass source and the inverter shall disconnect automatically from the critical load bus.
  2. Output Frequency: The inverter shall track the bypass continuously providing the bypass source maintains a frequency of 60 Hz +/- 0.5 Hz. The inverter will change its frequency at 0.1 Hz per second (adjustable 0.01 to 1.0 Hz per second) to maintain synchronous operation with the bypass. This shall allow make-before-break manual or automatic transfers. If the bypass fails to maintain proper frequency, the inverter shall revert to an internal oscillator which shall be temperature compensated and hold the inverter output frequency to 0.1% from the rated frequency for steady-state and transient conditions. Drift shall not exceed 0.1% during any 24 hour period. Total frequency deviation, including short time fluctuations and drift, shall not exceed 0.1% from the rated frequency.
  3. Phase-to-Phase Balance: System logic shall provide individual phase voltage compensation to obtain phase balance +/- 2% under all conditions including up to

- 50% load unbalance.
4. Fuse Protection: Each main power IGBT in the inverter shall be individually fused with a fast-acting fuse so that the loss of any semi-conductor shall not cause cascading failures. The display panel shall indicate a blown fuse occurring in any part of the inverter.
  5. Fault Sensing and Isolation: Fault sensing shall be provided to isolate a malfunctioning inverter from the critical load bus to prevent disturbance of the critical load voltage beyond the specified limits. An automatic output circuit breaker shall be provided to isolate a malfunctioning module from the critical load.
  6. Battery Protection: The inverter shall be provided with monitoring and control circuits to protect the battery system from damage due to excessive discharge. Inverter shutdown shall be initiated when the battery voltage has reached the end of discharge voltage. The battery end-of-discharge voltage shall be calculated and automatically adjusted for partial load conditions to allow extended operation without damaging the battery. Automatic shutdown based on discharge time is not acceptable.
- C. Inverter Bypass Operation: For times when maintenance is required or the inverter can not maintain voltage to the load due to sustained overload or malfunction, a bypass circuit shall be provided to isolate the inverter output from the load and provide a path for power directly from an alternate AC (bypass) source. The UPS control system shall constantly monitor the availability of the inverter bypass circuit to perform a transfer. The inverter bypass circuit shall consist of a static transfer switch, a circuit breaker to isolate the inverter, and a circuit breaker in parallel with the static transfer switch. The static transfer switch shall denote the solid-state device that can instantaneously connect the alternate AC source to the load. The inverter isolation breaker and system bypass breaker shall be motor-operated circuit breakers, self protecting in case of a fault in the distribution system. Series-rated devices shall not be used for this purpose. All breakers shall be rated 65,000 A.I.C.
1. Manual Load Transfers: A manual load transfer between the inverter output and the alternate AC source shall be initiated from the control panel. Manually initiated transfers shall be make-before-break utilizing the inverter isolation and bypass circuit breakers. The static switch shall not be required for manual transfers.
  2. Automatic Load Transfers: An automatic load transfer between the inverter output and the alternate AC source shall be initiated if an overload condition is sustained for a time period in excess of the inverter output capability or due to a malfunction that would affect the output voltage. Transfers caused by overloads shall initiate an automatic retransfer of the load back to the inverter only after the load has returned to a level within the rating of the inverter source. The UPS system logic shall allow 0 to 5 retransfers (adjustable) within any one-hour period to prevent cyclical transfers caused by overloads.
  3. Momentary Overloads: In the event of a load current inrush or branch load circuit fault in excess of the inverter rating, the static bypass switch shall connect the alternate AC source to the load for up to 40 milliseconds allowing up to 1000% of the normal rated output current to flow. Output voltage shall be sustained to the extent the alternate AC source capacity permits. If the overload condition is removed prior to the end of the 40 ms time period, the static bypass switch will turn off and the load shall remain on inverter power. If the overload remains, then a transfer to the alternate AC source is to be completed by closing the bypass circuit breaker.
  4. Protection and Backfeed Prevention: The critical output bus shall be protected from the flow of excess current through the static bypass switch path that may be caused by a low-impedance fault at the output of the UPS system. Each phase of the bypass circuit shall be protected by individual fuses and circuit breakers. Blown fuse monitors shall

indicate when a blown fuse will prevent the static bypass switch path from being available for automatic transfers.

- a. As required by UL1778 and CSA, the static bypass switch shall not backfeed UPS power to the bypass distribution system while the UPS is operating on battery during a bypass power outage. The purpose of this requirement is to prevent the risk of electrical shock on the distribution system when the normal source of power is disconnected or has failed. The static bypass switch shall be provided with redundant bypass power outage sensing circuits. The backfeed prevention system shall operate even if two component failures exist simultaneously. If a shorted SCR is detected, the static bypass switch shall be isolated and an alarm message shall be annunciated at the UPS control panel. The load shall remain on conditioned and protected power after detection of a shorted SCR and isolation of the static bypass switch.

#### D. Display and Controls

1. UPS Control Panel: The term UPS control panel denotes that portion of the UPS containing the display panel and control functions to provide complete monitoring and control through the use of menu-prompted commands. Membrane switches shall be used to select and execute operations from a Master Menu. The display and control panel shall be mounted on the SMS control section door. The display panel shall be 640 X 200 pixels, Liquid Crystal Display.
2. Logic: UPS system logic and control programming shall be resident in Application Specific Integrated Circuits. Rectifier, inverter, and system control logic shall be solid state. Switches, contacts, and relays shall only be used to signal the logic system as to the status of mechanical devices or to signal user control inputs. Relays shall be used to isolate the logic for customer external status and alarm signaling.
3. Metered Values: A microprocessor shall control the display and memory functions of the monitoring system. All three phases of three-phase parameters shall be displayed simultaneously. All voltage and current parameters shall be monitored using true RMS measurements for accurate (+/- 1%) representation of non-sinusoidal waveforms typical of computers and other sensitive loads. The following parameters shall be displayed:
  - a. Input voltage
  - b. Input current
  - c. Battery voltage
  - d. Battery charging/discharging current
  - e. Output voltage
  - f. Output frequency
  - g. Bypass input voltage
  - h. Bypass input frequency
  - i. Load current
  - j. Load kVA
  - k. Load kW
  - l. Total operating hours shall be available on a separate display screen
4. Power Flow Indications: A power flow diagram shall graphically depict whether the load is being supplied from the inverter, bypass, or battery and provide, on the same screen, the status of the following components:
  - a. AC input circuit breaker.
  - b. Battery circuit breaker.
  - c. Inverter output circuit breaker.
  - d. Bypass circuit breaker.
  - e. Static Transfer Switch (Connected, Disconnected).

- f. Time to overload transfer.
5. Battery Status Indicator: A battery status indicator shall display DC alarm conditions, shutdown voltages, the present battery voltage, and battery time remaining during discharge. A graphical representation of the battery voltage during the discharge shall be displayed. The graphical representation shall remain in the monitoring system memory until the next discharge occurs and shall be available for review of the battery performance.
6. Battery Cycle Monitor:
  - a. The UPS shall have a Battery Cycle Monitor (BCM) built into system firmware to document the cycle service of the battery. It shall collect and retain information on the last 132 events that involved discharging the UPS battery. Each battery discharge cycle is to be put into one of four categories, depending on the duration of the event:
    - 1) 0-30 Seconds Discharge
    - 2) 31-90 Seconds Discharge
    - 3) 91-240 Seconds Discharge
    - 4) Over 240 Seconds Discharge
  - b. The BCM shall collect and retain this information for each discharge cycle:
    - 1) System time and date
    - 2) Event Number
    - 3) Duration of cycle (seconds)
    - 4) Lowest DC Bus Voltage
    - 5) Highest DC Bus Current
    - 6) KW carried by the batteries at the start of cycle, and
    - 7) Battery Environment Ambient Temperature (with optional temperature sensor).
  - c. In addition, the BCM shall retain summary information on the total number of events, the cumulative ampere hours and the total discharge time since a given date.
  - d. The BCM shall be capable of storing information for up to 132 discharge cycle events in its data buffer. When the buffer approaches its capacity, a warning message shall be broadcast via terminal and modem communication channels and a complete listing of all records (in order of occurrence) shall be sent to the terminal port. Once the buffer is filled, new data will replace the old on a First In, First Out basis as new cycles occur.
  - e. The UPS operator shall be able to select either the BCM Summary screen or one of four screens showing detailed information on any one of the four categories of discharge (0-30 seconds, 31-90 seconds, 91-240 seconds and Over 240 seconds).
  - f. The Summary screen will ordinarily show Total Number of Discharge Cycles, Accumulated Battery Time, Accumulated Battery Amp Hours, Accumulated Battery Kilowatt Hours and the current temperature at the spot where the optional Battery Temperature Sensor has been positioned. During a battery discharge event, the screen shall change to show information about the current discharge cycle. The screen shall display Active Cycle Time in place of Accumulated Battery Time and substitutes Active Battery AH and Active Battery KWH for their accumulated counterparts.
  - g. The UPS shall allow this information to be collected remotely, through the communications board and modem, by a remote terminal or a personal computer equipped with a modem and communications program.
7. Alarms
  - a. The control panel shall report the system-level alarms listed below. An audible

alarm shall be activated when any of the alarms below occurs. All alarms shall be displayed in text form.

Input Fail	Output Over/Under Frequency
Control Power Fail	Output Under-voltage
DC Ground Fault	Output Over-voltage
DC Capacitor Fuse Blown	Overload
Battery CB Open	Overload Transfer
Battery Discharging	Overload Shutdown
Low Battery Warning	Reverse Power
Low Battery Shutdown	Rectifier Fuse Blown
DC Over-voltage Shutdown	Inverter Fuse Blown
Load-On Bypass	Hardware Shutdown
Auto Retransfer Primed	Emergency Off
Manual Reset/Retransfer	Ambient Over-temperature
Static Switch Unable	Fan Failed
Bypass Not Available	Equipment Over-temperature
Bypass Phase Sequence Wrong	Over-temperature Timeout

8. Controls
  - a. System-level control functions shall be:
    - 1) UPS/Bypass transfer pushbuttons
    - 2) AC Output Voltage Adjust +/- 5%
    - 3) Battery Circuit Breaker Trip pushbutton
    - 4) Emergency Module Off pushbutton with protective cover
    - 5) Horn Off pushbutton
    - 6) Control Enable pushbutton
    - 7) Display control pushbuttons: Up, Down, Select
    - 8) Alarm Reset pushbutton
9. Manual Procedures: Start-up, load transfers, and shutdown procedures shall be detailed on the display panel in text and graphic form.
  - a. Start-up:
    - 1) Step-by-step procedure screen including display of UPS voltage, bypass voltage, and phase synchronization.
    - 2) Walk-in display screen to simultaneously indicate DC volts, output volts, and input phase amps.
    - 3) Mimic screen to indicate power flow.
  - b. Load Transfers:
    - 1) Step-by-step procedure screen
    - 2) Mimic screen to indicate power flow
  - c. Shutdown:
    - 1) Step-by-step procedures screen
    - 2) Mimic screen to indicate power flow
10. Emergency Module Off
  - a. The UPS control panel shall have a local emergency module off pushbutton with protective cover. Pressing the emergency module off shall cause:
    - 1) Uninterrupted transfer of the load to bypass, and
    - 2) The input, output, and battery breakers to open, completely isolating the UPS (except bypass) from power.
  - b. Provisions shall be available for a remote emergency power off function, which completely removes power from the critical bus when activated.

E. Self-Diagnostics

1. Present Status Screen. The control system shall monitor and display all of the following parameters in a Present Status screen:
  - a. Input Voltage, Line-to-Line for all three phases.
  - b. Input Current for all three phases.
  - c. Output Voltage, Line-to-Line for all three phases.
  - d. Output Current for all three phases.
  - e. Output Frequency.
  - f. Battery Voltage.
  - g. Battery Amps.
  - h. Load kVA.
2. All three phases of the three-phase parameters shall be displayed simultaneously. All voltage and current parameters shall be monitored using true RMS measurements for accurate (+/- 1%) representation of non-sinusoidal waveforms typical of computers and other sensitive loads.

F. History Status File. A History Status file shall contain all of the information in the Present Status screens except Load kVA. The control system shall maintain this information in discreet 4 millisecond frames (1 millisecond resolution) updating memory on a First-In-First-Out basis. This shall provide status recall of a period of at least 256 milliseconds (64 frames); 160 milliseconds before the malfunction fault (40 frames), the fault frame, and 92 milliseconds after the malfunction (23 frames).

G. Event History File. The control system shall maintain an event history of the alarm conditions that have occurred during system operation. System memory shall be capable of storing at least 128 events for recall.

H. System Status File. The control system shall monitor and display the total operating hours of the UPS system.

I. Diagnostic Aids. The UPS shall be provided with the following built-in diagnostics for troubleshooting and circuit alignment aids:

1. Rectifier in control mode
2. UPS synchronizing with critical load bus
3. Positive DC bus ground fault
4. Negative DC bus ground fault
5. Bypass frequency higher than system output frequency
6. Bypass frequency lower than system output frequency
7. Automatic static transfer switch lockout
8. Command given to close inverter output circuit breaker
9. Command given to close bypass circuit breaker
10. Command given to open inverter output circuit breaker/bypass circuit breaker
11. Degree of overload
12. Undervoltage release for battery disconnect switch
13. Undervoltage release for input circuit breaker

J. Site Monitoring Capability. UPS control circuits shall be capable of interfacing with Liebert SiteScan central site monitoring systems. Interface (proprietary RS-422 format) shall be built into the UPS. The site monitoring signal-processing module shall be built into the system logic. The following shall be available for display:

1. Metering
  - a. Bypass volts (line-line, all phases)
  - b. Critical bus volts (line-line & line-neutral, all phases)
  - c. Critical bus current (all phases)
  - d. Critical bus frequency
  - e. Critical bus kVA
  - f. Critical bus kW
2. DC volts
  - a. Battery amps (+/-)
  - b. % Capacity
3. Digital Alarms
  - a. Fuse Cleared
  - b. Load On Bypass
  - c. Battery Discharging
  - d. Output Overload
  - e. Static Switch Disabled
  - f. Control Power Failure
  - g. Emergency Power Off
  - h. Battery Disconnected
  - i. Low Battery Reserve
  - j. Ambient Overtemperature
  - k. Module Cooling Failure

K. Remote Monitoring Capability:

1. The UPS control communication circuits shall also download operational data for analysis, upon request from a local or remote terminal in RS-232 format through a PC-compatible modem (RS-232 port shall be provided, but the modem is optional). The modem connection shall be provided with auto-dial capabilities. Information available for display shall include all alarms and systems parameters contained in the present status, event history, and history status files.
2. A Customer Alarm Interface terminal board shall be provided for the input and display of 8 external, customer-provided alarm points, each with a customer-selected name of up to 16 characters. The Customer may also assign the following actions individually to each alarm:
  - a. Latch horn on and display alarm until manually reset
  - b. Include this alarm in the summary alarm
  - c. Freeze the history status file
  - d. Annunciate horn while alarm is present
  - e. Initiate modem auto-dial
  - f. Delay action from this alarm for 0 to 9999 seconds.

L. Auto-Dial. The UPS shall include an RS-232 port capable of interfacing with a modem to report alarm and status information to a remote location. The modem control system shall have the capability to store two telephone numbers. In the event the system is unable to reach the first number, the second is attempted. This shall be accomplished automatically in the event of the occurrence of any of the following alarms:

- |                             |                   |
|-----------------------------|-------------------|
| 1. DC Capacitor Fuse Blown  | Overload Transfer |
| 2. Low Battery Shutdown     | Overload Shutdown |
| 3. DC Over-voltage Shutdown | Reverse Power     |

- |    |                          |                      |
|----|--------------------------|----------------------|
| 4. | Auto Transfer to Bypass  | Rectifier Fuse Blown |
| 5. | Output Under-voltage     | Inverter Fault       |
| 6. | Output Over-voltage      | Hardware Shutdown    |
| 7. | Over-temperature Timeout | Emergency Off        |

M. Simultaneous Communications

1. Site Monitoring, remote monitoring, and auto-dial communications described above shall be available simultaneously.

2.4 Battery Disconnect Breaker

- A. The UPS shall have a properly rated circuit breaker (500 VDC) to isolate it from the battery. This breaker shall be in a separate NEMA-1 enclosure or in a matching battery cabinet. When open, there shall be no battery voltage in the UPS enclosure. The UPS shall automatically be disconnected from the battery by opening the breaker when the battery reaches the minimum discharge voltage level or when signaled by other control functions. The UPS shall be provided with a pushbutton to trip the breaker from the control panel.

B. Battery Plant

1. Battery Power Pack
  - a. The battery power pack shall consist of sealed, valve-regulated batteries and a properly rated circuit breaker (500 VDC) for isolating the battery pack from the UPS. The battery cells and disconnect breaker shall be installed and housed in a NEMA-1 cabinet, matching the UPS style and design, that attaches to the UPS module to form an integral system.
  - b. The battery system shall be rated to support full load for a minimum of 10 minutes at 25E C. The battery system shall provide 100% initial capacity upon delivery.
  - c. The battery shall be lead-calcium, sealed, valve-regulated type with a one (1) year full warranty and a nine (9) year pro rata warranty under full float operation. The battery design shall utilize absorbent glass mat (AGM) technology to immobilize the electrolyte.

C. Required Accessories

1. Input Filter
  - a. The input filter shall reduce reflected input current distortion to less than 7% THD at full load at less than 10% at half load. The input filter shall also improve the input power factor to .92 at full load and to .97 at half load. The filter shall be installed inside the UPS module cabinet, not requiring any additional cabinet.
2. Maintenance Bypass Panelboard
  - a. Refer to the electrical drawings for a specification requirements.
3. Remote Alarm Panel
  - a. The remote alarm panel shall have LED alarm lights. An audible alarm shall sound upon any alarm condition. The flush-mounted NEMA 1 enclosed panel shall indicate:
    - 1) Load on UPS
    - 2) Load on Bypass
    - 3) Battery Discharging
    - 4) Low Battery Warning
    - 5) Overload

- 6) Ambient Overtemperature
- 7) System Summary Alarm
- 8) New Alarm Condition - (Fore a Second UPS Alarm Condition)

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## PART 3 - EXECUTION

### 3.1 FIELD QUALITY CONTROL

- A. The following inspections and test procedures shall be performed by factory-trained field service personnel at the project site during the UPS start-up.
  - 1. Visual Inspection
    - a. Inspect equipment for signs of damage.
    - b. Verify installation per drawings.
    - c. Inspect cabinets for foreign objects.
    - d. Verify neutral and ground conductors are properly sized and configured.
    - e. Inspect electrolyte level in cells (flooded cells only).
    - f. Inspect all cell cases.
    - g. Inspect each cell for proper polarity.
    - h. Verify all printed circuit boards are configured properly.
  - 2. Mechanical Inspection
    - a. Check all control wiring connections for tightness.
    - b. Check all power wiring connections for tightness.
    - c. Check all terminal screws, nuts, and/or spade lugs for tightness.
  - 3. Electrical Inspection
    - a. Check all fuses for continuity.
    - b. Confirm input and bypass voltage and phase rotation is correct.
    - c. Verify control transformer connections are correct for voltages being used.
    - d. Assure connection and voltage of the battery string(s).

### 3.2 UNIT START-UP

- A. Energize control power.
- B. Perform control/logic checks and adjust to meet specification.
- C. Verify DC float and equalize voltage levels.
- D. Verify DC voltage clamp and overvoltage shutdown levels.
- E. Verify battery discharge, low battery warning and low battery shutdown levels.
- F. Verify fuse monitor alarms and system shutdown.
- G. Verify inverter voltages and regulation circuits.
- H. Verify inverter/bypass sync circuits and set overlap time.
- I. Perform manual transfers and returns.

- J. Simulate utility outage.
- K. Verify proper recharge.

### 3.3 MANUFACTURER'S FIELD SERVICE

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#### A. Service Personnel

1. The UPS manufacturer shall directly employ a nationwide service organization, consisting of factory-trained field service personnel dedicated to the start-up and maintenance of UPS and power equipment.
2. The manufacturer shall provide a national dispatch center to coordinate field service personnel schedules. One toll-free number shall reach a qualified support person 24 hours/day, 7 days/week, 365 days/year. If emergency service is required, response time shall be 20 minutes or less.
3. Two local customer engineers shall be assigned to the site with a regional office as a backup. Daily automated reports shall be supplied to the regional office to document failed equipment. Automatic escalation procedures shall notify the national support manager if a site is not functioning within 24 hours.

#### B. Automated Site Monitoring

1. The UPS manufacturer shall provide as an option an automated site monitoring service. This service shall be staffed by a qualified support person 24 hours/day, 7 days/week, 365 days/year. At the detection of an alarm within the UPS, the controls shall initiate communications with the monitoring service. The monitoring service shall be capable of downloading all existing UPS system alarms to allow dispatch of a service engineer with repair parts.

#### C. Replacement Parts Stocking

1. Parts shall be available through an extensive network to ensure around-the-clock parts availability throughout the country.
2. Recommended spare parts shall be fully stocked by local field service personnel with back-up available from national parts center and the manufacturing location. The national parts center Customer Support Parts Coordinators shall be on-call 24 hours a day, 7 days a week, 365 days a year, for immediate parts availability. Parts from the national parts center shall be shipped within 4 hours on the next available flight out and delivered to the customer's site within 24 hours.

#### D. UPS Maintenance Training

1. Maintenance training courses for customer employees shall be available by the UPS manufacturer. This training is in addition to the basic operator training conducted as a part of the system start-up.
2. The training course shall cover UPS theory, location of subassemblies, safety, battery considerations and UPS operational procedures. The course shall include AC-to-DC conversion and DC-to-AC inversion techniques as well as control, metering, and feedback circuits to the Printed Circuit Board (PCB) level. Troubleshooting and fault isolation using alarm information and internal self-diagnostics shall be stressed.

#### E. Maintenance Contracts

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Life Sciences Research Center  
Logan, Utah

1. A complete offering of preventive and full-service maintenance contracts for both the UPS system and battery system shall be available.

#### 3.4 INSTALLATION

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- A. UPS system and equipment shall be installed in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements. A 4" high concrete pad shall be provided under the UPS system for housekeeping purposes.

END OF SECTION 260611



SECTION 260670 - LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Section 26001, "Electrical General Provisions," applies to work specified in this section.

1.2 SCOPE:

- A. The work covered by this section of the specifications consists of providing all design, materials, labor and items of service required for the completion of a functional lightning protection system as approved by the Engineer, and in strict accordance with this section of the specifications and the applicable contract drawings.
- B. If any departure from the contract drawings of submittal drawings covered below are deemed necessary by the Contractor, details of such departures and reasons therefore shall be submitted as soon as practicable to the Engineer for approval. No such departures shall be made without the prior written approval of the Engineer.
- C. The following specifications and standards of the latest issue form a part of this specification:
  - 1. Underwriters Laboratories UL96, 96A.
  - 2. National Fire Protection Code NFPA 780 (1995 edition).
  - 3. Lightning Protection Institute (LPI-175).

1.3 QUALITY ASSURANCE:

- A. The lightning protection system shall conform to the requirements of the UL and NFPA Standards for Lightning Protection Systems.
- B. The system to be provided under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest approved design. The equipment manufacturer shall also be UL listed and approved manufacturer and a fully certified manufacturer member in good standing of the Lightning Protection Institute. All materials specified for this work shall be supplied by VFC, Inc., 1409 S. 600 W. Unit a, Woods Cross, Utah 84087, Harger Lightning Protection, Inc., 1066 Campus Drive, Mundelein, IL 60060-3831, or approved LPI equal. For approval of LPI manufacturer other than specified, proposed material data and installation drawings must be submitted for review not less than 10 days prior to bid.

1.4 SUBMITTALS:

- A. Complete shop drawings showing the type, size, and locations for all equipment, grounds, and cable routing paths, etc., shall be submitted to the architect for approval prior to start of work.

- B. Samples and pertinent catalog data shall be submitted to the Engineer for approval.

PART 2 - PRODUCTS:

2.1 STANDARDS:

- A. All equipment used in this installation shall be factory inspected, approved and properly labeled in accordance with UL requirements.
- B. All equipment shall be new, the product of a single manufacturer as outlines above, and of a design and construction to suit the application where it is used in accordance with accepted industry standards and UL and NFPA Code requirements for Class I structures and as per manufacturer recommendations.

2.2 EQUIPMENT:

- A. All materials shall be copper or copper alloy and of the size, weight, and construction to suit the application where used in accordance with UL and NFPA Code requirements for Class II structures and as per manufacturer recommendations.
- B. Conductors shall be copper, of 28 strands 14-gauge minimum, VFC Cat. No. 28. Or as specified in contract drawings.
- C. Air terminals shall be solid, round copper bar of a minimum of 1/2" x 1 1/2", VFC Cat. No. 73, and shall project 10" minimum above the object to be protected. Locate and space according to UL and NFPA requirements, use aluminum points of the same size only when required for corrosion prevention.
- D. Air terminal bases shall be of cast bronze with bolt pressure cable connections and shall be securely mounted with stainless steel screws or bolts. Crimp type connectors are not acceptable. VFC Cat. No. 153, 150, 152, etc. as required.
- E. Ground rods shall be a minimum 3/4" in diameter and 10'-0" long. VFC Cat. No. #3410. They shall be connected to the system by exothermic weld.
- F. Cable fasteners shall be substantial in construction, electrolytically compatible with conductors and mounting surface and shall be spaced according to LPI and NFPA Code requirements. VFC Cat. No. 251, 262. When using adhesive supports, adhesive must be compatible with roof material, and shall be approved by roofing manufacturer prior to installation.
- G. Bonding devices, cable splicers and miscellaneous connectors shall be by exothermic weld or of cast bronze with bolt pressure connections to cable. Cast or stamped crimp fittings are not acceptable. Splicers similar to Cat. No. 204, 208, etc., bonding devices similar to VFC Cat. No. 216, 213, 234, 235 etc.
- H. Equipment on stacks and chimneys shall be protected from corrosion and sized in accordance with UL and NFPA requirements.
- I. All miscellaneous bolts, nuts and screws shall be brass, bronze, or stainless steel.

### PART 3 - INSTALLATION

#### 3.1 INSTALLATION:

- A. The installation shall be accomplished by an experienced installer who is a Certified Master installer of the LPI or working under the direct supervision of an LPI manufacturer as listed above or his authorized LPI Certified Master Installer representative.
- B. All equipment shall be installed in a neat workmanlike manner in the most inconspicuous manner possible. The system shall consist of a complete cable network on the roof involving all air terminals, splices, and bonds with cable downleads routed concealed either directly in the building construction or in conduit to ground.
- C. Downlead cables shall be brought down concealed within exterior walls of the structure.
- D. Copper equipment shall not be connected to aluminum surfaces except by means of an UL approved bimetal transition fitting.
- E. All structures over 60' tall shall have ground level potential equalization in the form of a counterpoise, or ground loop. This conductor shall completely encircle the structure connecting all Downleads at 24" below finish grade.

#### 3.2 COORDINATION:

- A. The lightning protection installer will work with other trades to insure a correct, neat and unobtrusive installation.
- B. It is the responsibility of the lightning protection installer to assure a sound bond to the main water service and to assure interconnection with other building ground systems, including both telephone and electrical. Proper arresters shall be installed on the power and telephone service by either the utility or the electrical contractor as applicable.

#### 3.3 COMPLETION:

- A. The lightning protection installer shall secure and deliver the U.L. Master Label "C" to the Engineer for the owner upon completion of the installation.
- B. The Contractor shall also submit copies of record drawings.

END OF SECTION 260670



SECTION 270715 - VOICE AND DATA COMMUNICATION CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section

1.2 SUMMARY

- A. This Section includes the following items for wiring systems used as signal pathways for voice and high-speed data transmission:

1. Mounting elements.
2. Unshielded twisted-pair cabling.
3. Fiber-optic cabling.
4. Coaxial cable.
5. Multi-user telecommunications outlet assemblies.
6. Workstation outlets.
7. Backboards.
8. Identification products.

- B. Related Sections include the following:

1. Division 28 Section "Access Control" for data transmission meeting RS-232 and RS-485 cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. Backbone: A facility (e.g., pathway, cable, or conductors) between telecommunications rooms or floor distribution terminals, the entrance facilities, and the equipment rooms within or between buildings.
- B. BICSI: Building Industry Consulting Service International.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. Horizontal Cabling: Cabling between and including the telecommunications outlet/connector and the horizontal cross-connect. Also the cabling between and including the building automation system outlet or the first mechanical terminations on the horizontal connection point and the horizontal cross-connect.
- F. IDC: Insulation displacement connector.
- G. LAN: Local area network.

- H. RCDD: Registered Communications Distribution Designer.
  - I. RMC: Rigid metallic conduit.
  - J. UTP: Unshielded twisted pair.
- 

#### 1.4 SUBMITTALS

##### A. Shop Drawings:

1. Include dimensioned plan and elevation views of telecommunications equipment rooms, labeling each individual component. Show equipment rack assemblies, method of field assembly, workspace requirements, and access for cable connections.
2. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
3. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
4. Cabling Administration Drawings.
5. Wiring diagrams to show typical wiring schematics including the following:
  - a. Workstation outlets, jacks, and jack assemblies.
  - b. Patch cords.
  - c. Patch panels.
  - d. Fiber-optic boxes.
  - e. Distribution racks.
  - f. Terminal racks.

##### B. Samples: For workstation outlets, jacks, jack assemblies, **[in specified finish, one for each size and outlet configuration] [and faceplates for color selection and evaluation of technical features]**.

##### C. Manufacturer Seismic Qualification Certification: Submit certification that distribution racks, patch panels, and their components will withstand seismic forces defined in Division 26 Section "Electrical Supports and Seismic Restraints." Include the following:

1. Basis for Certification: Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based. Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."  
\*\*\*Or\*\*\*
  - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity of each rack-mounted component and of each assembled rack type, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- D. Qualification Data: For Installer.
- E. Source quality-control test reports.

F. Field quality-control test reports.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must have on staff personnel certified by BICSI.
  - 1. Layout Responsibility: Preparation of Shop Drawings Cabling Administration Drawings, and field testing program development by an RCDD.
  - 2. Installation Supervision: Installation shall be under the direct supervision of a Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
- B. Source Limitations: Obtain all products except cables through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70, "National Electrical Code."

#### 1.6 COORDINATION

- A. Coordinate layout and installation of voice and data communication cabling with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
  - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
  - 2. Record agreements reached in meetings and distribute to other participants.
  - 3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Outlet Assemblies: One for each type for every 25 outlets shown on plans, but no less than one.
  - 2. Patch-Panel Units: One of each type.
  - 3. Connecting Blocks: One of each type.
  - 4. Device Plates: One of each type.
  - 5. Multi-user Telecommunications Outlet Assemblies: One of each type.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 SYSTEM REQUIREMENTS

- A. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.
- B. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in cross-connect and patch panels, and terminal strips to accommodate 50 percent future increase in the number of workstations shown on Drawings. This expansion requirement does not apply to horizontal cable from workstation outlet to first terminal board.

### 2.3 MOUNTING ELEMENTS

- A. Backboards: 3/4-inch (19-mm), interior-grade, fire-retardant-treated plywood.
- B. Distribution Racks: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
1. Module Dimension: Width compatible with EIA 310 standard 19-inch (480-mm) panel mounting.
  2. Finish: Baked-polyester powder coat.
- C. Power Strips: For mounting in the rack, with 20-V ac, NEMA WD 6, Configuration 15-15R receptacles, number as indicated, but in no case fewer than 6, and including the following:
1. LED indicator lights for power and protection status.
  2. LED indicator lights for reverse polarity and open outlet ground.
  3. Circuit breaker and thermal fusing. When protection is lost, circuit opens and cannot be reset.
  4. Circuit breaker and thermal fusing. Unit continues to supply power if protection is lost.
  5. Close-coupled, direct plug-in.
  6. Rocker-type on-off switch, illuminated when in on position.
  7. Peak Single-Impulse Surge Current Rating: [33] [26] [13] kA per phase.
  8. Protection modes shall be line-to-neutral, line-to-ground, and neutral-to-ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.
  9. One RJ11/12C telephone line protector, suitable for modem connection. Maximum clamping voltage 220 peak on pins No. 3 and No. 4.
- D. Wall-Mounting Rack: Aluminum, hinged wall bracket with provisions for power strip mounting.

- E. Floor-Mounting Rack: Steel, freestanding, modular, with vertical and horizontal cable management channels, top and bottom cable troughs, and grounding lug.
- F. Cabinets: Steel, freestanding, modular, with removable and lockable side panels, front and rear doors, ventilation openings in rear door and top panel, and the following components:
  - 1. Provisions for a roof-mounted ventilation fan.
  - 2. 250-cfm (118-L/s) roof-mounted ventilation fan.
  - 3. Key all locks alike.

#### 2.4 UNSHIELDED TWISTED-PAIR CABLING

##### A. Cable Manufacturers:

- 1. Avaya Inc.
- 2. Belden Inc.; Electronics Division.
- 3. CommScope Properties, LLC.
- 4. General Cable Technologies Corporation.
- 5. Helix/HiTemp Cables, Inc.
- 6. KRONE Incorporated.
- 7. Mohawk/CDT; a division of Cable Design Technologies.
- 8. Nordex/CDT, a Subsidiary of Cable Design Technologies.
- 9. Remeo Products Corp.
- 10. Superior Essex; Superior Telecommunications Inc.
- 11. West Penn Wire/CDT; a division of Cable Design Technologies.

##### B. Terminal and Connector Component and Distribution Rack Manufacturers:

- 1. AMP; a Tyco International Ltd. Company.
- 2. Amphenol Corporation.
- 3. Avaya Inc.
- 4. Connect-Tech Products.
- 5. Cooper Wiring Devices; a division of Cooper Industries, Inc.
- 6. Homaco.
- 7. Hubbell Premise Wiring.
- 8. KRONE Incorporated.
- 9. Leviton Voice & Data Division.
- 10. Lucent Technologies; Global Service Provider.
- 11. Mohawk/CDT; a division of Cable Design Technologies.
- 12. Molex Premise Networks; a division of Molex, Incorporated.
- 13. Nordex/CDT; a Subsidiary of Cable Design Technologies.
- 14. Panduit Corp.
- 15. Thomas & Betts Corporation.

##### C. 100-Ohm UTP: Comply with UL 444.

##### D. Backbone Copper Cable:

- 1. No. 24 AWG, [25] <Insert number> pair.
- 2. Comply with ICEA S-80-576 and TIA/EIA-568-B.2, [Category 5e] [Category 6] [Categories 5e and 6].

3. NFPA 70, type CMR complying with UL 1666.
4. Cable Jacket Color: Gray.

E. Horizontal Copper Cable:

1. No. 24 AWG, 100 ohm, four pair.
2. Comply with TIA/EIA-568-B.2, [Category 5e] [Category 6] [Categories 5e and 6].
3. NFPA 70, types CMG and CMP.
4. Cable Jacket Color: Blue.

F. Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, using modules designed for punch-down caps or tools.

1. IDC Terminal Block Modules: Integral with connector bodies, including plugs and jacks where indicated.
2. IDC Connecting Hardware: Consistent throughout Project.

G. Cross-Connect Panel: Modular array of IDC terminal blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: [One] <Insert number> for each conductor in assigned cables plus [25] <Insert number> percent spare.

H. Patch Panel: Comply with TIA/EIA-568-B.2, meeting or exceeding cable performance. Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair [UTP cable indicated] [conductor group of indicated cables, plus spares and blank positions adequate to satisfy specified expansion criteria].

I. Jacks and Jack Assemblies: Modular, color-coded, RJ-45 receptacle units with integral IDC-type terminals. Use keyed jacks for data service.

J. Patch Cords: Factory-made, four-pair cables in 48-inch (1200-mm) lengths; terminated with RJ-45 plug at each end. Use keyed plugs for data service.

## 2.5 FIBER-OPTIC CABLING

A. Cable, Terminal, and Connector Product Manufacturers:

1. Avaya Inc.
2. Berk-Tek; an Alcatel Company.
3. Chromatic Technologies; a Draka USA Company.
4. CommScope Properties, LLC.
5. Corning Cable Systems.
6. General Cable Technologies Corporation.
7. Mohawk/CDT; a division of Cable Design Technologies.
8. Molex Premise Networks; a division of Molex, Incorporated.
9. Nordex/CDT; a Subsidiary of Cable Design Technologies.
10. Optical Cable Corporation.
11. Panduit Corp.

12. Prestolite Wire Corp.
13. Superior Essex; Superior Telecommunications Inc.

B. Fiber-Optic Cable: 62.5/125-micrometer, multimode optical fiber.

C. Backbone Fiber Cable: [24] <insert number> fibers.

1. Comply with TIA/EIA-492AAAA, tight buffer.
2. NFPA 70, Type OFN complying with UL 1666.
3. Maximum Attenuation: [3.50] <insert number> dB/km at 850 nm; [1.25] <Insert number> dB/km at 1300 nm.
4. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
5. Cable Jacket Color: Orange.

D. Horizontal Fiber Cable: [Two] [Four] <insert number> fibers.

1. Comply with TIA/EIA-492AAAA, tight buffer.
2. NFPA 70, Types OFN and OFNP.
3. Maximum Attenuation: [3.50] <Insert number> dB/km at 850 nm; [1.0] <Insert number> dB/km at 1300 nm.
4. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
5. Cable Jacket Color: Orange.

E. Cross-Connect and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to satisfy specified expansion criteria.

F. Patch Cords: Factory-made, dual fiber cables in 36-inch (915-mm) lengths.

G. Cable Connecting Hardware:

1. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex- and duplex-Type [SC] [ST] <insert type> couplers. Insertion loss not more than 0.7 dB.
3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

## 2.6 COAXIAL CABLE

A. Manufacturers:

1. Alpha Wire Company.
2. B & L Coaxial Connections Ltd.
3. Belden Inc.; Electronics Division.
4. Coleman Cable.
5. CommScope Properties, LLC.
6. Helix/HiTemp Cables, Inc.
7. JSC Wire & Cable.
8. West Penn Wire/CDT; a division of Cable Design Technologies.

- B. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz, and shall be listed to comply with NFPA 70, Articles 810 and 820.
- C. RG-11/U: No. 14 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid. Jacketed with sunlight-resistant black PVC or PE. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C; NFPA 70, Type CATV.
- D. RG59/U: No. 20 AWG, solid, silver-plated, copper-covered steel conductor; gas-injected, foam-PE insulation. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip. Color-coded PVC jacket. NFPA 70, Type CATVR.
- E. RG-6/U: No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid. Jacketed with black PVC or PE. Suitable for indoor installations; NFPA 70, Type CATV or CM.
- F. RG59/U: No. 20 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid. PVC jacket. NFPA 70, Type CATV.
- G. RG59/U (Plenum Rated): No. 20 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid. Copolymer jacket. NFPA 70, Type CMP.
- H. Coaxial-Cable Connectors: Type BNC, 75 ohms. Of three-piece construction, consisting of a crimp-type center fit, sleeve, and main body.

## 2.7 MULTI-USER TELECOMMUNICATIONS OUTLET ASSEMBLY

- A. Manufacturers:
  - 1. ADC.
  - 2. American Access Technologies, Inc.
  - 3. Avaya Inc.
  - 4. Molex Premise Networks; a division of Molex, Incorporated.
  - 5. Nordex/CDT; a Subsidiary of Cable Design Technologies.
  - 6. Ortronics, Inc.
  - 7. <Insert manufacturer's name.>
- B. Modular unit suitable for terminating single or multiple horizontal cables in one central location, providing an intermediary point between telecommunications closet and workstation.
  - 1. NRTL listed as complying with UL 50 and UL 1863.
    - a. Unit shall be labeled to include maximum length of work-area cords.
    - b. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.
  - 2. Number of Terminals per Field: One for each conductor in assigned cables.
  - 3. Number of Connectors per Field:

- a. One for each four-pair UTP cable indicated.
  - b. One for each four-pair conductor group of indicated cables, plus [25] <Insert number> percent spare positions.
4. Mounting: [**Recessed in ceiling**] [**Wall**] [**Desk**] [**Furniture**].

## 2.8 WORKSTATION OUTLETS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, modular, RJ-45. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Dual jack-connector assemblies mounted in single or multigang faceplate.
1. Faceplate: High-impact plastic; color as selected by Architect.  
  
\*\* ALTERNATE: School Districts \*\*
    1. Faceplate: Stainless Steel
    2. Mounting: Flush, unless otherwise indicated.
    3. Legend: Factory-labeled, top jack "Voice" and bottom jack "Data," by silk-screening or engraving.
    4. Legend: Machine-printed, adhesive tape label identifying the circuit.
- C. Flush dual fiber-optic connector assemblies mounted in 2-gang faceplate with flush dual RJ-45 jack assembly.
1. Faceplate: High-impact plastic; color as selected by Architect.  
  
\*\* ALTERNATE: School Districts \*\*
    1. Faceplate: Stainless Steel
    2. Mounting: Flush, unless otherwise indicated.
    3. Legend: Factory-labeled, fiber-optic connectors "Data" and RJ-45 jacks "Voice," by engraving.
    4. Legend: Machine-printed, adhesive tape label identifying the circuit.

## 2.9 BACKBOARDS

- A. A-C, void-free plywood, 84 inches (2130 mm) high and 3/4-inch (19 mm) thick, fire rated.

## 2.10 GROUNDING AND BONDING

- A. Materials: Comply with NFPA 70, TIA/EIA-607, and UL 467.

## 2.11 IDENTIFICATION PRODUCTS

- A. Manufacturers:
1. Brady Worldwide, Inc.
  2. HellermannTyton.
  3. Kroy LLC.
  4. Panduit Corp.

5. <Insert manufacturer's name.>

- B. Comply with TIA/EIA-606-A and with applicable requirements in Division 26 Section "Electrical Identification."
- C. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.
- D. Computer-based cable management system, with integrated database[ **and graphic**] capabilities.
  - 1. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.
  - 2. Information shall be presented in database view, schematic plans, or technical drawings.
    - a. AutoCAD drawing software shall be used as drawing and schematic plans software.
  - 3. System shall interface with the following testing and recording devices:
    - a. Direct upload tests from circuit testing instrument into the PC.
    - b. Direct download circuit labeling into labeling printer.

2.12 SOURCE QUALITY CONTROL

- A. Coaxial Cable: Each cable spool sweep tested at the factory before shipping at frequencies from 5 MHz to 1 GHz. Sweep test shall test frequency response or attenuation over frequency of a cable by generating a voltage whose frequency is varied through specified frequency range and graphing the results.
- B. Fiber-Optic Cable: Each cable spool tested at factory before shipping at 850 and 1300 nm. Test and inspect <Insert equipment> according to <Insert standard designation>.
- C. UTP Cable Verification of Performance: Test every cable package or reel at factory to verify that cable complies with TIA/EIA-568-B.2 requirements.

PART 3 - EXECUTION

3.1 INSTALLATION STANDARDS

- A. Comply with BICSI TCI, TIA/EIA-568-B.1, TIA/EIA-568-B.2, TIA/EIA-568-B.3, and TIA/EIA-569-A.

3.2 EXAMINATION

- A. Examine pathway elements intended for cables.
  - 1. Verify proposed routes of pathways. Check raceways, cable trays, and other elements for compliance with space allocations, clearances, installation tolerances, hazards to cable installation, and other conditions affecting installation. Verify that cabling can be installed complying with EMI clearance requirements.
  - 2. Prepare wall penetrations and verify that penetrations of rated fire walls are made using products labeled for type of wall penetrated.

3. Identify plan to support cables and raceways in suspended ceilings. Verify weight of individual types and sizes of cables. Verify that load capacity of cable support structures is adequate for each pathway.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

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### 3.3 APPLICATION OF MEDIA

- A. Backbone Cable for Data Service: Use **[UTP Category 5e] [UTP Category 6] [fiber-optic]** cable for runs between equipment rooms and wiring closets and for runs between wiring closets.
- B. Backbone Cable for Voice Service: Use **[UTP Category 5e] <Insert other cable type>** cable for runs between equipment rooms and wiring closets and for runs between wiring closets.
- C. Horizontal Cable for Data Service: Use **[UTP Category 5e] [UTP Category 6] [fiber-optic]** cable for runs between wiring closets and workstation outlets.
- D. Horizontal Cable for Voice Service: Use UTP Category **[5e] <Insert category>** cable for runs between wiring closets and workstation outlets.

### 3.4 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Install cables in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces. Cable trays are specified in Division 26 Section "Raceway Systems." Raceways and boxes are specified in Division 26 Sections "Conduit Raceways" and "Electrical Boxes and Fittings."

**\*\* ALTERNATE \*\***

- C. Wiring Method: Install cables in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces. Cable trays are specified in Division 26 Section "Raceway Systems." Raceways and boxes are specified in Division 26 Sections "Conduit Raceways" and "Electrical Boxes and Fittings."
- D. Cable Installation:
  1. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
  2. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.
  3. Pulling Cable: Do not exceed manufacturer's written recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  4. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
  5. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and

- terminals.
6. Install UTP cables using techniques, practices, and methods that are consistent with Category **[5e]** **[6]** rating of components and that ensure Category **[5e]** **[6]** performance of completed and linked signal paths, end to end.
    - a. Do not untwist more than 1/2 inch (12 mm) of Categories 5e and 6 cables at connector terminations.
  7. Outdoor Coaxial Cable:
    - a. Outdoor connections shall be installed in enclosures complying with NEMA 250, Type 4X. Connectors shall be corrosion resistant with properly designed O-rings to keep out moisture.
    - b. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).
- E. Wiring within Wiring Closets and Enclosures:
1. Install plywood backboards on walls of equipment rooms and wiring closets from floor to ceiling.
  2. Mount patch panels, terminal strips, and other connecting hardware on **[backboards]** **[wall-mounted racks]** **[floor-mounted racks]** **[cabinets]** **<Insert other mounting option>**.
  3. Group connecting hardware for cables into separate logical fields.
  4. Train conductors to terminal points with no excess.
  5. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
- F. Separation from EMI Sources: Comply with BICSI TDM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment. Comply with the following minimum separation distances from possible sources of EMI:
1. Separation between unshielded power lines or electrical equipment in proximity to open cables or cables in nonmetallic raceways is as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: 5 inches (127 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: 12 inches (300 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: 24 inches (610 mm).
  2. Separation between unshielded power lines or electrical equipment in proximity to cables in grounded metallic raceways is as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: 2-1/2 inches (64 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: 6 inches (150 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: 12 inches (300 mm).
  3. Separation between power lines and electrical equipment located in grounded metallic conduits or enclosures in proximity to cables in grounded metallic raceways is as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    - b. Electrical Equipment Rating between 2 and 5 kVA: 3 inches (76 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: 6 inches (150 mm).
  4. Electrical Motors and Transformers, 5 kVA or HP and Larger: 48 inches (1200 mm).
  5. Fluorescent Fixtures: 5 inches (127 mm).
- G. Conduit:
1. Comply with TIA/EIA-569-A for maximum length of conduit and bends between pull points, and for pull-box sizing.

2. Use manufactured conduit sweeps and long-radius ells whenever possible.
3. In telecommunications rooms, position conduit ends adjacent to a corner on backboard (in case of a single piece of plywood) or in the corner of room (where multiple sheets of plywood are installed around perimeter walls of room). Use cable trays to route cables if conduits cannot be located in these positions. Secure conduits to backboard when entering room from overhead. Extend conduits 1 to 3 inches (25 to 76 mm) in finished floor.

- H. Backboards: Install plywood with 84-inch (2130-mm) dimension from floor up toward ceiling. Butt adjacent sheets tightly, and form smooth gap-free corners.

### 3.5 GROUNDING

- A. Comply with Division 26 Section "Grounding" and with TIA/EIA 607.

B. Grounding Points:

1. Locate grounding terminals in each equipment room, wiring closet, rack, and cabinet.
2. Telecommunications Grounding Busbars: Mount on wall of telecommunications entrance facility, equipment room, and closet, with standoff insulators.

C. Bonding Conductors:

1. Extend from telecommunications entrance facility to electrical entrance facility and connect to grounding electrode.
2. Where a panelboard for telecommunications is located in same room or space as a grounding busbar, bond to equipment ground bus of electrical panelboard.
3. Extend from telecommunications entrance facility to grounding busbars.
4. Extend from grounding busbars to ground terminals in equipment racks and cabinets.
5. Extend from grounding busbars to building metal frame within room, or to metal frame external to room but readily accessible.

D. Special Requirements:

1. Bonding conductors shall be insulated copper, No. 6 AWG minimum.
2. Install only in nonmetallic conduit, unless specifically required for protection of conductor. Metallic conduit, if used, shall be RMC. For RMC that exceeds 36 inches (915 mm) in length, conductors shall be bonded at each end of conduit.
3. Bonding conductors shall be installed without splices unless approved by Architect because of special circumstances. Where splices are necessary, they shall be accessible and shall be located in telecommunications spaces. Splices shall be by irreversible compression connectors or by exothermic welding.

### 3.6 IDENTIFICATION

- A. In addition to requirements in this Article, comply with TIA/EIA-606-A and with applicable requirements in Division 26 Section "Electrical Identification."

1. Administration class for this Project shall be Class [1] [2] [3] [4]:
2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

- B. Using cable and asset management software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable, jacks, connectors, and terminals to which it connects with same designation. Use logical and systematic designations for facility's architectural arrangement. At completion, cable and asset management software shall reflect as-built conditions.
- C. Use logical and systematic designations for facility's architectural arrangement and nomenclature, and a consistent color-coded identification of individual conductors.
- D. Cable and Wire Identification:
1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
  4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  5. Within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
  6. At Workstations: **[Label cables within outlet boxes] [Attach label to device plate].**
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cable administration-point labeling. Identify labeling convention and show labels for telecommunications closets, **[backbone pathways and cables,] [entrance pathways and cables,]** terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Perform the following field tests and inspections and prepare test reports:
1. Category 5e UTP Cabling Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2.

- Perform tests with a tester that complies with performance requirements in Annex I, complying with measurement accuracy specified in Annex H. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- b. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - c. Wire-map test that reports open circuits, short circuits, crossed pairs, reversed pairs, split pairs, and improper terminations.
  - d. Channel and permanent link tests for cable length, insertion loss, near-end crosstalk loss, power sum near-end crosstalk loss, equal-level far-end crosstalk loss, power sum equal-level far-end crosstalk, return loss, propagation delay, and delay skew. Performance shall comply with minimum criteria in TIA/EIA-568-B.2.
2. Category 6 UTP Cabling Tests:
- a. Tests shall include all tests of Category 5e, conducted from 1 to 250 MHz.
  - b. Channel and permanent link tests shall be performed with a tester that complies with performance requirements in TIA/EIA-568-B.2, Level III. Include tests for longitudinal or transverse conversion loss.
  - c. Performance shall comply with minimum criteria in TIA/EIA-568-B.2.
3. Fiber-Optic Cable Tests:
- a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  - b. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Link End-to-End Attenuation Tests:
- a. Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
  - b. Attenuation test results for horizontal links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
  - c. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
  - d. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
  - e. Retest and inspect cabling to determine compliance of replaced or additional work with specified requirements.

### 3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 270715



SECTION 270740 - TELEPHONE AND DATA SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 27 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to telephone and data systems.

1.2 DESCRIPTION OF WORK:

- A. Extent of telephone and data systems is indicated by drawings and schedules and is specified herein. Telephone and data systems includes the following:
  - 1. Telephone/data terminal backboards
  - 2. Telephone/data terminal cabinets
  - 3. Outlet Boxes and Raceways
  - 4. Grounding

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions as applicable.

1.4 SHOP DRAWINGS: Not required.

PART 2 – PRODUCTS

2.1 TELEPHONE/DATA TERMINAL BACKBOARDS:

- A. Provide 4"W x 8"H x 3/4"D, fire-treated or hypalon-coated plywood terminal backboard. Finish with insulating varnish.

2.2 TELEPHONE/DATA TERMINAL CABINETS:

- A. Provide terminal cabinets of code gauge steel, flush or surface, as shown, with concealed trim clamps, concealed hinges and flush locks. Paint in color as selected by architect.

2.3 OUTLET BOXES AND RACEWAYS:

- A. Provide outlet boxes and raceways in accordance with the following sections.
  - 1. Section 260110 - Conduit Raceways.
  - 2. Section 260135 - Electrical Boxes & Fittings
  - 3. Section 260072 – Electrical Support and Seismic Restraints

2.4 GROUNDING:

- A. Provide grounding conductors and accessories in accordance with the following sections:
1. Section 260120 - Conductors and Cables
  2. Section 260452 - Grounding.
- 

PART 3 - EXECUTION

3.1 GENERAL:

- A. Install telephone/data systems in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 RACEWAYS:

- A. Unless otherwise noted, extend 3/4" conduit from each telephone/data outlet to telephone terminal backboard, cabinet, or cable tray.
1. Unless noted otherwise, extend 3/4" conduit from each telephone/data outlet to accessible ceiling space.
- B. Minimum trade size is 3/4". Install a 200 lb. polypropylene pull cord in each empty conduit run.
- C. Where raceway systems only are specified, provide blank coverplates for all unused telephone and data outlets.

3.3 GROUNDING:

- A. Extend one #6 bare copper ground conductor from each telephone terminal board and/or cabinet to the service entrance ground bus. Coil 6' of conductor at each terminal backboard and/or cabinet.

END OF SECTION 270740

SECTION 270771 - SOUND SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 27 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to sound systems.

1.2 DESCRIPTION OF WORK:

- A. The contractor shall furnish all labor, equipment and materials necessary for the installation of sound system devices and equipment as indicated on the electrical drawings.

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions and other sections as applicable.
- B. GUARANTEE: All equipment and systems shall be guaranteed by the contractor for a period of one year following acceptance by the owner. The guarantee shall include all parts, labor, prompt field service, pickup, installation and delivery.
- C. MANUFACTURER: As indicated below.
- D. INSTALLER: The contractor for the sound system shall be regularly engaged in the installation and testing and maintenance of sound systems and shall be fully familiar with airport requirements.

1.4 SHOP DRAWINGS:

- A. Within thirty days after the contract award and prior to the purchase of any equipment, the sound system contractor shall submit for approval eight (8) copies of the following:
- B. A list of materials that are to be used on the project, including manufacturer, model number and technical information.

1.5 TEST AND REPORTS:

- A. The contractor shall perform all of the electrical and mechanical tests required by the equipment manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. The equipment supplier shall be able to refer to similar installations providing satisfactory service at the Salt Lake City International Airport.
- B. Part numbers and functions described herein are used to describe the levels of quality, features, and performance required by this specification.

2.2 SUPPLIERS / INSTALLERS:

- 1. Poll Sound
- 2. General Communication
- 3. Marshall Industries

2.3 SOUND SYSTEM EQUIPMENT (AIRPORT):

- A. TYPE A-L SPEAKER OUTLETS (LOW CEILINGS): Shall consist of the following equipment:

- 1. Loudspeakers: Atlas / Soundolier C10T47
- 2. Backbox: Lowell P68X
- 3. Baffle: Lowell JG-8X

- B. CABLES:

- 1. Speaker Cables: West Penn 25226
- 2. Microphone Cables: West Penn 25292

PART 3 - EXECUTION

3.1 GENERAL:

- A. Install sound systems in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 INSTALLATION METHODS:

- A. Adjust transformer taps of speakers as indicated on drawings.

3.3 RACEWAYS:

- A. All speaker and microphone cables shall be routed in either 3/4" conduits or cable trays as indicated on electrical drawings.

3.4 TESTING AND MAINTENANCE:

- A. Final test and inspection shall be held in the presence of the engineer, the architect, and the owner. The sound equipment supplier / installer shall conduct the tests. The contractor shall supply the personnel and equipment necessary to conduct the testing at no additional cost to the owner.

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Life Sciences Research Center  
Logan, Utah

END OF SECTION 270771

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SECTION 270781 - CCTV SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.
- B. This section is a Division 27 General Provisions section, and is part of each Division 26, 27, and 28 section making reference to CCTV systems.

1.2 DESCRIPTION OF WORK:

- A. The contractor shall furnish all labor, equipment and materials necessary for the installation of CCTV system devices and equipment as indicated on the electrical drawings.

1.3 QUALITY ASSURANCE:

- A. STANDARDS: Refer to Section 260010 - Electrical General Provisions and other sections as applicable.
- B. GUARANTEE: All equipment and systems shall be guaranteed by the contractor for a period of one year following acceptance by the owner. The guarantee shall include all parts, labor, prompt field service, pickup, installation and delivery.
- C. MANUFACTURER: As indicated below.
- D. INSTALLER: The contractor for the CCTV system shall be regularly engaged in the installation and testing and maintenance of CCTV systems.

1.4 SHOP DRAWINGS:

- A. Prior to the purchase of any equipment, the CCTV system contractor shall submit for approval eight (8) copies of the following:
  - 1. Catalog data of items that are to be used on the project, including manufacturer, model number and technical information.

1.5 TEST AND REPORTS:

- A. The contractor shall perform all of the electrical and mechanical tests required by the equipment manufacturer.

PART 2 – PRODUCTS

2.1 GENERAL:

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- A. Part numbers and functions described herein are used to describe the levels of quality, features, and performance required by this specification.

2.2 SUPPLIERS / INSTALLERS:

2.3 CCTV EQUIPMENT:

- A. CAMERAS: Sanyo VCC-3924 with Computar TG0412FCS with Pelco enclosure HS2000.
- B. LENSES: Computar TG0412FCS
- C. CAMERA HOUSING: Pelco enclosure HS2000
- D. MONITORS: JVC TM-9U 9" color monitor
- E. VIDEO CABLES: RG59 with 95% copper braid with foam dielectric & solid copper center conductor - West Penn 815 or equivalent. All cables routed in air plenums and not in conduit, shall be plenum-rated.
- F. POWER SUPPLY: 24V power supply as required - Edwards or equivalent.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Install CCTV systems in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 WIRING METHODS:

- A. All cables shall be routed in conduit, except in accessible ceiling spaces. Refer to other sections as applicable for raceway systems.

3.3 TESTING AND MAINTENANCE:

- A. Final test and inspection shall be held in the presence of the engineer, the architect, and the owner. The CCTV equipment supplier / installer shall conduct the tests. The contractor shall supply the personnel and equipment necessary to conduct the testing at no additional cost to the owner.

END OF SECTION 270781

SECTION 280721 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

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1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Nonsystem smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Firefighters' two-way telephone communication service.
8. Magnetic door holders.
9. Remote annunciator.
10. Addressable interface device.
11. Digital alarm communicator transmitter.
12. Radio alarm transmitter.
13. System printer.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

**\*\* OPTION 1 \*\***

- A. Noncoded, addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

**\*\* OPTION 2 \*\***

- B. Noncoded, addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

- C. System shall be UL-listed and factory mutual-approved.

## 1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

- 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

## 1.6 SUBMITTALS

- A. General Submittal Requirements:

- 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
- 2. Shop Drawings shall be prepared by persons with the following qualifications:
  - a. Trained and certified by manufacturer in fire-alarm system design.
  - b. NICET-certified fire-alarm technician, Level III minimum.
  - c. Licensed or certified by authorities having jurisdiction.

- B. Product Data: For each type of product indicated.

- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

- 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
- 2. Include voltage drop calculations for notification appliance circuits.
- 3. Include battery-size calculations.
- 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
- 5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
- 6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
- 7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

- D. Qualification Data: For qualified Installer.

- E. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
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- F. Field quality-control reports.
- G. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
  3. Record copy of site-specific software.
  4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
    - a. Frequency of testing of installed components.
    - b. Frequency of inspection of installed components.
    - c. Requirements and recommendations related to results of maintenance.
    - d. Manufacturer's user training manuals.
  5. Manufacturer's required maintenance related to system warranty requirements.
  6. Abbreviated operating instructions for mounting at fire-alarm control unit.
  7. Copy of NFPA 25.
- H. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
  2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  3. Device address list.
  4. Printout of software application and graphic screens.
- I. The disks containing fire alarm files shall be supplied to the owner. These disks shall include all information required to allow the owner to change the fire alarm program themselves. These computer disks shall contain a minimum of the following:
1. CAD drawing files of the building fire alarm map.
  2. CAD drawing files of as-build fire alarm component and point-to-point connections.
  3. General configuration programming.
  4. Job-specific configuration programming.
  5. Tutorial file on complete programming of the fire alarm system.
- J. The system contractor/supplier shall provide a "Certificate of Compliance" to the Authority Having Jurisdiction in accordance with NFPA Pamphlet 72B (1986 Edition), Section 2-2.6, at the

completion of operational acceptance tests, as required herein. This will be applicable to all types of fire alarm systems.

- K. A complete set of CAD "as-built" drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of equipment shall be delivered to the owner upon completion of the system installation.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project. Installation shall be by personnel certified by NICET as fire-alarm Level II technician
- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

#### 1.8 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
  - 1. Notify Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
  - 2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

#### 1.9 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

#### 1.10 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

- 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.11 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
- 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
- 3. Smoke Detectors, Fire Detectors[, **and Flame Detectors**]: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
- 4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
- 5. Keys and Tools: One extra set for access to locked and tamperproofed components.
- 6. Audible and Visual Notification Appliances: One of each type installed.
- 7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers / Installers: Subject to compliance with requirements, provide products by one of the following:

Manufacturer

Installer / Telephone

Notifier

Fire Protection Services Corp. / (801) 363-9696

- B. Manufacturers for non-system smoke detectors: Subject to compliance with requirements, provide products by one of the following:

- 1. Gentex Corporation.
- 2. System Sensor.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices[ **and systems**]:

1. Manual stations.
2. Heat detectors.
3. Flame detectors.
4. Smoke detectors.
5. Duct smoke detectors.
6. Verified automatic alarm operation of smoke detectors.
7. Automatic sprinkler system water flow.
8. Heat detectors in elevator shaft and pit.
9. Fire-extinguishing system operation.
10. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit[ **and remote annunciators**].
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
8. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.
9. Activate stairwell and elevator-shaft pressurization systems.
10. Close smoke dampers in air ducts of designated air-conditioning duct systems.
11. Recall elevators to primary or alternate recall floors.
12. Activate emergency lighting control.
13. Activate emergency shutoffs for gas and fuel supplies.
14. Record events in the system memory.
15. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
10. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit[ **and remote annunciators**]. Record the event on system printer.

### 2.3 FIRE-ALARM CONTROL UNIT

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#### A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
  - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
  - b. Include a real-time clock for time annotation of events on the event recorder and printer.
2. Addressable initiation devices that communicate device identity and status.
  - a. Smoke sensors shall additionally communicate sensitivity setting[ **and allow for adjustment of sensitivity at fire-alarm control unit**].
  - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
3. Addressable control circuits for operation of mechanical equipment.

#### B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two (2) lines of forty (40) characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands[ **and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters**].

#### C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
  - a. Initiating Device Circuits: Style D.
  - b. Notification Appliance Circuits: Style Z.
  - c. Signaling Line Circuits: Style 6.
  - d. Install no more than 100 addressable devices on each signaling line circuit.
2. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
  - a. Initiating Device Circuits: Style B.
  - b. Notification Appliance Circuits: Style Y.
  - c. Signaling Line Circuits: Style 4.

- d. Install no more than 100 addressable devices on each signaling line circuit.
3. Serial Interfaces: Two RS-232 ports for printers.
- D. Stairwell Pressurization: Provide an output signal using an addressable relay to start the stairwell pressurization system. Signal shall remain on until alarm conditions are cleared and fire-alarm system is reset. Signal shall not stop in response to alarm acknowledge or signal silence commands.
  1. Pressurization starts when any alarm is received at fire-alarm control unit.
  2. Alarm signals from smoke detectors at pressurization air supplies have a higher priority than other alarm signals that start the system.
- E. Smoke-Alarm Verification:
  1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
  2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
  3. Record events by the system printer.
  4. Sound general alarm if the alarm is verified.
  5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- F. Notification Appliance Circuit: Operation shall sound in Temporal Pattern 3.
- G. Elevator Recall:
  1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
    - a. Elevator lobby detectors except the lobby detector on the designated floor.
    - b. Smoke detector in elevator machine room.
    - c. Smoke detectors in elevator hoistway.
  2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
  3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
    - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- H. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.
- I. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

- J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- K. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet located in the fire command center or as a special module that is part of fire-alarm control unit.
  - 1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
    - a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
    - b. Programmable tone and message sequence selection.
    - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
    - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
  - 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
  - 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- L. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- M. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
  - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- N. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
  - 1. Batteries: Sealed, valve-regulated, recombinant lead acid.
  - 2. Capacity: Size for all finished and unfinished spaces within building plus twenty-five (25) percent ampere-hour capacity.
- O. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

## 2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
  2. Station Reset: Key-operated switch.
  3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
  4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

## 2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Detectors shall be two-wire type.

**\*\* OPTION 1 \*\***

2. Detectors shall have an Integral Addressable Module, arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit. Detectors shall also be base-mounted, with the detector and associated electronic components mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

**\*\* OPTION 2 \*\***

3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
  - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
  - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
  - c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

- a. Primary status.
- b. Device type.
- c. Present average value.
- d. Present sensitivity selected.
- e. Sensor range (normal, dirty, etc.).

3. This is the default detector type to be used on the product, unless specifically indicated otherwise.

C. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

- a. Primary status.
- b. Device type.
- c. Present average value.
- d. Present sensitivity selected.
- e. Sensor range (normal, dirty, etc.).

3. Use this type of detector only when specifically indicated on the drawings.

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

- a. Primary status.
- b. Device type.
- c. Present average value.
- d. Present sensitivity selected.
- e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

## 2.6 NONSYSTEM SMOKE DETECTORS

### A. Single-Station Smoke Detectors:

1. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac **with** 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device.
2. Auxiliary Relays: One Form A and one Form C, both rated at 0.5 A.
3. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet (3 m) according to UL 464.
4. Visible Notification Appliance: 177-cd strobe.
5. Heat sensor, 135 deg F (57 deg C) combination rate-of-rise and fixed temperature.
6. Test Switch: Push to test; simulates smoke at rated obscuration.
7. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
8. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
9. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
10. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

### B. Single-Station Duct Smoke Detectors:

1. Comply with UL 268A; operating at 120-V ac.
2. Sensor: LED or infrared light source with matching silicon-cell receiver.
  - a. Detector Sensitivity: Smoke obscuration between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) when tested according to UL 268A.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.
  - a. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.
6. Remote Multi-Signaling Accessory: Power-Trouble-Alarm indicator lights, on Test-Reset keyed switch, and strobe.

## 2.7 HEAT DETECTORS

- ### A. General Requirements for Heat Detectors: Comply with UL 521.

- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- D. Continuous Linear Heat-Detector System:
1. Detector Cable: Rated detection temperature [**155 deg F (68 deg C)**] **<Insert temperature>**. NRTL listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short-circuit wires at the location of elevated temperature.
  2. Control Unit: Two-zone or multizone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
  3. Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone shall be individually reported to central fire-alarm control unit as separately identified zones.
  4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

## 2.8 NOTIFICATION APPLIANCES

### **\*\* OPTION 1 \*\***

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.

### **\*\* OPTION 2 \*\***

- B. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

- D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
- E. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.
- F. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
  - 1. Rated Light Output:
    - a. 15/30/75/110 cd, as indicated in drawings, or
    - b. 15/30/75/110 cd, selectable in the field.
  - 2. Mounting: Wall mounted unless otherwise indicated.
  - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
  - 4. Flashing shall be in a temporal pattern, synchronized with other units.
  - 5. Strobe Leads: Factory connected to screw terminals.
  - 6. Mounting Faceplate: Factory finished, [red] [white].
- G. Voice/Tone Notification Appliances:
  - 1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
  - 2. High-Range Units: Rated 2 to 15 W.
  - 3. Low-Range Units: Rated 1 to 2 W.
  - 4. Mounting: semirecessed.
  - 5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

## 2.9 FIREFIGHTERS' TWO-WAY TELEPHONE COMMUNICATION SERVICE

- A. Dedicated, two-way, supervised, telephone voice communication links between fire-alarm control unit, the fire command center, and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:
  - 1. Selective-talk type for use by firefighters and fire wardens.
  - 2. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously.
  - 3. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is activated, it causes audible signal to sound and high-intensity lamp to flash.
  - 4. Selector panel controls shall provide for simultaneous operation of up to six telephones in selected zones. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.
  - 5. Display: [Graphic] [Liquid-crystal digital] to indicate location of caller.
  - 6. Remote Telephone Cabinet: Flush- or surface-mounted cabinet as indicated, factory-standard red finish, with handset.

- a. Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating "Fire Emergency Phone."
- b. With "break-glass" type door access lock.

7. Remote Telephone Jack Stations: Single-gang, stainless-steel-plate mounted plug, engraved "Fire Emergency Phone."
8. Handsets: Six (6) sets with noise-canceling microphone stored in a cabinet in the fire command center.

## 2.10 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
  1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
  2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
  3. Rating: 24-V ac or dc.
  4. Rating: 120-V ac.
- B. Material and Finish: Match door hardware.

## 2.11 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
  1. Mounting: Flush cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

## 2.12 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal **[to elevator controller to initiate elevator recall] [to circuit-breaker shunt trip for power shutdown]**.

## 2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
  - 1. Verification that both telephone lines are available.
  - 2. Programming device.
  - 3. LED display.
  - 4. Manual test report function and manual transmission clear indication.
  - 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
  - 1. Address of the alarm-initiating device.
  - 2. Zone of the supervisory signal.
  - 3. Zone of the trouble-initiating device.
  - 4. Loss of ac supply or loss of power.
  - 5. Low battery.
  - 6. Abnormal test signal.
  - 7. Communication bus failure.
- E. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

#### 2.14 SYSTEM PRINTER

- A. Printer shall be listed and labeled by an NRTL as an integral part of fire-alarm system.

#### 2.15 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
  - 1. Factory fabricated and furnished by manufacturer of device.
  - 2. Finish: Paint of color to match the protected device.

### PART 3 - EXECUTION

#### 3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.

- B. Power for the panel, battery charger, or any other device which affects the operation of the system shall be controlled through a single circuit breaker labeled, "Fire Alarm System – Do Not Turn Off." Connect to engine generator-supported emergency circuit where available.
- C. Equipment Mounting: Install wall-mounted fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
  - 1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
  - 2. Locate fire alarm control unit as directed by the authority having jurisdiction.
- D. Raceway: Install fire alarm conductors in raceway. Fire alarm system conductors from different zones may be combined in common conduit. Make certain that raceway and wire quantity, size, and type are suitable for equipment supplied and is within NEC standards. No wiring other than that directly associated with the fire alarm and detection systems shall be permitted inside the fire alarm conduits. All conduit, mounting boxes, junction boxes, panels, detectors, alarm devices, etc., shall be mounted and fastened with appropriate fittings to insure positive grounding throughout the system.
- E. Loop wires through each device in zone for proper supervision. Tee-taps are not permitted. Wiring splices are to be avoided to the maximum extent possible; if needed, they must be made only in junction boxes. Transposing or changing color-coding of the wires shall not be permitted.
- F. Provide dust protection for installed and existing (if any) smoke detectors until finish work is completed and building is ready for occupancy.
- G. Protect conductors from cuts, abrasion, and other damage during construction.
- H. Minimum conductor size shall be 14 AWG, unless otherwise specified. Shielded and/or stranded conductors shall be provided where recommended by the manufacturer.
- I. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
  - 1. Connect new equipment to existing control panel in existing part of the building.
  - 2. Connect new equipment to existing monitoring equipment at the supervising station.
  - 3. Expand, modify, and supplement existing control equipment as necessary to extend existing control functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- J. Smoke- or Heat-Detector Spacing:
  - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
  - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
  - 3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
  - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.

5. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
  6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.
- 
- K. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
  - L. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
  - M. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
  - N. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
  - O. Audible Alarm-Indicating Devices: Install at +80 inches (2032 mm) above finished floor, but not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
  - P. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn at +80 inches (2032 mm) above finished floor, but at least 6 inches (150 mm) below the ceiling.
  - Q. Device Location-Indicating Lights: Locate in public space near the device they monitor.
  - R. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
  - S. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.
  - T. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that will resist 100-mph (160-km/h) wind load with a gust factor of 1.3 without damage.
  - U. Do not install manual fire alarm boxes close to light switches.
  - V. Manual alarm initiating stations shall be provided at all required building exits, boiler rooms, kitchens, and main administrative offices, and elsewhere to provide a maximum 200' travel distance to a pull station from any point in the building.
  - W. Post copy of wire identification list inside fire alarm panel door and other area accessible to fire alarm service personnel.
  - X. The control and other panels shall be mounted with sufficient clearance for observation and testing.

- Y. All fire alarm junction boxes shall be identified with zone number and red paint for easy identification.
- Z. Mount remote multi-signaling accessory for non-system duct smoke detector in a readily accessible location and wire complete.

### 3.2 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
  - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
  - 3. Smoke dampers in air ducts of designated air-conditioning duct systems.
  - 4. Alarm-initiating connection to elevator recall system and components.
  - 5. Alarm-initiating connection to activate emergency lighting control.
  - 6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
  - 7. Supervisory connections at valve supervisory switches.
  - 8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
  - 9. Supervisory connections at elevator shunt trip breaker.
  - 10. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
  - 11. Supervisory connections at fire-pump engine control panel.

**\*\* University of Utah Alternate \*\***

- B. Interconnections with Central Fire Alarm Panel in Building 301:
  - 1. Provide all necessary provisions for automatic reporting of all alarms from the project fire alarm system to the remote station receiving console in Building 301 via telephone lines leased from the telephone company. The University Environmental Health & Safety Department will make the final connection to the leased telephone line on the Building 301 end. On the project end, the contractor will provide a conductor pair, run in conduit from the fire alarm panel to the telephone panel, and will make the final connection to the leased telephone line.
  - 2. When the project fire alarm system installation has progressed to the appropriate stage of completion, the contractor will make a written request to the University Campus Design & Construction Department to arrange for the leased telephone line. This request must be made a minimum of two weeks prior to final connection. (Campus Design & Construction will make a request to the University Telecommunications Department for the leased line and will pay the Telephone Company and University Public Safety Department connection fees. The University Public Safety Department will cover the ongoing lease costs. Campus Design & Construction will inform the University Fire Marshal of the final connection date.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.
- C. All fire detection devices shall be marked in nominal 1/2" high letters with the zone and device number (for example: a mark reading, "1-20," indicated Zone 1, Device Number 20).
- D. Building Fire Map:
  - 1. A building fire alarm map shall be supplied to the owner, indicating the exact location and address of all individual devices. Install the building map adjacent to the fire alarm panel. Provide a high-quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall have a clear center for viewing the CAD fire alarm drawing. The edges of the sign shall be colored to match the building interior. The building map shall indicate zoning by the use of five different colors, minimum.

### 3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

### 3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by Engineer and authorities having jurisdiction .
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions and Authority Having Jurisdiction. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions and Authority Having Jurisdiction.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions and Authority Having Jurisdiction.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 280721



## SECTION 311100

### SITE DEMOLITION

#### PART 1 – GENERAL

##### 1.01 SUMMARY

A. Section includes:

1. Demolition and removal of existing curb and gutter, sidewalk.
2. Demolition and removal of asphalt pavement.
3. Salvage

B. General provisions of the Contract, including General and Supplementary General Conditions and Division 1 apply to work of this Section.

C. Related Sections:

- Section 312100 - Earthwork
- Section 321218 – Pavement Repair

##### 1.02 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.

B. Remove and Salvage: Items indicated to be removed and salvaged remain to the Owner's property. Remove, clean, and pack or crate items to protect against damage.

C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in locations indicated.

D. Existing to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by the Architect, items may be removed to a suitable protected storage location during demolition and then cleaned and reinstalled in their original locations.

##### 1.03 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.

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- B. Historical items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to the Owner, which may be encountered during demolition, remain the Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Owner.

#### 1.04 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specifications Sections, for information only, unless otherwise indicated.
- B. Proposed dust-control measures.
- C. Proposed noise-control measures.
- D. Schedule of demolition activities indicating the following:
  - 1. Detailed sequence of demolition and removal of work, with starting and ending dates for each activity.
  - 2. Dates of shutoff, capping, and continuation of utility services.
- E. Inventory of items to be removed and salvaged.
- F. Inventory of items to be removed by Owner.
- G. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damaged caused by operations.
- H. Landfill records for record purposes indicating receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes, if encountered.

#### 1.05 PROJECT CONDITIONS

- A. Any building to be demolished will be vacated and its use discontinued before start of work.
- B. The Owner assumes no responsibility for actual condition of building (if any) to be demolished.
- C. Asbestos: It is not expected that asbestos will be encountered in the course of this Contract. If any materials suspected of containing asbestos are encountered, do not disturb the materials. Immediately notify the Architect and the Owner.
- D. Consult with the Owners regarding removal and salvage of major mechanical, plumbing and

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electrical items before removing. Items of salvageable value to Contractor may be removed from any structure as work progresses. Storage and sale of items will not be permitted on site.

- E. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- F. Demolition contractor shall arrange for disconnecting and sealing utilities serving structures to be demolished, prior to start of demolition work.

## **PART 2 - PRODUCTS – (NOT USED)**

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be remove and salvaged.
- D. Survey condition of any buildings within the project boundary that might be affected by demolition. Determine whether removing any element might result in structural deficiency of unplanned failure of any portion of the structure or adjacent structures during demolition.
- E. Perform surveys as needed and as Work progresses to detect hazards resulting from demolition activities.

### **3.02 UTILITY SERVICES**

- A. Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations. Provide not less than 72 hours notice to the Owner if shutdown of existing utility service is required during any changeovers.
- B. Locate, identify, disconnect, and seal or cap off indicated utility services serving any structure to be demolished. Arrange shut-offs with indicated utility companies.

### **3.03 PREPARATION**

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- A. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations.
- B. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
- C. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around the demolition areas.
  - 1. Erect temporary protections, such as but not limited to, walks, silt fences, railings, canopies, and covered passageways.
  - 2. Protect existing appurtenances, site improvements, and landscaping to remain.

#### 3.04 POLLUTION CONTROLS

- A. Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air, in accordance with governing environmental protection regulations.
- B. Provide structural and non-structural controls in accordance with a stormwater management plan.

#### 3.05 DEMOLITION

##### A. Structure Demolition

- 1. Remove structures and incidentals such as but not limited to foundations, sidewalks, pavement slabs, fences and outbuildings.
- 2. If removing building structures, remove foundation walls at least 2 feet below the finished grade or 2 feet below natural ground surface. Remove floor slab or break it into pieces no large than 3 feet square.
- 3. Refer to Section 02300 – Earthwork for fill and compaction of below grade areas and voids resulting from structure demolition.
- 4. Promptly repair damages to adjacent facilities caused by demolition operations.

##### B. Pipe Demolition

- 1. Salvage pipe and do not damage.
- 2. Plug disconnected pipe lines near right of way line, if pipe is to be abandoned.

3. Excavate and shut off the corporation stop for service laterals.

C. Portland Cement Concrete Pavement Demolition

1. Remove concrete to the nearest expansion joint or saw cut
2. Make concrete cuts straight, vertical to surface, true and full depth.
3. Do not use the machine mounted impact hammers.

D. Asphalt Concrete Pavement Demolition

1. Saw cut to full depth and remove asphalt concrete paving
2. When asphalt concrete overlays Portland Cement Concrete pavements do not use a machine mounted impact hammer.
3. Replace any temporary saw-cuts per Section 02575.

E. Milling

1. Mark covers frames and other street fixtures for protection
2. Verify installation of invert covers in storm drain and sanitary sewer systems.
3. Calculate and mark depth of mill cut on pavement.
4. Control dust
5. Mill pavement to grade.
6. Remove excess material.
7. Clean milled surfaces.

3.06 Salvaged Materials

Except for items indicated to be retained as Owner's property, other removed and salvaged materials not indicated for reuse shall be Contractor's property and removed from site with further disposition at Contractor's option.

3.07 Disposal of Demolished Materials

- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

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- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION 311100

## SECTION 311200

### SITE CLEARING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes the following:

1. Protecting existing trees and vegetation to remain.
2. Removing trees and other vegetation.
3. Clearing and grubbing.
4. Topsoil stripping.
5. Removing above-grade site improvements.
6. Disconnecting, capping or sealing, and abandoning site utilities in place.
7. Disconnecting, capping or sealing, and removing site utilities.

- B. Related Sections include the following:

1. Division 1 Section "Field Engineering" for verifying utility locations and for recording field measurements.
2. Division 1 Section "Construction Facilities and Temporary Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and environmental protection measures during site operations.
3. Division 2 Section "Building Demolition" for demolition of buildings, structures, and site improvements.
4. Division 31 Section "Tree Protection and Trimming" for protecting trees remaining on-site that are affected by site operations.
5. Division 31 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.
6. Division 32 Section "Landscaping" for finish grading, including placing and preparing topsoil for lawns and planting.

##### 1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.

#### 1.4 MATERIALS OWNERSHIP

- A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the site.

#### 1.5 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
- B. Record drawings according to Division 1 Section "Contract Closeout."
  - 1. Identify and accurately locate capped utilities and other subsurface structural, electrical, and mechanical conditions.

#### 1.6 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

#### 1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing indicated removal and alteration work on property adjoining Owner's property will be obtained by Owner before award of Contract.

- C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- D. Notify utility locator service for area where Project is located before site clearing.

## **PART 2 - PRODUCTS (Not Applicable)**

### **2.1 SOIL MATERIALS**

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 2 Section "Earthwork."
  - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated.
- D. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

### **3.2 TREE PROTECTION**

- A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.
  - 1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.

2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.
- B. Do not excavate within drip line of trees, unless otherwise indicated.
- C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
1. Cover exposed roots with burlap and water regularly.
  2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
  3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
  4. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.
1. Employ a qualified arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
  2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the qualified arborist.

### 3.3 UTILITIES

- A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing when requested by Contractor.
1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
1. Owner will arrange to shut off indicated utilities when requested by Contractor.
  2. Arrange to shut off indicated utilities with utility companies.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Architect not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Architect's written permission.
- D. Excavate for and remove underground utilities indicated to be removed.
- E. Removal of underground utilities is included in Division 15 mechanical or Division 16 electrical Sections.

### 3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
  3. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
  4. Use only hand methods for grubbing within drip line of remaining trees.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
1. Place fill material in horizontal layers not exceeding 8-inch loose depth, and compact each layer to a density equal to adjacent original ground.

### 3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
1. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Limit height of topsoil stockpiles to 72 inches .
  2. Do not stockpile topsoil within drip line of remaining trees.

3. Dispose of excess topsoil as specified for waste material disposal.
4. Stockpile surplus topsoil and allow for respreading deeper topsoil.

### 3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
  1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

### 3.7 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311200

## SECTION 311300

### STORM WATER POLLUTION PREVENTION

#### PART 1 GENERAL

##### 1.1 DESCRIPTION

- A. The work of this section consists of implementing measures to prevent Storm Water Pollution during construction activities, in accordance with Federal, State, and local regulations, and in accordance with the Storm Water Pollution Prevention Plan (SWPPP) to be prepared for this project.

##### 1.2 SUBMITTALS

- A. Submit Storm Water Pollution Prevention Plan after contract award and before the pre-construction conference.
- B. Plans showing proposed arrangements and methods for control of erosion, sedimentation, and pollutant conveyance in storm water resulting from construction activities. Show that the Stormwater Pollution Prevention Plan satisfies all Federal and State NPDES permit requirements.
- C. Provide sufficient information for evaluation of:
  - 1. Erosion protection measures and products;
  - 2. Drainage management strategies; and
  - 3. Surface restoration.
- D. Submit schedules for inspection and monitoring of all storm water pollution prevention measures.
- E. Submit manufacturer's product information and installation recommendations for silt fence, filter fabric and erosion control blanket, straw bales, and any other materials proposed for use on this project.

##### 1.3 QUALITY ASSURANCE

- A. Before commencing construction activities, such as grading, excavation or filling in any part of the site, Contractor shall plan for temporary structures to guide runoff away from the work area and to capture eroded material before it reaches natural water courses. The measures shall be in accordance with reviewed and approved storm water pollution prevention plans.
- B. Arrange construction activities to minimize erosion to the maximum practical extent. Clearing, excavation, and grading shall be limited to those areas of the project site necessary for construction. Minimize the area exposed and unprotected.

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- C. Clearly mark and delineate the limits of work activities. Equipment shall not be allowed to operate outside the limits of work or to disturb existing vegetation. Excavation and grading shall be completed during the dry season to the maximum extent possible.

#### 1.4 REGULATORY REQUIREMENTS

- A. Apply and obtain all required permits in a timely fashion, as there may be significant lead time in obtaining permits from the local NPDES Permitting Agency.
- B. Implement the requirements of the National Pollutant Discharge Elimination System (NPDES) for erosion control due to storm water runoff during construction.
- C. Notice of Intent (NOI)
  - 1. The Contractor shall file a Notice of Intent (NOI), implement the accepted SWPPP during construction and, upon completion of the construction, file a Notice of Termination (NOT), all as described in the following requirements. Implement all good housekeeping practices, inspections and record keeping.
  - 2. Provide a Draft SWPPP for the project which includes the following information and forms:
    - a. Site description.
    - b. Expected sequencing of operations and construction schedule.
    - c. Weather monitoring procedure.
    - d. Descriptions and details of erosion controls, including dust control.
    - e. Erosion control plans.
    - f. Controls for other potential onsite storm water pollutants.
    - g. Applicable specifications.
    - h. Maintenance and inspection procedures and forms.
    - i. Description of potential non-storm water discharges at site.
    - j. Notice of Intent (NOI) form. **(Completed)**
    - k. Notice of Termination (NOT) form. **(Template)**
    - l. Contractor and Sub-contractor Certification forms.
    - m. Other record keeping forms and procedures.

- n. Good housekeeping practices and procedures, including vehicle wash-down areas, protection of equipment storage and maintenance areas, and sweeping of roadways related to hauling activities.
3. The Contractor and the Owner's Representative will jointly review the draft SWPPP and agree to any needed revisions. The Contractor and the Owner's Representative will then accept and sign the revised SWPPP. When the SWPPP is accepted, it will be the document in force on the project. The accepted SWPPP will describe and ensure implementation of the practices which will be used to reduce the pollutants in storm water discharges to assure compliance with the terms and conditions of the EPA permit. Place the SWPPP and all updates in a three-ring binder so that completed inspection forms and other records may be inserted. The Contractor shall maintain a current copy of the SWPPP and all associated records and forms at the jobsite throughout the duration of the project. The SWPPP shall be available for public inspection and for the inspection and use of the Owner's Representative.
  4. Implement the SWPPP as required throughout the construction period and maintain all erosion control elements in proper working order. Do not perform clearing and grubbing or earthwork until the SWPPP has been implemented. Prior to construction, the Contractor and all subcontractors shall sign certifications (included in the SWPPP) that they understand the requirements of the NPDES permit. All subcontractors shall comply with the requirements of the NPDES under the supervision of the Contractor. The contractor shall designate the erosion control supervisor who will be responsible for implementing the SWPPP. The erosion control supervisor shall be familiar with the SWPPP procedures and practices and shall ensure that emergency procedures and the SWPPP are updated as needed and available for inspection. The SWPPP (including inspection forms) and all data used to complete the NOI shall be provided to the Owner's Representative at the completion of the project.
  5. Inspections and Revisions to Plan:
    - a. The Contractor and the Owner's Representative will perform a weekly inspection of the site. The inspection shall include disturbed areas that have not been finally stabilized, areas used for storage of materials, locations where vehicles enter or exit the site, and all erosion and sediment controls that are included in the Plan. Inspections shall be documented on forms provided in the Plan. The inspection forms shall be retained onsite in the Plan notebook throughout the construction period.
    - b. It may be necessary to revise the Plan during construction to make necessary improvements or revisions or to respond to unforeseen conditions noted during construction or site inspections. For that purpose, the Plan shall specify the mechanism whereby revisions may be proposed by the Contractor or the Owner's Representative and incorporated into the Plan, including review and acceptance of minor changes. The Contractor and the Owner's Representative will jointly accept and sign each revision to the Plan before implementation. Accepted modifications

will be implemented within 7 calendar days following the date of the inspection when deficiencies or necessary corrections are first noted.

- c. Temporary erosion and pollution control measures shall be used to correct conditions that develop during construction that were not foreseen during design, that are needed prior to installation of permanent control features, or that are needed temporarily to control erosion that developed during normal construction practices but are not associated with permanent control features on the project.
- d. Provide additional temporary erosion and pollution controls made necessary by Contractor's errors or negligence at no additional cost to the Government.
- e. Maintain erosion and sediment control features until final acceptance of project.

D. Notice of Termination (NOT)

- 1. Upon final acceptance, the Contractor shall file a NOT.

1.5 JOB CONDITIONS

- A. The Contractor shall maintain records of work performed on the sediment control structures.
- B. The Contractor shall not remove any erosion or sediment control measure without prior permission from the Contracting Officer.
- C. The Contractor shall obtain approval from the Owner's Representative prior to making changes to erosion control plans.

1.6 SEQUENCE OF CONSTRUCTION

- A. The Contractor shall be responsible for arranging and conducting an Erosion and Sediment Control meeting/briefing to inform all parties scheduled to be on-site during the project of the measures to be implemented for proper erosion and sediment control (may be included as part of the Pre-Construction Meeting).
  - 1. Installation of silt fences, storm drain protection, and all other forms of erosion and sediment control shall not begin until after this meeting has occurred.
- B. The Contractor shall notify the Owner's Representative in writing and by telephone of the following events:
  - 1. The required erosion and sediment control meeting/briefing.
  - 2. Following installation of required sediment control structures.
  - 3. Prior to removal of or modification to sediment control structures.

4. Prior to removal of all sediment control structures.
  - C. Silt fences, storm drain protection, and all other forms of erosion and sediment control shall be installed, inspected, and accepted by the Owner's Representative before beginning any utility excavation.
  - D. Temporary silt fences shall be installed around any stockpiles and/or excavated material that cannot be backfilled during the same day in which it was excavated. Temporary silt fences shall also be placed immediately downstream of any utility trench that has not been backfilled at the end of the working day. Temporary silt fences shall be installed prior to leaving the work site for the day.
  - E. Silt fences and storm drain protection shall be inspected by the Contractor weekly. Repairs to these devices shall be completed prior to leaving the work site for the day.
  - F. The Contractor shall prevent the deposition of materials onto paved areas. The Contractor shall inspect the paved areas for deposited materials weekly and remove the materials immediately.
  - G. Failure to maintain silt fences and storm drain protection shall be cause for an immediate stop-work order.
  - H. Silt fences shall be removed with permission of the Owner's Representative within 20 working days after final acceptance of the project and/or after the establishment of permanent stabilization of all excavations and fill areas.

## PART 2 PRODUCTS

### 2.1 EQUIPMENT

- A. Before the work begins, sufficient equipment shall be available on the site to assure that the operation and adequacy of the erosion control plans can be continuously maintained.

### 2.2 EROSION CONTROL PRODUCTS

- A. Submit manufacturer's product information and installation recommendations for all products.

### 2.3 EROSION CONTROL MEASURES

- A. Erosion control measures shall consist of silt fencing, barrier protectors, straw bales, temporary soil retention blankets, excelsior drainage filters, sediment traps and berms.
- B. Berms and excelsior drainage filters shall be used to form sediment traps and to control run-on and run-off into other areas, including creeks, streams, marshes, access roads, well areas, and the staging areas.

- C. Erosion control measures shall be used to contain only direct precipitation in the construction zone. The contained water shall be allowed to percolate into the ground or drain slowly through the drainage filter sediment traps.
- D. Earthen sediment traps or holding ponds shall not be used unless accepted by the Contracting Officer.

### PART 3 EXECUTION

#### 3.1 GENERAL DESCRIPTION

- A. Furnish, install, maintain, and operate necessary control measures and other equipment necessary to prevent erosion. Temporary measures shall be to Contractor's own design and Contractor shall be solely responsible for risks related to the management of erosion control during construction.

#### 3.2 METHODS

- A. Construct berms to reduce runoff velocity as well as direct surface runoff around and away from all fuel containment, storage, and borrow areas.
- B. Divert surface runoff around and away from cut and fill slopes by constructing berms or ditches at the base of disturbed slopes. Provide conveyance for the runoff in temporary pipes or protected channels to temporary sediment traps.
- C. Place drainage filters around all catch basins to create sediment traps to control run-off from the construction area.
- D. Excess water used for dust control shall be contained within the demolition areas by the erosion control measures.

#### 3.3 MAINTENANCE OF TEMPORARY FACILITIES

- A. Inspect erosion and sediment control structures weekly. Ensure erosion and sediment control structures remain effective throughout excavation and grading operations. Relocate structures as necessary.
- B. Inspect control structures after each significant rainfall. Promptly repair breaches which occur.
- C. The Contractor shall remove entrapped sediment from behind excelsior drainage filter after each storm.

#### 3.4 DISPOSAL OF SEDIMENT FROM STORM WATER POLLUTION CONTROL STRUCTURES

- A. Sediment excavated from temporary sediment control structures shall be disposed on the site with general fill, or with topsoil. Sediment shall be allowed to dry out as required before reuse.

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- B. Contractor shall place the sediment removed from traps and other structures where it will not enter a storm drain or watercourse and where it will not immediately reenter the basin.

3.5 REMOVAL OF TEMPORARY STORM WATER POLLUTION CONTROL MEASURES

- A. All temporary control measures shall be removed with permission of the Owner's Representative within 20 working days after final acceptance of the project, and/or once grading is completed and slopes have stabilized.

END OF SECTION



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## SECTION 312100

### EARTHWORK

#### PART 1 GENERAL

##### 1.01 SUMMARY

###### A. Section Includes:

1. Topsoil stockpiling, trenching or excavation and backfilling for utility systems and related appurtenances;
2. Excavation, backfilling and compacting for structures, pavements and sidewalks including dewatering, erosion control, and other items of earthwork as shown on Drawings and specified herein.

###### B. Related Documents:

1. The Contract Documents, as defined in the General Conditions, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.

###### C. Related Sections:

1. Section 330510 - Excavating, Backfilling and Compacting for Utilities.
2. Section 311200 – Site Clearing.

##### 1.02 SUBMITTALS

###### A. Test Reports:

1. Field density (compaction) test reports of each test made.
2. Optimum moisture-maximum density curves for each type of soil encountered.

###### B. Fill Samples and Tests:

1. Provide for each type fill material to be used on project, with testing results indicating compliance with requirements specified, for approval prior to start of work.
2. The Owner shall authorize each type of fill to be used on the project as structural fill.

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(See articles 2.01 through 2.04 of this section).

### 1.03 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable requirements of federal, state and local laws, regulations and codes having jurisdiction at project site
- B. Reference Standards: Applicable requirements of standards and specifications referenced herein apply to the work of this Section.
- C. Field Quality Control: Testing and Inspection: Owner will obtain and pay for services of an independent commercial testing laboratory for performing field quality control testing of soils during construction; costs of retesting because of noncompliance with requirements specified, including recompaction of deficient areas, are at Contractor's expense.

### 1.04 PROJECT CONDITIONS

- A. Coordination: Coordinate all work with City and Utility Company Personnel.
- B. Cooperation: Coordinate this work with the work of other Sections to avoid any delay in progress of building or any interference with progress of other work. Where required for proper construction operations, perform portions of work included in this Section separate from general building excavation as directed.
- C. Payment for Soils Work:
  - 1. The Contractor shall be responsible for the cost of preparing the site for the proposed construction including excavation, stockpiling, providing suitable fill material for satisfactory sub grade and final site preparation, removal and replacement of unsuitable material exposed on surface or encountered within existing soil as it is excavated to six inches below spread footings or slabs on grade as well as to the depth and extent specified or shown on the Drawings for installation of all site improvements including foundations, utilities, paving, sidewalks, and on-site structures. The cost for this shall be included in the Contractor's base bid, and shall be at no additional cost to Owner.
  - 2. The Owner shall have final authority and make the final decision during construction on the depth and extent to which unsatisfactory materials need to be removed and replaced. Any additional excavation, soil remediation or replacement must be authorized by the Owner prior to starting that work.
- D. Excavation Classification: All excavation work is unclassified and includes removal and disposal of earth fills, rock, rubble, trash and other materials encountered in excavation and

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grading operations. The Contractor's basic bid includes all costs for providing a site acceptable for the proposed construction. No additional payment shall be made for removal and replacement of unacceptable materials encountered during site preparation. In the event rock is encountered, rock removal shall not be performed. The Owner shall be the final authority and shall make the final decision during Construction to the depth and extent to which unsatisfactory materials must be removed and replaced.

E. Existing utilities:

1. Locations indicated are approximate
2. Contact local utility location service (Blue Stakes) 48 hours prior to excavation and verify exact locations of all existing utilities.
3. Perform necessary exploratory tests for verification if necessary. The Owner, the Architect and the Engineer will assume no responsibility for hazardous conditions, losses and accidents arising out of failure to perform by the Contractor or other Parties or both.
4. Should incorrectly charted or uncharted piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility services in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of utility owner.

F. Disposition of utilities:

1. Observe rules and regulations governing respective utilities during execution of work of this Section.
2. Adequately protect all active utilities from damage:
3. Remove or relocate active utilities only as shown or as specified.

G. Benchmarks, Monuments and Other Reference Points: Protect from damage and displacement; if disturbed or destroyed, replace at Contractor's expense.

H. Keep dirt, dust, noise and other objectionable nuisances to a minimum. The Contractor is responsible to comply with all applicable local ordinances.

I. Protection:

1. Barricades:

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- a. Furnish and maintain barricades, signs and markings for excavated areas in accordance with requirements of all local codes and as herein specified.
  - b. Paint and maintain barricades in good condition. Mount flashing yellow lights and maintain same.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
  3. Protect excavation bottom against freezing when atmospheric temperature is less than 35 degrees F.

## PART 2 PRODUCTS

### 2.01 FILL AND BACKFILL MATERIALS - GENERAL

- A. A cut and fill balance has not been made. Contractor is responsible for establishing quantity of additional fill required or excess that must be hauled away. No additional compensation will be made for importation of additional material or for disposal of surplus material off site, as specified herein.

### 2.02 STRUCTURAL FILL

- A. Acceptable Materials: One or combination of following, as required, as approved by Owner and recommended by Soils Engineer:
  1. On-Site Excavated Material, excluding debris, other deleterious materials and unacceptable soils as defined by Section 2.02 B..
  2. Imported Materials
    - a. ASTM D2487 Soil Classification Groups GW, GM, GP-GM, GW-GM, SM, SW. Maximum percentage passing #200 Sieve: 15%
    - b. ASTM D2487 Soil Classification Groups SP and GP may not be used.
- B. Unacceptable Materials: ASTM D2487 Soil Classification Groups SC, CL, CH, PT, OH, OL, ML, MH, generally described as and including following:
  1. Peat, mulch and/or other highly organic swamp soils.
  2. Organic and inorganic clays of low to high plasticity.

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3. Silts and Elastic silts.

**PART 3 EXECUTION**

3.01 EXAMINATION

- A. Examine areas in which work is to be performed. Report in writing to Owner all prevailing conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Starting work constitutes acceptance of the existing conditions and the Contractor shall then, at his expense, be responsible for correcting all unsatisfactory and defective work encountered.

3.02 PREPARATION

- A. The civil drawings show the original topography and proposed limits of construction.
- B. In case of conflict between final grade elevations (finish grade) shown by spot elevations and by contours, contact the Engineer for clarification before proceeding.
- C. Conform to dimensions and elevations indicated. Do not exceed plus or minus five-tenths of one-foot variation from design grading elevations shown unless approved by the Engineer in writing.
- D. Dewatering:
  - 1. Prevent ground and subsurface water from flowing into excavations, from flooding project site and surrounding properties, and from collecting and ponding; provide and maintain all temporary drainage and dewatering systems required.
  - 2. Install pumps, sumps and suction and discharge lines, as required.
  - 3. Install temporary deviations from grades indicated to channel water away from excavations.
  - 4. Leave no sumps or pockets at completion of each day's grading operations.
  - 5. If water is encountered during footing and foundation excavation, install pumps of capacity to remove water while excavations are being made and continue pumping for 24 hours following placing of concrete footings and erection of foundation walls to grade. Maintain dewatering operations until construction of permanent drainage is

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completed.

E. Shoring and Bracing:

1. Install as required to protect slopes and earth banks from cave-ins, and to protect adjacent surfaces and structures from settlement. Remove before backfilling is completed, but not until after permanent supports are in place.
2. When work is interrupted by rains, do not resume operations until moisture content and field density tests of upper 6" of in-place materials have been made by the Soils Engineer and approved by Owner.
3. Shoring, bracing or underpinning required for the project (if any) shall be designed by a professional engineer registered in the State of Utah.

F. Do not place fill or backfill material in water, on material containing frost, or during unfavorable weather conditions. When inclement weather is expected, grade and seal surface of fill as required to limit percolation of surface water.

G. Establish and identify required lines, levels, contours and datum.

H. Topsoil Stripping and Conservation: Following requirements may be waived by Soils Engineer in areas that do not contain satisfactory topsoil:

1. Remove topsoil of horticultural value from areas to be covered by new building construction and from areas to be paved, excavated, or regraded. Remove without contamination with subsoil. Strip to 6" minimum depth. Keep free of roots, stones and other undesirable materials. Do not strip topsoil when wet.
2. Stockpile in locations convenient to areas shown to receive topsoil later or where directed by Soils Engineer. Do not stockpile to depth exceeding 8 feet. Do not drive heavy equipment over stockpiled material or spread topsoil.

I. Proof-rolling:

1. Proof-roll over entire areas receiving fill material, after topsoil and existing fill is removed, in presence of the owner's representative.

J. Following topsoil stripping, existing fill removal and proof-rolling operations, but before placing fill and backfill, clean ground surfaces free of all trash; debris; loose, frozen, wet or soft soil; and other undesirable surface materials before proceeding with work.

K. Soil Remediation:

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1. Undercut and remove soft or unstable soils that fail to compact and replace with acceptable fill material compacted to density specified in Section 3.04. Place soil in lifts of 12" loose depths and compact each lift to density specified when using heavy compaction equipment, and lifts not more than 4" loose depth for material compacted by hand operated tampers.
2. Before compaction, moisten or aerate each layer as needed to provide optimum moisture content. Compact each layer to required percentage of density for each area classification. Do not place backfill or fill materials on surfaces that are muddy, frozen, or contain frost or ice.
3. Place backfill and fill material evenly adjacent to structures, piping or conduit to required elevations. Carry material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

### 3.03 GRADING

- A. Earthwork contractor shall bring finish grades to the finished grades shown on the Drawings in all areas. In landscaped areas, the landscape contractor shall complete the grading. Earthwork contractor shall remove all excess topsoil from site and stockpile only the amount necessary to complete finish work.
- B. Grade to required profiles, contours, elevations and sub grade levels shown on Drawings, with allowances made for depths required for placement of topsoil and construction of paving, walks, equipment slabs or pads and floor slabs.
  1. Lawn and landscaped areas: Finish areas to receive topsoil to within not more than 0.1 foot above or below required sub grade elevations.
  2. Walks: Shape surfaces of areas under walks to line, grade, and cross section, with finish surface within 0.1 foot of required sub grade elevation.
  3. Pavements: Shape surface under pavement to line, grade and cross section, with finish surface within 1/2 inch of required sub grade elevation.
  4. Building slabs: Under building slabs grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within 1/2 inch tolerance when tested with a 10 foot straight edge.
- C. Control grading around buildings and on site; slope ground away from buildings to prevent water from running into excavated areas or damaging other structures so that entire project is well drained and free from water pockets.

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- D. Provide uniform levels and slopes between elevations shown on Drawings, and between elevations shown and existing finished grades shown to be maintained. Round abrupt changes in slopes.

### 3.04 STRUCTURAL FILL

A. General:

1. Soils Engineer based upon test results is sole judge as to when specified compaction densities have been obtained. When retesting is needed to verify that unacceptable site preparation has been remedied, the cost for retesting shall be paid by the Contractor. Compaction shall comply with the recommendations in the Geotechnical Investigation by AGEC, dated October 5, 2006, No. 1060850.
2. Contractor is responsible for correcting at his expense, including costs of testing, all areas with insufficient compaction.
3. Place acceptable material in horizontal lifts not exceeding 12" in loose depth, with each lift extending for entire length and width of each area being filled. Level material which is frozen or contains frost.
4. Reduce or increase moisture content of fill by drying or uniform sprinkling with water, as required to achieve moisture content within 2% of optimum as required for specified degree of compaction.
5. Disk each layer of fill to break down oversize clods, to thoroughly mix nonuniform materials, and to secure uniform moisture content, as required to insure uniform density and proper compaction.
6. Maintain positive surface slope to allow runoff and to prevent ponding of surface water. If surface water ponds, dewater as required. Remove all saturated or disturbed soil before placing additional fill material.
7. Number of compaction equipment passes required is dependent upon degree of compaction specified. Overlap rolling passes as required to completely cover area of fill.
8. After cuts are made and existing fill is removed,, scarify entire area to 12" depth and compact to following minimum density for areas listed:
  - a. Areas Receiving Structural Fill including Foundations: 95% Modified Proctor Density (ASTM D-1557) within 2% of optimum moisture content.

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b. Under Paving and Walk Areas: 90% Modified Proctor Density within 2% of optimum moisture content.

c. Under Lawn and Unpaved Areas: 85% Modified Proctor Density (ASTM D-1557).

B. Structural Fill:

1. Material: Acceptable materials complying with the requirements of Articles 2.01 and 2.02.
2. Location: Place as sub grade under building, pools and pool decks, to a point 5 feet outside building walls and pool decks. Place as sub grade under pavements and walkways to a point 2 feet beyond edge.
3. Construct to grades and for minimum depths indicated. Undercut existing grade as required.
4. Compact to 95% of Modified Proctor Density (ASTM D-1557), at moisture content within 2% of optimum; maintain specified moisture content until placement of foundations, , and obtain Owner's approval of method used for maintaining moisture control. Compact to 90% of Modified Proctor Density (ASTM D-1557), at moisture content within 2% of optimum for concrete slabs and pavement. Compact to 85% of Modified Proctor Density (ASTM D-1557), at moisture content within 2% of optimum for retaining wall backfill.

C. Nonstructural Fill:

1. Materials: Acceptable Materials complying with requirements of Articles 2.01 and 2.02.
2. Location: Use for all other fills, unless otherwise specified or directed by Owner.
3. Construction to grades and for minimum depths indicated. Undercut existing grade as required.
4. Compact to following densities for areas listed:
  - a. Sub grade Below Paving, Walks, and Slabs on Grade: 90% of Modified Proctor Density at moisture content within 2% of optimum.
  - b. Below Grassed and Planted Areas: 85% of Standard Proctor Density.

3.05 FOUNDATION AND FOOTING EXCAVATION

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- A. If grade beam foundation, excavate bottom of foundations to exact grade called for on Drawings. Do not disturb bottom of excavation. Fill over-excavated areas with concrete.
- B. Excavate 4" lower than scheduled grade beam depths for void box placement.
- C. Excavate beyond outside of walls to allow for inspection, placing and removal of forms and for installing of waterproofing and drain tile, except where concrete is authorized to be deposited directly against excavated surfaces. Leave excavation open until work has been inspected and approved.
- D. If pile foundations, stop excavations from 6" to 12" above bottom of footing before piles are placed. After piles have been driven or drilled, remove loose or displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

### 3.06 FOUNDATION BACKFILL

- A. Material: Acceptable Structural Fill material complying with requirements of Articles 2.01 and 2.02.
- B. Remove surface debris and debris in excavation before placing backfill.
- C. Do not use material which is frozen or contains frost.
- D. Allow footing and foundation walls to attain full design strength before placing backfill.
- E. Exercise care during placing and compacting operations. Place to prevent wedging action, eccentric loading, and displacement of walls or structure.
  - 1. Use hand operated compaction equipment within 4 feet of walls.
  - 2. Where fill is placed along both sides of foundation walls, place and compact simultaneously on both sides of walls.
  - 3. Repair, or remove and replace all damage to foundation walls and structure occurring during placement and compaction operations at no additional cost to Owner.
- G. Place material in horizontal lifts not exceeding 12" loose depth before compacting. Level each lift before compacting. When using hand compaction equipment, do not exceed 4" loose depth per horizontal lift.
- H. Compact all backfill to 95% of Modified Proctor Density within 2% of optimum moisture content.

### 3.07 TRENCHING AND BACKFILLING FOR UTILITY SYSTEMS

A. Trench Excavation:

1. Provide open cut excavation, except short sections may be tunneled if approved by consultant and demonstrated by Contractor that pipe, cable or duct can be properly installed, backfilled and compacted. Heavy construction equipment, building materials, excavated soil and vehicular traffic should not be allowed within 1/3 of the slope height from the top of any excavation.
2. Excavate to necessary width, depth and alignment for proper material installation. Cut trench banks as nearly vertical as practicable, but to safety standards of governing authorities. Stockpile material suitable for backfilling a sufficient distance from banks to avoid overloading and cave-ins.
3. Accurately grade trench bottoms to provide uniform bearing and support for each pipe section on undisturbed soil along full pipe length, except for areas where necessary to excavate for bell holes and for sealing pipe joints. Dig holes and depressions for joints after trench bottom has been graded, so pipe rests on prepared bottom for full length. Remove all stones to avoid point bearing. When excavating in rock, provide at least 4 inches of soil cushion on all sides of pipe and accessories. The use of 3/4" (max) gravel for pipe haunching and embedment shall be acceptable when it meets the approval of the pipe manufacturer and Owner's Construction Representative.
4. Remove wet or otherwise unstable or unacceptable material encountered beyond depths indicated and replace with sand, gravel or concrete.

B. Excavation for Appurtenances: Excavate for manholes and similar structures, to leave 12" minimum clearance between outer surfaces and embankment or timber used to hold and protect banks. Fill over-excavation with sand, gravel or concrete.

C. Backfilling:

1. Do not backfill until utilities systems have been inspected and accepted by the Owner.
2. Backfill Materials: Acceptable Structural Fill materials at all other locations, complying with requirements of Articles 2.01 and 2.02.
3. Deposit material in lifts of 12" loose depth before compacting each lift to 90% of Modified Proctor Density within 2% of optimum moisture content under paving, walks, building slabs, and other slabs on grade, and compacting to 85% of Modified Proctor Density under lawns and planting areas. When using hand compaction equipment, place material in lifts not to exceed 4" loose depth.

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4. Backfill trenches to top of ground level.
5. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.
6. Restore ground surface, pavements, base courses, and compacted sub grade disturbed by utilities systems trenching and backfilling work to their original condition, construction and finishes.

### 3.08 FIELD QUALITY CONTROL

- A. Testing and Inspection Services: Owner will retain the services of a testing firm to perform observations, inspections and testing during execution of site work and any other tests deemed necessary to determine compliance with specifications.
- B. Contractor shall coordinate with testing firm's Inspectors and Technicians to facilitate the execution of their duties.
- C. Upon completion of excavation, testing firm shall inspect and test the work and determine the suitability of the soil and preparation of subsequent site work.
- D. Testing firm will submit to Owner reports of all observations, inspections and tests.

END OF SECTION 312100

## SECTION 321217

### ASPHALTIC CONCRETE PAVING

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED

- A. The Work in this section includes the construction of new asphaltic concrete pavement sections.
- B. Prepare sub-grade to receive base course.
- C. Place untreated base courses, work and compact.

##### 1.02 REFERENCE STANDARDS

ASTM D1557 - Tests for Moisture - Density Relationship of Soils using 10 lb. (4.5 kg) Rammer in 18 inch (457 mm) Drop.

##### 1.03 INSPECTION AND TESTING

- A. Testing and inspection will be performed so as to minimize disruption to Work.
- B. Allow testing laboratory access to the mixing plant for verification of weights or proportions, character of materials used and determination of temperatures used in the preparation of asphaltic concrete mix.
- C. When and if required, the testing laboratory will perform laboratory tests on proposed asphaltic pavement mix(es) to determine conformity with requirements.
- D. The testing laboratory will perform one (1) series of compaction tests per 100 square yards for untreated base course and one (1) series of compaction tests per 100 square yards for each lift of asphalt surface course.
- E. When untreated base course or portion thereof has been placed and compacted in accordance with requirements, notify the testing laboratory to perform density tests. Do not place asphalt surface courses until results have been verified and base course installation approved.
- F. If compaction tests indicate that untreated base course or asphalt surface course do not meet specified requirements, remove defective work, replace and retest at own

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expense. core testing may be required by the Engineer to evaluate defective work.

#### 1.04 SUBMITTALS

- A. Certified sieve analysis of untreated base course material and samples of this material for determination of Proctor values.
- B. Certified sieve analysis of aggregate materials for asphalt pavement.
- C. Proposed asphalt pavement mix with Marshall Test results for the proposed mix.
- D. Seven (7) days prior to delivery of any bituminous paving to the job site, the Contractor shall submit the proposed job mix to the Engineer for approval. The job mix shall be submitted by the Contractor, and no bituminous mixture shall be manufactured until it has been approved. Data shall be provided that show the proposed mix will produce a mixture which meets the requirements of these specifications and the specific Marshall Test results, including density voids analysis and stability flow tests. Previously established test results will be accepted provided the tests were performed within the last six months.

### PART 2 - PRODUCTS

#### 2.01 UNTREATED BASE COURSE MATERIALS

Granular Base. Angular crushed natural stone; free from shale, organic matter and debris; graded within following limits:

1" GRADATION	
<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch	100
1/2-inch	79 to 91
No. 4	49 to 61
No. 16	27 to 35
No. 50	17-21
No. 200	5 to 12

- B. Primer. Homogeneous medium curing liquid asphalt; of type recommended for asphaltic paving; of grade to suit job conditions.
- C. Tack Coat. Emulsified asphalt (AC-10) to be used as the tack coat shall meet the requirements of ASTM D977-80, Grade SS-1N or ASTM D2397-79 Grade CSS-1N.

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## 2.02 ASPHALT PAVEMENT MATERIALS

- A. Mineral Aggregate. Mineral aggregate shall consist of crushed stone, crushed gravel, or crushed slag conforming to the following requirements:
1. Coarse aggregate, retained on the No. 4 sieve, shall consist of clean, hard, tough, durable and sound fragments, and shall be free from organic matter or other deleterious substances.
  2. That portion of the aggregate retained on the No. 4 sieve shall have not less than 50% of particles by weight with at least one mechanically fractured face or clean angular face.
  3. Fine aggregate passing the No. 4 sieve may be either a natural or manufactured product. The aggregate shall be clean, hard grained and moderately sharp, and shall contain not more than 2% by weight of vegetable matter or other deleterious substances.
  4. That portion of the fine aggregate passing the No. 40 sieve shall be non-plastic when tested in accordance with AASHTO Designation T-90.
  5. The weight of minus 200 mesh material retained in the aggregate, as determined by the difference in percent passing a No. 200 sieve by washing and dry sieving without washing, shall not exceed 6% of the total sample weight. The portion of fine aggregate passing the No. 200 sieve shall be determined by washing with water in accordance with AASHTO Designation T-11.
  6. The aggregate shall be of uniform density and quality and shall have a rodded weight of not less than 75 lbs/cu. ft. when tested in accordance with AASHTO Designation T-19.
  7. The aggregate shall have a percentage of wear not exceeding 40 when tested in accordance with AASHTO Designation T-96.
- B. Asphalt Cement. Homogeneous; free of water; will not foam when heated to 177 C; 85/100 penetration grade; shall meet requirements of ASTM D3381; viscosity AC 10 for moderate climates.
- C. Seal Coat. Fog type as defined in Manual No. 4; The Asphalt Institute (MS-4).

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2.03 ASPHALT PAVEMENT MIX

- A. Combine mineral constituents in proportions to produce a mixture conforming to following gradation requirements:

3/4" GRADATION

<u>Sieve Size</u>	<u>Percent Passing By Weight</u>
3/4"	100
1/2"	75-91
#4	46-62
#16	22-34
#50	11-23
#200	5-9

1/2" GRADATION

<u>Sieve Size</u>	<u>%Passing By Weight</u>
1/2"	100
#4	60-80
#16	28-42
#50	11-23
#200	5-9

- B. Percentage by weight of asphalt cement in mixture. 5.0% to 7.0% for surface course.
- C. Maintain thorough and uniform mixture.
- D. Bring asphalt cement and mineral constituents to required temperatures before mixing. Ensure aggregates are sufficiently dry so as not to cause foaming in mixture.

**PART 3 - EXECUTION**

### 3.01 PREPARATION

- A. Ensure grading of sub-grade to required elevation.
- B. Scarify sub-grade, where asphalt pavement is to be placed, to a depth of minimum 8 inches.
- C. Water and thoroughly mix sub-grade until optimum moisture content is obtained when deficiency of moisture content exists. When excess of moisture exists, rework, aerate and allow sub-grade to dry until optimum moisture content is obtained.
- D. Before final rolling, shape entire section, add additional sub-soil as required and compact sub-grade to provide grades, elevation and cross-section indicated. Points of finished sub-grade surface shall be within 1 inch of elevations indicated. Compact to 95% Modified Proctor Density (ASTM D-1557) within 2% of optimum moisture content.

### 3.02 PLACEMENT OF UNTREATED BASE COURSE

- A. Bring sub-base course to required depth(s) and profiles indicated. Extend sub-base course minimum 6 inches beyond asphalt pavement width. Place in layers not exceeding 4 inches in depth. Compact each layer to 95% maximum laboratory density, or as shown on the plans. Properly compact areas adjacent to curbs, catch basins, manholes and other areas not accessible to rollers with mechanical or hand tamping devices. Ensure granular sub-base course materials are not contaminated with deleterious materials.
- B. Add water during compaction to bring granular material to optimum moisture content.
- C. Spread base course materials over prepared granular sub-base to a minimum compacted depth as indicated on the drawings. Compact to 96% maximum laboratory density. Ensure top surface of base course is true to lines and grades indicated, with all points within 1/2 inch of elevations indicated.
- D. Add water during compaction to bring stabilizing base course materials to optimum moisture content. When an excess moisture exists, rework stabilizing base course materials until optimum moisture content is obtained.

### 3.03 PLACEMENT OF ASPHALT PAVEMENT

- A. Place asphalt pavement surface course within 12 hours of priming untreated base course.
- B. Place asphalt pavement to compacted depth indicated on the drawings. The maximum compacted depth of each lift of asphalt surface course shall not exceed 3-inch thickness.

- C. Do not place asphalt pavement when surface temperature is 4<sup>0</sup>C or lower; or during rainy weather; or when the subgrade, sub-base, or base course is wet or frozen; or during other unfavorable weather conditions as determined by the Engineer. Ensure asphalt pavement is minimum 118<sup>0</sup>C immediately after placing and prior to initial rolling.
- D. Offset longitudinal joints in succeeding course at least six (6) inches transversely to avoid a vertical joint through more than one course.
- E. Compact asphalt paving surface course to required density, with approved rolling equipment. Start compaction as soon as pavement will bear equipment without checking or undue displacement. Compact each layer to 96% maximum laboratory density, or as shown on the plans.
- F. Carry out compaction in three operations in pass sequence. Ensure each pass of roller overlaps previous passes to ensure smooth surface free of roller marks. Keep roller wheels sufficiently moist so as not to pick up material.
- G. Perform hand tamping in areas not accessible to rolling equipment.
- H. Ensure joints made during paving operations are straight, clean, vertical and free of broken or loose material. Prime vertical surfaces of joints to ensure tight bond.
- I. Ensure surface of completed asphalt pavement is true to lines, profiles and elevations indicated, and is free from depressions exceeding 1/2 inch when measured with a 10 ft. straightedge.
- J. Do not allow vehicular traffic on newly paved areas until surface has cooled to atmospheric temperature, minimum of 6 hours after final installation.

#### 3.04 ADJUSTING MANHOLE FRAMES AND VALVES

- A. Adjust manholes, valves, and other appurtenances to required elevations.
- B. Provide concrete collars when adjustments are required. Collars shall be installed in accordance with Section 321218 - Pavement Repair, and shall be placed to a minimum total pavement thickness of six (6) inches.
- C. Adjustment of manholes, valves, and other appurtenances are considered incidental to the Work and no additional payment will be made for adjustments or paving repairs.

END OF SECTION 321217

## SECTION 321218

### PAVEMENT REPAIR

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED

- A. This section provides for the furnishing of all labor, tools, materials, equipment and in performing all operations in connection with the restoration of all existing asphalt pavement surfaces which have been removed or damaged during the course of the work under this Contract.
- B. Work shall include cutting, removal, and disposal of existing pavement, and the placement of a twelve (12)-inch thick untreated base course and a bituminous surface course of a thickness equal to the adjacent existing pavement plus one (1) inch, minimum of four (4) inches total thickness.

##### 1.02 RELATED WORK

Section 013300	Contractor Submittals
Section 014000	Quality Control
Section 330510	Excavating, Backfilling, and Compacting for Utilities
Section 321217	Asphaltic Concrete Paving

##### 1.03 REFERENCES

- A. *State of Utah Standard Specifications for Road and Bridge Construction*
- B. ASTM D422 Particle Size Analysis of Soils
- C. ASTM D1556 Density of Soil In Place by the Sand-Cone Method
- D. ASTM D1557 Moisture Density of Soils and Soil Aggregate Mixtures using 10-pound Rammer and 18-inch Drop (Modified Proctor)
- E. ASTM D1559 Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
- F. ASTM D2922 Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)

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G. ASTM D2950 Density of Bituminous Concrete In Place by Nuclear Methods

#### 1.04 INSPECTION AND TESTING

A. Testing and inspection will be accomplished in accordance with Section 321217 paragraph 1.03.

1.05 SUBMITTALS (Refer to Section 321217, paragraph 1.04)

### PART 2 - PRODUCTS

#### 2.01 UNTREATED BASE COURSE

A. Untreated base course materials shall be composed of angular crushed natural stone free of shale, organic matter, and debris.

B. The gradation when tested in accordance with ASTM D422 shall be as shown on the following page.

<u>1" GRADATION</u>	
<u>Sieve Size</u>	<u>Percent Passing By Weight</u>
1"	100
1/2"	79-91
#4	49-61
#16	27-35
#50	17-21
#200	7-11

#### 2.02 ASPHALT PAVEMENT

A. Asphalt pavement shall be a mixture of local aggregates and asphalt cement plant mixed and hot laid.

B. Bituminous material to be mixed with the mineral aggregates shall be asphalt cement conforming to the *State of Utah Standard Specifications for Road and Bridge Construction*, except that minimum flash point for all grades shall be 350°F

C. Asphalt cement shall be grade AC-10 or AC-20.

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- D. The percent of asphalt cement in the asphalt job mix shall be 5% to 7% by weight of total mix.
- E. The combined dry mineral aggregate shall be uniformly graded and of such size that it meets one of the following gradations when tested in accordance with ASTM D422.

3/4" GRADATION

<u>Sieve Size</u>	<u>Percent Passing By Weight</u>
3/4"	100
1/2"	75-91
#4	46-62
#16	22-34
#50	11-23
#200	5-9

1/2" GRADATION

<u>Sieve Size</u>	<u>%Passing By Weight</u>
1/2"	100
#4	60-80
#16	28-42
#50	11-23
#200	5-9

- F. The maximum aggregate size shall not be more than one-half the thickness of the compacted course to be constructed.

2.03 BITUMINOUS TACK COAT

- A. Bituminous tack coat. Emulsified asphalt (AC-10) to be used as the tack coat shall meet the requirements of ASTM D977-80, Grade SS-1N or ASTM D2397, Grade CSS-1N.

**PART 3 - EXECUTION**

3.01 PAVEMENT REMOVAL

- A. Obtain approval from the Engineer prior to saw-cutting or removing pavement.

- B. Saw-cut pavement vertically along the lines forming the trench. Do not damage pavement outside the limits of removal.
- C. Remove pavement from site immediately and dispose of properly.
- D. Pavement beyond the cut edge damaged during removal of the pavement or other construction operations shall be cut again to form a neat vertical edge for pavement repair at no additional cost to the Owner.

### 3.02 TEMPORARY PAVEMENT PLACEMENT

- A. Provide temporary gravel surfaces with a minimum thickness of 6 inches in good condition immediately after final backfill is placed over pipe, and prior to opening to traffic.
- B. Maintain temporary gravel surfaces in good condition by blading, sprinkling, rolling, adding gravel, etc., until final pavement is placed.
- C. Complete final pavement replacement as soon as possible to provide maximum safety and convenience to traffic as directed by the Engineer or as specified in the road cut permit.

### 3.03 PREPARATION OF SUBGRADE

- A. Ensure subgrade conforms to required grades and elevation. Remove any temporary gravel surfacing placed, to the depth of subgrade as indicated.
- B. Ensure compaction of subgrade meets required density.

### 3.04 PLACEMENT OF UNTREATED BASE COURSE

- A. Bring sub-base course to required depth(s) and profiles indicated. Extend sub-base course minimum 6 inches beyond asphalt pavement width. Place in layers not exceeding 4 inches in depth. Compact each layer to 95% maximum laboratory density, or as shown on the plans. Properly compact areas adjacent to curbs, catch basins, manholes and other areas not accessible to rollers with mechanical or hand tamping devices. Ensure granular sub-base course materials are not contaminated with deleterious materials.
- B. Add water during compaction to bring granular material to optimum moisture content.
- C. Spread base course materials over prepared granular sub-base to a minimum compacted depth as indicated on the drawings. Compact to 96% maximum laboratory density.

Ensure top surface of base course is true to lines and grades indicated, with all points within ½ inch of elevations indicated.

- D. Add water during compaction to bring stabilizing base course materials to optimum moisture content. When an excess moisture exists, rework stabilizing base course materials until optimum moisture content is obtained.

### 3.05 APPLICATION OF BITUMINOUS TACK COAT

- A. Ensure edges of existing pavement are clean and free of loose or foreign material to permit adhesion of bituminous materials.
- B. Apply tack coat material to existing pavement edges and casting immediately prior to placement of asphalt pavement.

### 3.06 PLACEMENT OF ASPHALT PAVEMENT

- A. Obtain permits from state and local authorities before augering/jacking operations begin.
- B. Place asphalt pavement to compacted depth indicated on the drawings. The maximum compacted depth of each lift of asphalt surface course shall not exceed 3-inch thickness.
- C. Do not place asphalt pavement when surface temperature is 4°C or lower; or during rainy weather; or when the subgrade, sub-base, or base course is wet or frozen; or during other unfavorable weather conditions as determined by the Engineer. Ensure asphalt pavement is minimum 118°C immediately after placing and prior to initial rolling.
- D. Compact asphalt paving surface course to required density, with approved rolling equipment. Start compaction as soon as pavement will bear equipment without checking or undue displacement. Compact each layer to 96% maximum laboratory density, or as shown on the plans.
- E. Do not allow vehicular traffic on newly paved areas until surface has cooled to atmospheric temperature, minimum of 6 hours after final installation.
- F. Perform hand tamping in areas not accessible to rolling equipment.
- G. Ensure surface of completed asphalt pavement is true to lines, profiles, and elevations of adjacent pavement surfaces.

### 3.07 ADJUSTING MANHOLE FRAMES AND VALVES

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- A. Adjust manholes, valves, and other appurtenances to required elevations.
- B. Provide asphalt collars when adjustments are required. Collars shall be placed to a minimum total pavement thickness of six (6) inches.
- C. Adjustment of manholes, valves, and other appurtenances are considered incidental to the Work and no additional payment will be made for adjustments or paving repairs.

END OF SECTION 321218

## SECTION 321314

### PORTLAND CEMENT CONCRETE PAVEMENT

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED

The work in this section includes the replacement of disturbed or damaged concrete walks, ramps, driveways, driveway approaches, aprons, curbs and gutters, and the associated base materials.

##### 1.02 REFERENCE STANDARDS

- |    |            |   |
|----|------------|---|
| A. | ASTM C150  | Portland Cement   |
| B. | ASTM C94   | Ready-Mixed Concrete  |
| C. | ASTM C260  | Air-Entraining Admixtures for Concrete  |
| D. | ASTM A185  | Welded Steel Wire Fabric for Concrete Reinforcement   |
| E. | ASTM A615  | Deformed and Plain Billet-Steel Bars for Concrete Reinforcement                                       |
| F. | ASTM C33   | Concrete Aggregates   |
| G. | ASTM D1751 | Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction                     |
| H. | ASTM C309  | Liquid Membrane - Forming Compounds for Curing Concrete   |
| I. | ASTM D1557 | Tests for Moisture - Density Relations of Soils using 10-lb (4.5 kg) Rammer and 18-inch (457 mm) Drop |

##### 1.03 RELATED WORK

- |                |   |
|----------------|---|
| Section 330510 | Excavating, Backfilling, and Compacting for Utilities |
| Section 033000 | Cast-In-Place Concrete                                |

##### 1.04 INSPECTION AND TESTING

- A. Three (3) concrete test cylinders will be taken for and up to every 100 cu. yds. of concrete placed.

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- B. One (1) additional test cylinder will be taken during cold weather concreting, and be cured on job site under same conditions as concrete it represents.
- C. One (1) slump test will be taken for each set of test cylinders taken.

**PART 2 - PRODUCTS**

**2.01 GRAVEL BASE MATERIALS**

- A. Gravel Base: Angular crushed natural stone; free from shale, clay and friable materials and debris; graded within following limits:

<u>Sieve Size</u>	<u>1" GRADATION</u>	<u>Percent Passing</u>
1 inch (25 mm)		100
¾ inch (19 mm)		90 to 100
½ inch		79 to 91
3/8 inch		65 to 70
No. 4		49 to 61
No. 16		27 to 35
No. 50		17 to 21
No. 200		5 to 12

**2.02 CONCRETE MATERIALS**

- A. Portland Cement. ASTM C150; Type IIA Modified or Type V.
- B. Fine Aggregate.

- 1. Fine aggregate for concrete shall conform to the requirements of AASHTO M-6 with the following exceptions:

Max. Percentage by Weight

Clay Lumps	0.5
Coal, Lignite, or Shale	0.3
Material Passing No. 200 Sieve	4.0

The sum of the above materials and other deleterious substances such as shale, alkali, mica, coated grains, or soft and flaky particles shall not exceed 4% by weight.

- 2. Grading. Fine aggregate shall be well graded from coarse to fine and shall conform to the following gradation requirements:

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For Concrete:

<u>Sieve Size</u>	<u>% Passing</u>
3/8 inch	100
No. 4	90 to 100
No. 50	10 to 30
No. 100	2 to 10

C. Coarse Aggregates

1. General. Coarse aggregates for concrete shall consist of crushed stone, gravel, or other approved inert materials of similar characteristics, or combinations thereof, having strong and durable pieces. The aggregates shall be free from vegetable matter, lumps or balls of clay, adherent films of clay, or other matter that would prevent thorough bonding, in accordance with the following limits.
2. Deleterious Substances. The amount of deleterious substances shall not exceed the following limits:

Max. Percentage by Weight

Shale or Coal	0.3
Clay Lumps	0.3
Material Passing a No. 200-Sieve	2.0
Other deleterious substances, such as friable, thin, elongated, or laminated pieces	2.0

The sum of the above material and other deleterious substances shall not exceed five percent (5%) by weight.

3. Wear and Soundness. Coarse aggregates for concrete shall have a percentage of wear of not more than 40 when tested in accordance with AASHTO T-96 or show a sodium sulphate loss not to exceed 12 percent (12%) when tested in accordance with AASHTO T-104. The wear and soundness requirements may be waived, or modified, by the Engineer provided that the coarse aggregate has a proven service record for similar service and exposure.
4. Grading. Coarse aggregate for concrete shall meet the following gradation limits for the concrete class specified. Other sizes or combinations of sizes may be used when specified.

Sieve	Percent Passing
<u>Designation</u>	<u>(by weight)</u>

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1 "	100
¾"	95-100
½"	-
3/8"	20-55
No. 4	*0-10

\*Not more than five percent (5%) shall pass a No. 8 sieve.

- D. Water. Clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious material.
- E. Air Entrainment. ASTM C260.

#### 2.03 REINFORCEMENT

- A. Reinforcing Steel. 60 ksi yield strength; plain deformed billet steel bars; ASTM A615; plain finish.
- B. Welded Steel Wire Fabric. Plain type, ASTM A185; plain finish.
- C. Tie Wire. Minimum 16 gage annealed type, or patented system acceptable to Engineer.

#### 2.04 FORM WORK AND ACCESSORIES

- A. FORM WORK. Matched, tight fitting and adequately stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of concrete.
- B. Pre-formed Expansion Joint Material. Joint material shall comply with the requirements of ASHTO M-213, ASTM D994, ASTM D1751 or ASTM D1752. Minimum 2-inch thick.
- C. Use slip form equipment only upon approval of Engineer.

#### 2.05 CONCRETE MIX

- A. Mix and proportion to produce minimum 4000 psi (MPa) concrete at 28 days with maximum slump of 3 inches and 5 to 7 percent air-entrainment.
- B. Use accelerating admixtures in cold weather only when acceptable to Engineer. Use of admixtures shall not relax cold weather placement requirements. Do not use calcium chloride.
- C. Use set-retarding admixtures during hot weather only when acceptable to Engineer.

#### 2.06 CURING COMPOUND

Curing Compound. ASTM C309, Type I, liquid membrane curing compound.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION OF SUB-GRADE**

- A. Ensure rough grading has brought sub-grade to required elevations.
- B. Fill soft spots and hollows with additional fill.
- C. Level and compact sub-grade, to receive granular base for concrete walks, ramps, curbs and gutters, to 96% max. laboratory density, AASHTO T-99, Method D.
- D. Check curb and gutter grades to verify drainage.

#### **3.02 PLACEMENT OF GRAVEL FILL AND SAND CUSHION**

- A. Place and level gravel base over prepared sub-grade to a compacted depth indicated on drawings true to lines and levels. Compact to 95% of maximum modified proctor density, ASTM D 1557.
- B. During concrete placement, keep base sufficiently moist to prevent excessive absorption of water from freshly placed concrete.

#### **3.03 FORMING**

- A. Form vertical surfaces to full depth and securely position to required lines and levels. Ensure form ties are not placed so as to pass through concrete.
- B. Arrange and assemble FORM WORK to permit easy dismantling and stripping, and to prevent damage to concrete during FORM WORK removal.

#### **3.04 PLACING REINFORCING**

- A. Reinforce concrete walks, curbs and gutters. Allow for minimum 12-inch concrete cover.
- B. Do not extend reinforcing through expansion and contraction joints. Provide dowelled joints through expansion and contraction joints, with one end of dowels fitted with capping sleeve to allow free movement.

#### **3.05 FORMING EXPANSION AND CONTRACTION JOINTS**

- A. Place contraction joints transverse to the line of work at regular intervals equal to the width of the sidewalk and at intervals not exceeding 10 feet for curbs and gutters. Where possible, make joints of curbs coincide with joints in walks. When sidewalks abut curb, provide continuous joint filler.

- B. Place expansion joints at immovable structures, at points of curve, and at intervals not to exceed 40 feet for curbs and gutters and sidewalks. Expansion joint material to be 1/2-inch thick, placed to full depth and width of joint.
- C. Fit joints with filler of required profiles, set perpendicular to longitudinal axis of walks, ramps, curbs and gutters.

### 3.06 PLACING CONCRETE

- A. Place concrete, screed and wood float surfaces to a smooth and uniform finish, free of open texturing and exposed aggregate. Consolidate by spading or vibration.
- B. Avoid working mortar to surface.
- C. Make 3-inch wide dummy joints at 5-foot intervals.
- D. Round all edges, including edges of dummy and expansion and contraction joints, with 2-inch radius edging tool.
- E. Where paved surfaces are adjacent to walks, make concrete curbs and gutters integral with walks. Make expansion and contraction joints of curbs coincide with walk joints. Provide dummy joint at line between walks and curbs.
- F. Provide exposed surfaces of walks, curbs and gutters with fine-haired broom finish, applied transverse to the line of work.
- G. Pour concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur.
- H. Conform to ACI 305 when concreting during hot weather.
  - 1. Concrete just placed shall be protected from the direct rays of the sun and forms and reinforcement shall be sprinkled with cold water just prior to placing concrete. The Contractor shall avoid excessive mixing of the concrete after arrival on the job.
  - 2. Concrete with a temperature above 90°F, when ready for placement, will not be acceptable and will be rejected.
- I. Conform to ACI 306 when concreting during cold weather.
  - 1. Concrete shall not be placed on frozen ground, and no frozen material or material containing ice shall be used. Materials for concrete shall be heated when temperature is below 40°F, or is expected to fall below 40°F within 72 hours. Concrete after placing shall be protected by covering, heating, or both.

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2. All details of the Contractor's handling and protecting of concrete during freezing weather shall be subject to the approval and direction of the Engineer. All procedures shall be in accordance with provisions of ACI 306.
- J. Ensure finished surfaces do not vary from true lines, levels, or grade by more than  $\frac{1}{8}$  inch in 10 feet (3 mm in 3 m) when measured with straightedge.
- K. Apply curing compound on finished surfaces immediately after placement. Apply in accordance with manufacturer's recommendations.

### 3.07 PROTECTION

- A. Do not allow vehicular traffic or construction equipment to cross sidewalks or curbs and gutters following installation, unless otherwise approved by the Engineer.
- B. Remove and replace damaged areas, discolored areas, or cracked sections at no additional cost to the Owner.

END OF SECTION 321314



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## SECTION 321315

### CONCRETE DRIVEWAY, WALK, CURB AND GUTTER

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED

- A. Sub grade preparation for walkways, ramps, curbs and gutters, waterways.
- B. Base course for walkways, ramps, curbs and gutters, waterways.
- C. Concrete walkways, ramps, curbs and gutters, waterways and other concrete flat work, complete with reinforcement as required.

##### 1.02 RELATED WORK

- A. Section 312100: Earthwork

##### 1.03 REFERENCE STANDARDS

- A. ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- B. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- C. ASTM C33 - Concrete Aggregates.
- D. ASTM C94 - Ready-Mixed Concrete.
- E. ASTM C150 - Portland Cement.
- F. ASTM C260 - Air-Entraining Admixtures for Concrete.
- G. ASTM C309 - Liquid Membrane - Forming Compounds for Curing Concrete.
- H. ASTM C1116 - Fiber Reinforcement.
- I. ASTM D1557 - Tests for Moisture - Density Relations of Soils using 10 lb (4.5 kg) Rammer and 18 inch (457 mm) Drop.
- J. ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

##### 1.04 INSPECTION AND TESTING

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- A. Three (3) concrete test cylinders will be taken for every 100 cu. yds. of concrete placed.
- B. One (1) additional test cylinder will be taken during cold weather concreting, and be cured on job site under same conditions as concrete it represents.
- C. One (1) slump test will be taken for each set of test cylinders taken.

**PART 2 - PRODUCTS**

**2.01 UNTREATED BASE COURSE MATERIAL**

- A. Angular crushed natural stone; free from shale, clay and friable materials and debris; graded within following limits per ASTM C 136:

GRADATION, 1" MAXIMUM SIZE

<u>Sieve Size</u>	<u>% Passing</u>
1 inch (25 mm)	100
¾ inch (19 mm)	90 to 100
½ inch	78 to 90
3/8 inch	65 to 70
No. 4	47 to 61
No. 16	23 to 35
No. 50	10 to 20
No. 200	5 to 11

- B. Material passing the No. 40 sieve: Non-plastic and liquid limit less than twenty-five (25), when tested in accordance with AASHTO Test Methods T-89 and T-90.
- C. Percentage of wear not to exceed fifty (50) when tested in accordance with AASHTO Test Method T-96.
- D. Rodded Weight: Not less than 75 pounds per cubic foot when tested in accordance with AASHTO Test Method T-19.
- E. California Bearing Ratio Value (CBR) of eighty (80) minimum when tested in accordance with ASTM Test Method D-1883.
- F. Determine material passing the No. 200 sieve by washing in water in accordance with ASTM Test Method T-11.

**2.02 CONCRETE MATERIALS**

- A. Portland Cement: ASTM C150; Type II

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B. Fine Aggregate for Concrete.

1. Fine aggregate deleterious substance limits conform to the requirements of ASTM C 33 with the following exceptions:

<u>Substance</u>	<u>Max. % by Weight</u>
Clay Lumps	0.5
Coal and Lignite	0.3
Other Substances	2.0

2. Grading. Well-graded fine aggregate from coarse to fine conforming the following gradation requirements:

<u>Sieve Size</u>	<u>% Passing</u>
3/8 inch	100
No. 4	90 to 100
No. 50	10 to 30
No. 100	2 to 10

C. Coarse Aggregates for Concrete.

1. Crushed stone, gravel, or other approved inert materials of similar characteristics, or combinations thereof, having strong and durable pieces.
2. The aggregates shall be free from vegetable matter, lumps or balls of clay, adherent films of clay, or other matter that would prevent thorough bonding. Coarse aggregate deleterious substance limits conform to the requirements of ASTM C 33 with the following exceptions:

<u>Substance</u>	<u>Max. % by Weight</u>
Coal and Lignite	0.3
Clay Lumps	0.3
Soft Fragments	2.0
Other deleterious substances (such as friable, thin, elongated, or laminated pieces)	2.0

3. Wear and Soundness. ASTM C88. Percentage of wear for coarse aggregates of not more than 40 when tested in accordance with AASHTO T-96 or show a sodium sulphate loss not to exceed 12 percent (12%) when tested in accordance with AASHTO T-104. The wear and soundness requirements may be waived, or modified, by the Engineer provided that the coarse aggregate has a proven service record for similar service and exposure.

4. Gradation. Per ASTM C33. Coarse aggregate for concrete shall meet the following gradation limits for the concrete class specified. Other sizes or combinations of sizes may be used when specified.

<u>Sieve Designation</u>	<u>Percent Passing (by weight)</u>
1 "	100
3/4"	95-100
1/2"	-
3/8"	20-55
No. 4	*0-10

\*Not more than five percent (5%) shall pass a No. 8 sieve.

- D. Water: Clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious material, complying with AASHTO T-26.
- E. Air-Entraining Agent: Use in all weather-exposed concrete. Comply with ASTM C260, except the dilative durability factor in the freezing and thawing test shall not be less than 95.
- F. Fiber Reinforcement (include when specifically indicated): Synthetic fibers engineered and designed for secondary reinforcement of concrete slabs, complying with ASTM C116, Type III.

#### 2.03 CONCRETE MIX

- A. Mix and proportion to produce minimum 4000 psi compressive strength concrete at 28 days with maximum slump of 3 inches and 5 to 7 percent air-entrainment.
- B. Provide Ready-Mixed concrete. Comply with ASTM C 94.
- C. Use accelerating admixtures in cold weather only when acceptable to Engineer. Use of admixtures shall not relax cold weather placement requirements. Do not use calcium chloride.
- D. Use set-retarding admixtures during hot weather only when acceptable to Engineer.

#### 2.04 REINFORCING MATERIALS

- A. Reinforcing Bars: 60 ksi yield strength; plain deformed billet steel bars; ASTM A615; plain finish.
- B. Epoxy-Coated Reinforcing Bars (use where indicated): ASTM A775 with ASTM A 615, Grade 60 deformed billet steel bars.

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- C. Welded Steel Wire Fabric: Plain type, ASTM A185; plain finish.
- D. Tie Wire: Minimum 16 gage annealed type, or patented system acceptable to Engineer.
- E. Joint Dowel Bars: Plain steel bars, ASTM A615, Grade 60 plain steel bars.
- F. Supports for Reinforcement: Chairs, spacers, dowel bar supports and other devices for spacing, supporting and fastening reinforcing bars, welded wire fabric and dowels in place. Use wire bar-type complying with CRSI specifications.

## 2.05 FORMS

- A. Plywood, metal, metal-framed plywood or other acceptable panel type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Use flexible or curved forms for curves of a 100-foot or less radius. Provide forms with matched, tight-fitting joints and adequate stiffeners to support weight of concrete without deflection detrimental to tolerances and appearance of concrete.
- B. Slip form construction may be used subject to approval of the Engineer. Provide slip-forming equipment with traveling side forms of sufficient dimensions, shape, and strength to support concrete laterally for a sufficient period of time during placement to produce pavement of the required cross-section. The equipment shall spread, consolidate, screed, and float finish the freshly placed concrete in such a manner as to provide a dense homogeneous pavement.
- C. Form Release Agent: Provide commercial formulation form-release agent that will not stain or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces. Comply with VOC limitation regulations.

## 2.06 JOINT MATERIAL

- A. Provide joint material of type, thickness, and widths indicated on the drawings.
- B. Joint Filler: Bituminous mastic complying with ASTM D 994, formed and encased between 2 layers of bituminous saturated felt or 2 layers of glass-fiber felt. Minimum 1/2 inch thick.
- C. Joint Sealant: Provide one of the following:
  - 1. Concrete Joint Sealer, Cold-Applied: Elastomeric type complying with ASTM C 920, Type S or M, Grade P or NS, Class 25, Use T, NT, M and O, chemically curing suitable for vehicular or pedestrian use, types of construction and substrates indicated, as recommended by Manufacturer.
    - a. Self-leveling
    - b. Shore Hardness: 40 plus or minus, 5 ASTM D 2240.
    - c. Final cure: 4 days maximum.

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- d. Service range: -10 to 150 degrees F.
- 2. Concrete Joint Sealer, Hot-Applied: Resilient and adhesive compound type complying with ASTM D 340, Type and Grade suitable for specific application as recommended by Manufacturer.
- D. Obtain joint sealing materials from a single manufacturer for each different product required.
- E. Provide materials that are compatible with one another and with joint substrates under the conditions of service and application.

#### 2.07 CURING MATERIALS

- A. Insulating Coverings: One of the following.
  - 1. Straw.
  - 2. Insulating blankets.
- B. Moisture-Retaining cover: One of the following, complying with ASTM C 171.
  - 1. Waterproof paper.
  - 2. Polyethylene film.
  - 3. White burlap-polyethylene sheet.
- C. Curing Compound: White-pigmented waterborne membrane-forming curing compound free from permanent color, complying with ASTM C 309, Type I, Class B.
- D. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

#### 2.08 PAINTED TRAFFIC LINES AND MARKINGS

- A. Alkyd-resin ready-mixed paint, complying with AASHTO M 248, Type F. Provide approved substitute as required to comply with applicable VOC limitations.
- B. Color.
  - 1. Pavement and Parking Striping, Stop Bars - White.
  - 2. Crosswalks and Zebra Striping - White.
  - 3. Fire Lane Curbs - Red.

4. Accessible Parking Markings - Blue.
- C. Non-slip Aggregate Finish (where indicated): Fused aluminum oxide granules or crushed emery as the abrasive aggregate for a non-slip finish, with aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory graded, packaged, rustproof, non-glazing, and unaffected by freezing, moisture and cleaning materials.
- D. Bonding Agent: Acrylic or styrene butadiene
- E. Epoxy Adhesive: ASTM C881, two-component material suitable for damp or dry surfaces. Material type, grade and class to suit requirements.
- F. Apply pavement markings only with equipment manufactured specifically for that purpose. Use equipment capable of applying a stripe of the desired width with a tolerance of plus or minus 1/4 inch.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION**

- A. Check construction staking. Notify Engineer of conflicts or slope and drainage deficiencies. Failure to check and verify or notify Engineer will result in Contractor repairing and drainage deficiencies at no additional cost to the Owner.
- B. Check form work with construction staking and drawing elevations prior to placing concrete. Adjust form work as necessary. Notify Engineer of conflicts or slope and drainage deficiencies.

#### **3.02 PREPARATION OF SUBGRADE**

- A. Ensure rough grading has brought subgrade to required elevations.
- B. Fill soft spots and hollows with additional structural fill.
- C. Level and compact subgrade, to receive granular base course for concrete walkways, ramps, curbs and gutters, to 95% of maximum laboratory density, AASHTO T-99, Method D.

#### **3.03 PLACEMENT OF BASE COURSE**

- A. Place and level untreated base course over prepared subgrade to a compacted depth indicated on drawings true to lines and levels. Compact to 95% of maximum modified proctor density, ASTM D 1557.

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- B. Adjust moisture content of base course material, as determined by ASTM D 698, as necessary to plus or minus 2 percent of optimum moisture as required to obtain the specified degree of compaction.
- C. Protect placed and compacted base course. Remove and replace "softened" base course areas occurring between base course placement and concrete placement.
- D. During concrete placement, keep base sufficiently moist to prevent excessive absorption of water from freshly placed concrete.

#### 3.04 FORM WORK

- A. Provide sufficient forms to allow continuous progress of the work and so the forms can remain in place at least 24 hours after concrete placement.
- B. Make forms sufficiently tight to prevent loss of concrete.
- C. Form vertical surfaces to full depth and securely position to required lines, dimensions, and levels. Ensure form ties are not placed so as to pass through concrete.
- D. Arrange and assemble form work to permit easy dismantling and stripping, and to prevent damage to concrete during form work removal.
- E. At construction joints, overlap forms over hardened concrete at least 6 inches. Prevent offsets or loss of concrete at construction joint. Maintain a true surface.
- F. Position expansion joint material and other embedded items accurately and support to prevent displacement.
- G. Provide formed openings for elements embedded in or passing through concrete.
- H. Apply form release agent on form work per manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.
- I. Do not pry against face or visible edges of concrete to remove forms. Remove and replace sections of concrete work damaged during form removal at no additional cost to the Owner.
- J. Thoroughly clean and properly coat forms before reuse.

#### 3.05 REINFORCEMENT PLACEMENT

- A. Reinforce concrete walks, curbs and gutters as required on the drawings.
- B. Clean reinforcement of loose rust, mill scale, earth, ice, or other bond-reducing materials.

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- C. Comply with Concrete Reinforcing Steel Institute's recommended practice for placing and supporting reinforcing bars.
- D. Maintain minimum cover over reinforcement. Allow for a minimum 1-1/2 inch concrete cover unless otherwise noted.
- E. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps to prevent continuous laps.
- F. Do not extend reinforcing through expansion and contraction joints. Provide doweled joints through expansion and contraction joints, with one end of dowels fitted with capping sleeve to allow free movement.

### 3.06 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete form work installation, reinforcing steel, and items to be embedded.
- B. Remove snow, ice or frost from base course surface and reinforcing before placing concrete. Do not place concrete on surfaces that are frozen.
- C. Moisten base course if required to provide uniform dampened condition at the time of concrete placement.
- D. Coordinate with the testing laboratory prior to delivery of concrete. Schedule to have a testing agent on site prior to the start of the pour.
- E. Do not discharge concrete into forms if the slump or air-entrainment does not meet the specification requirements.
- F. Do not discharge concrete if the time period from the batching at the plant to site discharge exceeds the following:
  - 1. Air temperature less than 90 degrees F.: 1-1/2 hours
  - 2. Air temperature over 90 degrees F. (without a retarder): 1 hour
  - 3. Air temperature over 90 degrees F. (with a retarder): 1-1/2 hours
- G. When concrete arrives at the site with a slump below specified, water may be added if the maximum approved water/cement ratio and maximum slump is not exceeded provided that:
  - 1. Approved mix design allows for on-site addition of water.

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2. Water addition can be accurately measured to within a gallon of the desired quantity.
  3. Water addition is followed by 3 minutes of mixing at mixing speed prior to discharge.
- H. Place concrete per ACI 301.
1. Hot Weather Placement: Place per ACI 305.
  2. Cold Weather Placement: Place per ACI 306.1. Non-chloride accelerating admixture may be used in concrete work placed at temperatures below 50 degrees F.
- I. Maintain mixed concrete temperature at time of placement between 60 degrees F. and 90 degrees F.
- J. Do not disturb reinforcement, inserts, embedded parts and formed joints.
- K. Do not break or interrupt successive pours such that cold joints occur at locations other than expansion type joints.
- L. Honeycomb or embedded debris in concrete is not acceptable.
- M. Consolidate per ACI 309.
- N. Placement of curb and gutter by slip-form paving equipment is acceptable. Comply with the following:
1. Provide adequate control for lines, grades and elevations.
  2. Provide equipment that will produce required cross-section, lines, grades, finish and jointing as specified for formed concrete.
  3. Prevent damage to adjacent curbs, gutters and pavement by equipment.
  4. After placement, check fresh concrete with a straight-edge to ensure the concrete complies with tolerances specified.
  5. Provide final finish on slip-formed curb and gutter in accordance with Section 3.07.
  6. If results are not acceptable, remove and replace work with formed concrete.

### 3.07 CONTRACTION JOINTS

- A. Construct at right angles to top surface of placement.

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- B. Construct straight unless otherwise indicated.
- C. Construct traverse and longitudinal joints the same dimension.
- D. Tooled Joints (Score Lines): Maximum depth 1 inch with a top radius of  $\frac{1}{2}$  inch, unless otherwise noted on the drawings.
- E. Saw Cut Joints: Saw cuts before uncontrolled shrinkage cracking occurs. Do not tear or ravel concrete during sawing.
- F. Templates:  $\frac{1}{8}$  to  $\frac{3}{16}$  inch wide.
- G. Sidewalks: Construct contraction joints as follows.
  - 1. At intervals equal to the width of the sidewalk and transverse to the line of the walk.
  - 2. Radial at curbs and walks.
  - 3. Place longitudinal joints in walks with width of walk in feet is greater than 2 times the walk thickness in inches (e.g. Maximum width of a 4 inch thick walk before placement of a longitudinal joint is 8 feet).
  - 4. At walk returns make joints radial.
  - 5. Match longitudinal and traverse joints with adjacent walks.
- H. Curb, Gutter, Waterway: Construction joints as follows:
  - 1. Place joints at intervals not exceeding 10 feet.
  - 2. At curb radius and walk returns make joints radial.
  - 3. Where possible, make joints of curbs coincide with joints in walks.
  - 4. Where integral curb and gutter is adjacent to concrete pavement, align joints with pavement joints where practical.

### 3.08 EXPANSION JOINTS

- A. Place expansion joints where indicated on the drawings and at immovable structures, when sidewalks abut curb, at points of curve, and at back of curb returns.
- B. Construct at right angles to top surface of placement.

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- C. Construct straight unless otherwise indicated.
- D. Construct traverse and longitudinal joints the same dimension.
- E. Place expansion joint material to full depth and width of joint. Fit joints with filler of required profiles, set perpendicular to longitudinal axis of walks, ramps, curbs and gutters.
- F. Do not place longitudinal expansion joints in waterways
- F. Do not place expansion joints in curb returns.
- G. Do not extend reinforcement through an expansion joint. Place dowel mechanisms as required.

### 3.09 SEALED JOINTS

- A. Provide sealed joints where required on the drawings. Install cold or hot-applied sealant as required.
- B. Saw cut joints as necessary to provide the required sealant thickness and depth.
- C. Remove oil, grease, wax, form-release agents, curing compounds and other materials by sand or water blasting as recommended by the manufacturer of the sealant. Remove frost and moisture prior to sealing.
- D. Install sealants in uniform, continuous ribbons without gaps or air pockets with complete bonding of joint surfaces.
- E. Fill surface rabbet flush with pavement surface.
- F. Fill joints to a depth equal to 75 percent of the joint width, but not less than 3/8 inch deep or greater than 5/8 inch deep, unless otherwise indicated on the drawings.
- G. Do not overfill joints. Clean overflow or spillage from adjoining surfaces.

### 3.10 FINISHING

- A. Round all edges, including edges of expansion and contraction joints, with 1/2 radius edging tool, unless otherwise noted on the plans. Eliminate tool marks on concrete surfaces.
- B. Ensure finished surfaces do not vary from true lines, levels or grade by more than 1/8 inch in 10 feet (3 mm in 3 m) when measured with straightedge.
- C. Screed and float exposed surfaces to a smooth and uniform finish, free of open texturing and exposed aggregate. Avoid working mortar to surface. Remove and replace sections where the surface has been overworked at could result in spalling.

- D. Finish exposed surfaces of walks with grades of less than or equal to 6 percent with a fine-hair broom applied transverse to the line of the walk.
- E. Finish exposed surfaces of walks with grades of greater than 6 percent with a rough broom applied transverse to the centerline.
- F. Finish exposed surfaces of curbs, gutters and waterways with a medium texture broom applied longitudinal to the line of the curb, gutter or waterway.
- G. Provide detectable warnings in the concrete surface at curb ramps
- H. Do not add water to concrete surface (sprinkle) without approval of the Engineer.

### 3.11 CURING

- A. Apply curing compound on finished surfaces immediately after placement. Apply in accordance with manufacturer's recommendations.
- B. Do not apply curing compound to areas to receive special finishes or paint.
- C. Protect placed concrete from freezing or excessive moisture loss. Install covers or apply compounds as required. Apply compounds in accordance with manufacturer's recommendations.

### 3.12 PAINTING

- A. Apply traffic paint for curbs and markings at all fire lanes and other locations as indicated on the drawings.
- B. Apply with mechanical equipment to produce uniform straight edges.
- C. Apply at manufacturer's recommended rates to provide a 15-mil minimum wet film thickness.

### 3.13 FIELD QUALITY CONTROL

- A. Line: Less than 1/2 inch variance in 10 feet and not more than 1 inch from true line at any location.
- B. Grade: Not more than 1/4 inch variance in 10 feet. Flood curb and gutter with water after final cure has been reached. Remove and replace any area where ponding is found to stand more than 3/8 inch deep.
- C. Walk Cross Slope: Slope indicated on plans or 4 percent maximum, 1 percent minimum.

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### 3.14 PROTECTION

- A. Prevent damage to placed concrete.
- B. Exclude traffic or equipment from placed concrete for a minimum of 14 days.
- C. Maintain a clean surface and remove spill and surface stains until Substantial Completion.
- D. Remove and replace damaged areas, discolored areas, or cracked sections at no additional cost to the Owner.
- E. Do not backfill against placed concrete for a minimum of 7 days, unless otherwise approved by the Engineer.
- F. Do not permit paving operations (base course or asphalt) against placed curbs, gutters and waterways for a minimum of 7 days, unless otherwise approved by the Engineer.
- G. Do not permit paving operations against placed curbs and gutters without completed backfilling behind curbs.

END OF SECTION 321315

SECTION 32 90 00 – LANDSCAPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this section.

1.2 SUMMARY

- A. The extent of the landscape development work is shown on the drawings and in schedules and includes topsoil, ammendments, preparation of landscaped areas, placement of all plant materials, crushed stone and bark mulches, maintenance and guarantee for plantings, and other information shown or specified.
1. Subgrade Elevations: Subgrade elevations shall be provided at plus or minus 2" as shown in the drawings. Landscape grading shall be restricted to placement of all topsoil and preparation of finish grade.
- B. Related Sections:
1. Irrigation 32 84 23
  2. Site Grading

1.3 RECORD DRAWINGS

- A. The Contractor will keep a record of all departures from the contract drawings that occur during construction. These shall be kept on a clean set of prints of the contract drawings. The Owner's Authorized Representative will review the "record drawings" to verify that changes are being recorded as construction occurs.
- B. The Contractor to deliver to the Owner's Authorized Representative a copy of the record drawings in hard copy form prior to final payment.

1.4 QUALITY ASSURANCE

- A. The landscape work shall be done by a single licensed Landscape Contractor specializing in landscape work. The on site supervisor must have a minimum of three years experience in landscape construction and one year experience in a supervisory role.

1.5 PLANT MATERIAL SOURCE QUALITY CONTROL

- A. General: Ship landscape materials with certificates of inspection as required by governmental authorities. Comply with governing regulations applicable to landscape materials.
- B. The source or supplier for all plant materials shall be furnished to the Owner's Authorized

Representative prior to the delivery of any plant materials on site or stored elsewhere.

- C. Provide trees and shrubs, and other plant materials grown in a recognized nursery in accordance with good horticultural practice. Provide healthy, vigorous stock grown under climatic conditions similar to the locality of the project and free of disease, insects, eggs, larvae, and defects such as knots, sun-scale, injuries, abrasions, or disfigurement.
- D. Plant materials and other landscape items will be evaluated according to compliance with drawings, schedules, and specifications; as well as overall aesthetic quality, grower or supplier reputation, physical inspection, and American Association of Nurseryman Standards (AANS).
- E. All plant materials are to be inspected and approved by the Owner's Authorized Representative at the time of delivery on site. This approval does not constitute final acceptance of any plant material. All plant materials will be inspected again at time of final inspection and once again at the end of the warranty period. Any plant found to be unacceptable at any of these inspections shall be immediately removed and replaced.
- F. **DO NOT MAKE SUBSTITUTIONS.** If specified landscape material is not obtainable, submit in writing proof of non-availability from a minimum of three suppliers regularly engaged in the growing and sale of the kind and species of plants specified and a proposal for use of equivalent material for evaluation to be accepted or not accepted prior to the bid.

#### 1.6 PLANT MATERIALS

- A. Trees, shrubs, and other plants: Do not prune prior to delivery. Do not bend or bind-tie in such a manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery.
- B. Deliver plants after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set plants in shade, protect from weather and mechanical damage, and keep roots moist.
- C. Do not remove container-grown stock from container until planting time
- D. Label at least one plant of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.
- E. Substitutions: If specified landscape material is not obtainable, submit in writing proof of non-availability and a proposal for use of equivalent material for evaluation to be accepted or unaccepted prior to the bid.
- F. Sizes: Provide plants of the sizes shown or specified. Plants of a larger size may be used pending approval by the Owner's Authorized Representative and if sizes of root balls or containers are increased proportionately.

#### 1.7 STORAGE AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at the site.
- B. The Contractor shall check the materials upon delivery to assure that proper material has been received.

1.8 GRADING AND TOPSOIL

- A. Observe the conditions under which work is to be performed, and notify the Owner's Authorized Representative of unsatisfactory conditions.
- B. Topsoil Analysis: Furnish a soil analysis made by a qualified independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay, sand), deleterious material, pH, and mineral and plant-nutrient content of topsoil.
- C. Provide topsoil analysis for imported topsoil.

1.9 EXISTING UTILITIES

- A. Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required, to minimize possibility of damage to underground utilities. The Contractor shall have the utilities located prior to digging. It is the responsibility of the Contractor to repair or replace any damage incurred by the contractor or the contractor's employees at no expense to the owner.

1.10 EXCAVATION

- A. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify the Owner's Authorized Representative before planting.

1.11 PLANTING SCHEDULE

- A. Prepare a proposed planting schedule for approval by the Owner's Authorized Representative. Schedule the dates for each type of landscape work during the normal seasons for such work in the area of the site. Correlate with specified maintenance periods to provide maintenance throughout the specified time period. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.
- B. Proceed with and complete the landscape work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work required.

1.12 GUARANTEE

- A. The guarantee specified shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Guarantee trees, shrubs and other plants for one year following substantial completion against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control.

- C. Remove and replace trees, shrubs or other plant material found to be unacceptable at the time of substantial completion and once again at the end of the warranty period. Replacements shall be made during the growing season and shall comply with all requirements and specifications. Any delay in the completion of any item of work in the planting operation which extends the planting into more than one season shall extend the guarantee period accordingly.

### 1.13 MAINTENANCE

- A. Plant maintenance work shall consist of watering, weeding, caring for plants, edging and mowing the lawn, fertilizing, and performing the following plant establishment work.

- 1. The entire project shall be satisfactorily maintained until substantial completion of the landscape. The maintenance period will begin when all items of work have been completed as specified in the foregoing articles until substantial completion. If project is not accepted, contractor shall be required to continue maintenance until project is accepted.

- 2. All areas including sidewalks and gutters shall be clean and free of debris and weeds. All plant materials shall be live, healthy, free of infestations or weeds, and be of acceptable growth for the time of year. The contractor shall obtain written release from the Owner before ending maintenance

## PART 2 - PRODUCTS

### 2.1 TOPSOIL

- A. Topsoil: Imported topsoil is required in all landscape areas. Imported topsoil shall consist of natural sandy loam and be of uniform quality, free from subsoil, hard clods, stiff clay, hard-pan, sod, partially disintegrated debris or any other undesirable material. Soil shall be free of plants, roots, or seeds that would be toxic or harmful to growth. Topsoil shall be obtained from naturally drained areas and shall contain at least 2 percent organic material as determined by loss upon ignition of a moisture free sample that has been dried in accordance with current methods of the Association of Official Agricultural Chemists.

- 1. Contractor shall furnish a certified report of an approved analytical chemist showing the analysis of the topsoil proposed for use, both stockpiled and imported. Topsoil shall have the follow analysis range.

pH	5.0 - 8.2
Soluble Salts	<4 ds/m or mmho/cm
Sodium Absorption Ratio (SAR)	-7
Organic Matter	2%
Sand	<70%
Silt	<70%
Clay	<30%

- 2. Furnish sample of topsoil to Owner's Authorized Representative prior to delivery of topsoil on site.

- B. Prior to the installation of any topsoil, Contractor shall inspect the existing subgrade for compliance to the specifications with regards to the grade and cleanliness. Any discrepancy shall be brought to the attention of the Owner's Authorized Representative for appropriate action.

- C. Spread the topsoil to the depths specified on the drawings – 12 inches for all landscape lawn areas and 18" in all shrub and perennial areas.

## 2.2 PLANT MATERIALS

- A. Quality: Provide trees, shrubs and other plants that comply with the recommendations and requirements of ANSI 260.1 "Standard for Nursery Stock" and as further specified. The Owner's Authorized Representative reserves the right to refuse plant materials, which does not meet the quality required for the project.
- B. Locally Grown Plant Materials: To the extent possible, provide plants and other materials grown within northern Utah and southern Idaho. Provide a list of all materials and indicate whether or not they are locally grown.
- C. Deciduous Trees: Provide trees of height and caliper listed or shown and with minimum branching configuration recommended by ANSI 260.1 for type and species required. Provide single stem trees except where special forms are shown or listed.
  - 1. Provide balled and burlapped (B&B) deciduous trees.
  - 2. Container grown deciduous trees will be acceptable in lieu of balled and burlapped deciduous trees and where specified in plant schedule subject to specified limitations of ANSI 260.1.
- D. Deciduous Shrubs: Provide shrubs of the height and size shown or listed and with not less than the minimum number of canes required by ANSI 260.1 for the type and height of shrub required.
  - 1. Container grown deciduous shrubs will be acceptable subject to specified limitations of container grown stock.
- E. Coniferous Evergreen Trees and Shrubs: Provide evergreen trees and shrubs of the sizes shown or listed. Provide normal quality evergreens with well balanced form complying with minimum requirements for other size relationships to the primary dimension indicated on the Planting Plans.
  - 1. Container grown evergreens will be acceptable subject to the specified limitations for container grown stock.
- F. Groundcovers/Perennials/Vines: Provide materials of the species and size indicated and grown according to ANSI requirements.

## 2.3 GRASS MATERIALS

- A. Sod: All sod shall be two years old that has been cut fresh the morning of installation. Only sod that has been grown in a commercial sod farm shall be used. Do not use sod from any other source. All sod that has not been laid with 24 hours shall be deemed unacceptable and will be removed from the site.
  - 1. Provide Turf Type Tall Fescue Sod using a mix of seed that is locally grown.

## 2.4 MISCELLANEOUS MATERIALS

- A. Water: Potable.
- B. Chemical Fertilizer: Fertilizer shall be based on topsoil analysis.
- C. Herbicides: EPA registered and approved, of type recommended by manufacturer.
- D. Crushed Stone: Crushed Stone shall "Squeegie" by Staker Parson, or equal approved for color and texture.
- E. Concrete Edging: Class A(AE) concrete. Concrete placed with a slip form/extrusion machine shall have a maximum slump of 2-1/2 inches.
- F. Bark Mulch: Medium shredded bark mulch. Submit samples before bringing mulch onto project. Provide 3" mulch layer.
- G. Cobble Stone: Provide cobble, installed in detention basins using cobble that ranges in size from 6" to 10". Cobble shall be rounded, river rock type stone in medium buff or tan color tones.

## PART 3 - EXECUTION

### 3.1 COORDINATION

- A. The contractor shall coordinate his work with that of other contractors on site, and shall cooperate to the fullest extent to see that the work is completed in a timely and workmanship like manner.

### 3.2 INSTALLATION OF TOPSOIL

- A. Prior to the installation of any topsoil and mulch, contractor shall inspect the existing grade for compliance to the specifications with regards to the grade and cleanliness. Any discrepancy shall be brought to the attention of the Owner's Authorized Representative for appropriate action.
- B. When contract operations have been completed to a point where the areas will not be disturbed, finish grade shall be cleaned free of waste material of all kinds. Scarify and pulverize the subgrade to a depth of not less than 6" inches. Scarification shall be completed in all landscaped areas.

### 3.3 PREPARATION FOR PLANTING TREES AND SHRUBS

- A. The exact locations of all plants must be approved by the Owner's Authorized Representative prior to the digging of any holes. Refer to the drawings for the sizes and preparation of holes. Prepare all holes according to the details on the drawings.
- B. To avoid a soil water interface problem, excavated soil material from planting holes should be inspected by the Owner's Authorized Representative to determine if such soil should be used

as backfill material. If it is determined that the excavated material is not of good quality, then it shall be modified.

### 3.4 TREE AND SHRUB PLANTING

- A. Prior to planting, fill excavated tree pit with water and allow to percolate out. If, after 24 hours, the water has not percolated out of the pit, notify the Owner's Authorized Representative. Do not plant until the problem has been corrected.
- B. The tree planting holes should be so that the root flare is 2" above the adjacent finish grade. Trees must be placed on undisturbed soil at the bottom of the planting hole. The tree hole depth shall be determined so that the tree may be set at finish grade, using the top of the root flare as a guide.
- C. Set tree on soil, cut wire basket, remove burlap from top 2/3 of ball, and remove. ALL twine, wrappings, etc.
- D. All tree holes shall be backfilled in 12-inch lifts and settled and tamped to minimize any settling of the tree.
- E. Upon completion of backfilling operation, thoroughly water the tree to completely settle the soil and fill any voids that may have occurred.
- F. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches. All cuts, scars and bruises shall be properly treated according to the direction of the Owner's Authorized Representative. Proper pruning techniques shall be used. Do NOT leave stubs and do NOT cut the leader branch. Improper pruning shall be cause for rejection of the plant material.
- G. Saucers: Saucer shall be formed at the base and it shall be watered the same day as planting.
- H. Mulching: Upon completion of all planting operations, remove all undesirable material from the surface of the planting beds, including all rocks over the size of 1 1/2" diameter. Install the specified mulch in all shrub planting beds and tree basins to a uniform depth of 3".

### 3.5 SODDING

- A. Preparation for Sodding
  - 1. When contract operations have been completed to a point where the areas will not be disturbed, subgrade shall be cleaned free of waste material of all kinds. Scarify and pulverize the subgrade to a depth of not less than 6" inches. Scarification shall be completed in all areas that are to be sodded.
  - 2. Distribute topsoil to a depth of 12" over all lawn planting areas under the contract. Do not place topsoil over subgrade that is frozen or damp.
  - 3. The surface on which the sod is to be laid shall be firm and free of footprints, depressions or

undulations of any kind. The surface shall be free of all materials larger than 1/2" in diameter.

4. The finish grade of the topsoil adjacent to all sidewalks, mow strips, etc., and prior to the laying of the sod, shall be 1 1/2" below the top surface of the concrete or hard surface. NO EXCEPTIONS.

B. Installing Sod

1. Prior to laying of sod, the entire surface to receive sod shall be uniformly covered with the specified fertilizer at the rate of 4 pounds per 1000 square feet.
2. Upon completion of the laying operation, an inspection of the area shall be made. All voids and large cracks between individual pieces of sod shall be filled with topsoil, prior to watering.
3. Watering of the sod shall be the complete responsibility of the contractor by whatever means necessary to establish the sod in an acceptable manner prior to acceptance by the owner. An irrigation system is in place on the site, but if for whatever reason, water is not available in the system, it is the full responsibility of the contractor to water the sod by whatever means, until the sod is accepted by the Owner's Authorized Representative.
4. Upon completion of filling all voids in the newly laid sod areas, the sod is to be completely saturated with water.
5. Protection of the newly laid sod shall be the complete responsibility of the contractor. Provide acceptable visual barriers by means of barricades set at appropriate distances and strings or tapes between the barriers as an indication of new work. Restore any damaged areas caused by other, erosion or vehicular traffic until such a time as the lawn is accepted by the Owner's Authorized Representative.

3.6 WEED CONTROL

- A. Weed control is required. The extent of control depends on the type, quantity, and stage of weeds. The following are methods that may be used to control weeds. Apply herbicide so no damage to protected vegetation occurs whether inside or outside of the project site. Damage to protected vegetation or vegetation outside the project site will be reimbursed to the Owner or replaced by the Contractor in a manner satisfactory to the Owner's Authorized Representative, and according to the International Society of Arboriculture Method of "Valuation for Landscape Trees, Shrubs, and Other Plants", latest edition.
- B. Post Emergent:
  1. Mix and apply postemergent herbicide according to manufacturer's recommendations indicated in the "Weeds Controlled" section of the label, and apply to actively growing vegetation.
  2. Apply the spray mixture so that all undesired vegetation is uniformly covered, but avoid causing overspray and drift. Spray target vegetation so that it is wet, but short of run-off.
  3. Prune all suckers at the base of any trees to the soil level prior to application.

4. Do not apply postemergent herbicide in any of these conditions: When rainfall is expected within six hours; when there is growth stress as a result of drought, insects, disease, or plant damage; or when there is heavy dust on plants.
5. Do not walk or permit other traffic on treated areas when they are wet from application. Shoes and equipment may track spray solution to areas where vegetation is not to be treated.
6. Repeat application, as necessary to completely eradicate undesired vegetation.

C. Pre-emergent:

1. Mix and apply pre-emergent herbicide according to manufacturer's recommendations and information on the side panel, and the following: Use granular applicators designed to apply herbicide at Manufacturer's suggested highest rate.
2. Calibrate the applicator according to the manufacturer's directions prior to use and check frequently during application to be sure the equipment is working properly and distributing the granules uniformly. Do not apply more than the recommended amount.
3. Apply granular herbicide according to manufacturer's recommendations and on site conditions and soil preparation requirements or restrictions appropriate to the herbicide used.
4. The pre-emergent application must be followed within 8 hours with overhead watering or rainfall equivalent to 1/2".
5. License: Use a State Licensed applicator to apply herbicide.

D. Mechanical Control:

1. Mechanically control the weeds by pulling, cutting, hoeing, or by any other directed means approved by the Owner's Authorized Representative.
2. Weeds in a dormant stage or other condition which cannot be effectively controlled with postemergent herbicide shall be removed from the site by mechanical methods.

### 3.7 CLEANUP AND PROTECTION

- A. During landscape work store materials and equipment where directed. Keep pavements clean and work area in an orderly condition.
- B. Protect landscape areas, work and materials from damage due to operations by other contractors, trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.
- C. The contractor shall keep the site free from accumulation of waste material. At the time of completion, all areas must be swept or washed clean and all rubbish removed to the satisfaction of the Owner's Authorized Representative.

3.8 INSPECTION AND ACCEPTANCE

- A. When the landscape work is completed, the Owner's Authorized Representative will, upon request, make an inspection to determine Substantial Completion.
- B. The guarantee begins from the date of Substantial Completion.
- C. Where inspected landscape work does not comply with the requirement, replace rejected work and continue specified maintenance until re-inspected by the Owner's Authorized Representative and found to be acceptable. Remove rejected plants and materials promptly from the project site.
- D. As-built Drawings: Furnished to the Owner's Authorized Representative at the time of the Final Inspection before Certificate of Substantial Completion will be issued.

END OF SECTION 32 90 00

SECTION 32 84 23 – IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Section apply to this section.
- B. Consult the index to be certain that the set of documents and specifications is complete. Report omissions or discrepancies to the Owner's Authorized Representative before bidding.

1.2 SUMMARY

- A. The irrigation system will be constructed using the valves, piping, fittings, controllers, wiring, etc., of sizes specified.
- B. Irrigation lines shown on the drawings are essentially diagrammatic. Locations of all valves, piping, wiring, etc. will be modified only with the permission of the Owner's Authorized Representative.
- C. It is the intention of these specifications, together with the accompanying drawings to accomplish the work of installing an irrigation system that will operate in an efficient and satisfactory manner according to the workmanlike standards established for the irrigation industry.

1. As-built Irrigation Drawings: Prepare as-built drawings which shall show deviations from the contract documents made during construction affecting the main line pipe, controller locations, remote control valves, and manual drain valves. The drawings shall also indicate and show approved substitutions of size, materials and manufacturer's name and catalog number. The Contractor will keep a record of all departures from the contract drawings that occur during construction. These shall be kept on a clean set of prints of the contract drawings. The Owner's Authorized Representative will review the "as-builts" to verify that changes are being recorded as construction occurs.

2. As-built Drawings shall be furnished to the Owner's Authorized Representative in hard copy at the time of the Systems Inspection before any Substantial Completion Date will be issued.

- D. The work in this Bid Package consists of furnishing and installing an underground irrigation system and irrigation service to roof-top planters as shown on the drawings and specifications. Include all labor, equipment and materials and perform all operations in connection with the construction of the irrigation system
- E. It will be the contractor's responsibility to report to the Owner's Authorized Representative any deviations between the drawings, specifications and the site. Failure to do so prior to the installing of equipment, and resulting in replacing, and/or relocating, will be done at the contractor's expense.
- F. Permits and Fees: Obtain all permits and pay required fees to any governmental agency having jurisdiction over the work. Inspections required by local ordinances during the course of

construction shall be arranged as required. On completion of the work, satisfactory evidence shall be furnished to the Owner's representative to show that all work has been installed in accordance with the ordinances and code requirements. See existing utilities paragraph below.

- G. Coordination: Coordinate and cooperate with other contractors to enable the work to proceed as rapidly and efficiently as possible.
- H. Inspection of Site: Installer shall acquaint himself with all site conditions. Should utilities not shown on the plans be found during excavations notify the Owner's Authorized Representative. Failure to do so will make installer liable for any and all damage thereto arising from his operations subsequent to discovery of such utilities not shown on plans.
- I. Existing Utilities: Before any trenching, excavation or digging below the surface for any reason is begun, the contractor shall have the area utilities located in order to determine as close as possible the location of all underground utilities. The contractor will conduct his work in such a manner to protect all utilities from damage. It is the responsibility of the contractor to repair or replace any damage incurred by the contractors work or workers at no expense to the owner.
- J. Protection of Existing Site Conditions: The installer shall take necessary precautions to protect site conditions to remain. Should damage be incurred, the Installer shall repair the damage to its original condition at his own expense.
- K. Guarantee: All work shall be guaranteed for compliance with the drawings and specifications for a period of one year after the date of substantial completion. The contractor shall make good any deficiencies at the time he is notified of any faults, and place in satisfactory condition any damage to the buildings or grounds without cost to the owner. All guarantees shall be in writing and approved by the Owner's Authorized Representative before submitting to the Owner.
- L. The work covered by this section of the specifications consists of furnishing all labor, material, equipment and supplies in performing all operations in connection with the irrigation system and all site work in strict accordance with this section of specifications and applicable drawings.
- M. Any minor items of labor or materials not specifically noted on the drawings or specifications; but obviously necessary for the proper completion of the work, are to be considered as incidental to and are to be included in the contract.

### 1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Licensed firms regularly engaged in manufacture of irrigation systems products of types, materials, and sizes required, whose products have been in satisfactory use in similar service.
- B. Installer Qualifications: Licensed firm regularly engaged in successful installation of irrigation systems similar to that required for project.

### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for irrigation system materials and products.
- B. Maintenance Data: Submit maintenance data and parts lists for irrigation system materials and products.

## PART 2 - PRODUCTS

### 2.1 PIPE AND FITTINGS:

- A. All pipes, mainline and laterals shall be schedule 40 PVC with ratings printed on pipe.
- B. All fittings for lateral pipe shall be PVC SCH 40 and 80 as detailed.
- C. All quick couplers shall be installed on pre-assembled swing joint.

### 2.2 CONTROL VALVES:

- A. Rainbird GB valves. Size as noted on plans.

### 2.3 DRAIN VALVES AND VALVE MARKERS:

- A. All drain valves on pressure line shall be a 3/4" ball valve. Each valve shall have a 2" PVC sleeve with a valve marker cap and six inch valve box.

### 2.4 VALVE BOXES:

- A. Control valve boxes shall have a "T"-type bolt down lid as manufactured by Carson-Brooks, Rainbird, Ametek, or approved equal. Valve boxes shall be of sufficient size as properly house and service equipment. Color of valve box lid is to match surrounding landscape. (ie. Green for turf areas, tan/brown or grey for mulch areas.)

### 2.5 ELECTRICAL WIRE:

- A. Control wire shall be a direct burial cable PE insulated type not smaller than #14.
- B. For all wire connections to remote control valves and all splices of wire in the field, use 3M DBY connectors. All wire splices shall be in a box.

2.6 CONTROLLERS:

- A. Rainbird (compatible with Maxicom system, including radios and antennae).

2.7 TRENCH BEDDING MATERIAL:

- A. Bedding material shall be a sandy material free of rocks. Where existing soil does not meet this requirement, imported material shall be used.

2.8 SLEEVES

- A. Pipe and control wiring and tubing under walks, roads and other hard surfaces shall be installed in Class 200 PVC sleeves or PVC Sewer pipe as noted on the plans.

2.9 BACKFLOW PREVENTER:

- A. Watts 919-QTU 2" Reduced Pressure Principle Backflow Assembly.

2.10 STOP AND WASTE VALVE:

- A. 2" Brass stop and waste valve as manufactured by Mueller.

2.11 QUICK COUPLER VALVE

- A. Shall be as described in the irrigation legend on the drawings and shall be installed with brass riser and pre-manufactured swing joint.

2.12 GLUE

- A. Solvent & Cement, shall be IPS Weld-On-Line - No. P-70 Primer and No. 711 Cement, for PVC socket fittings for use on all pipe fittings.

2.13 SPRINKLER HEADS

- A. Rotor Heads: Rainbird
- B. Spray Heads: Rainbird
- C. Bubblers: Rainbird

2.14 DRIP EQUIPMENT

- A. Netafim equipment and connections.

PART 3 - EXECUTION

- 3.1 The contractor, prior to installing the system, must verify existing water pressure. If there is a failure to obtain the needed pressure or if an excess of pressure exists for normal operation, the contractor shall contact the Owner's Authorized Representative for any adjustments to the system. Failure to report any discrepancies in pressure due to whatever reason, and installation done prior to notification of Owner's Authorized Representative shall be done at the expense of the contractor.

3.2 TRENCHES

- A. Trenches shall be dug as deep and wide as necessary to properly place the irrigation piping. All trenches shall be backfilled and tamped sufficiently to insure no settling of the surface.
- B. The contractor, in placing the irrigation lines, etc. may uncover material not suitable for finished grading. This material shall be removed from the site. After the installation of the lines, the finished grading shall be smoothed over and restored to its original condition, using additional topsoil where necessary.

3.3 PIPE ASSEMBLY

- A. The plans show the general arrangement of all piping. Should local conditions necessitate the rearrangement of some, or if piping can be run to better advantage, the contractor, before proceeding with the work, shall prepare and submit drawings of such to the Owner's Authorized Representative's office and obtain written approval before commencing work shown by these drawings.
- B. A bedding material shall be placed a minimum of 3" in all directions around all mainline pipes prior to backfilling. Lateral line pipes shall have a minimum of 3" in all directions.
- C. All mainlines, as shown on drawings, shall be installed to a depth of 18 inches minimum.
- D. All PVC lateral lines as shown on drawings shall be installed to a depth of 12 inches minimum.
- E. Lines bordering curbs or sidewalks shall be 12 inches away to allow for maintenance and access to the lines.
- F. All mainlines greater than 2 inches in size shall be installed with thrust blocks wherever a change of direction occurs.

- G. When the lateral pipe lines are connected and any risers in place but before any tubing is installed, the control valves shall be opened and flushed with a full head of water to clean out the system.
- H. PVC joints shall be glued according to manufacturer's recommendations. Glued joints shall set for 24 hours before pressure is applied to lines. Before trenches are backfilled all lines shall be pressurized and checked for leaks.

#### 3.4 DRAIN VALVES:

- A. Install drain valves at all valve clusters and low points on irrigation system line. All drain valves shall be of manual type for operation by handle keys. Drain valves in planted areas shall be provided with sleeve and marker. Drain valves shall be provided with a gravel sump not less than 12" X 12" X 18" deep in size and with gravel 3/4" to 1" in size to insure continued dependable drainage. Cover drain material with landscape filter fabric and backfill remainder with excavated material.

#### 3.5 VALVES

- A. Control valves shall be located in as shown on plans.
- B. Each bank or section of control valves shall be enclosed in an adequate size valve box and extensions to allow the disassembly of valves contained within. Valve boxes shall be at finished grade with valve stems 4 inches below top of box and with 12" of pea gravel under the valve.

#### 3.6 CONTROLLER AND CONTROL WIRES

- A. Install controller as per manufacture's recommendations and as detailed.
- B. All wire connections to valves and all splices shall be water tight.
- C. Control wires must be buried at least 12 inches below finished grade and bundled with a plastic tape every 20 feet. Provide boxes at direction changes greater than 45 degrees. Tie a loose 20" loop in all wiring in pull boxes. Where control wire leaves main or lateral line, enclose it in Class 200 PVC conduit.
- E. Install 2 spare wires from the controller to valves 1, 16, 17
- F. Electric controller shall be coded so that neutral wires are one color and shrub area wires are another color and spare wires are another.

#### 3.7 SPRINKLER HEADS

- A. Rotor Heads: Install as detailed and as per manufacturer recommendations.

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- B. Spray Heads: Install as detailed and as per manufacturer recommendations.
- C. Bubblers: Install as detailed and as per manufacturer recommendations.

### 3.8 INSPECTION

- A. At the time of final inspection the entire system must then be tested in the presence of the Owner's Authorized Representative. It must operate in a satisfactory manner, with a full uniform coverage.
- B. Before the final inspection is complete, the contractor must furnish 'as-built' drawings. These drawings should be updated on a daily basis to assure accuracy. The drawings must show the location of all valves, pipe, heads, controller control lines, and drain valves used on the job. These drawings and maintenance manuals must be submitted at the time of final inspection or in accordance to the general conditions.

### 3.9 GUARANTEE

- A. In accordance with the General Conditions.

END OF SECTION



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## SECTION 330510

### EXCAVATING, BACKFILLING, AND COMPACTING FOR UTILITIES

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED

- A. Obtain excavation permits from state and local authorities.
- B. Excavate for utility systems and process piping systems, including manholes, catch basins, valves and other appurtenances to the points of connection with the building utility or structure piping five (5) feet outside of the building or structure.
- C. Locate and protect existing utilities, structures, landscaping, and other existing features.
- D. Dewater excavations as required.
- E. Support excavations as required.
- F. Place and compact bedding, pipe zone, and backfill materials over pipes and appurtenances to rough grade elevation.
- G. Stockpile and dispose of material

##### 1.02 QUALITY ASSURANCE

- A. Provide soil testing during excavation and placement of fill and backfill materials in accordance with Section 014000.
- B. Perform soil testing during excavation and placement of fill, bedding, initial backfill, and backfill materials to show compliance with the requirements of the Contract Documents.

##### 1.03 REFERENCES

- A. ASTM D422 Particle Size Analysis of Soils.
- B. ASTM D424 Calculating the Plasticity Index.
- C. ASTM D698 Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate

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Mixtures, using 5.5-lb (2.49-kg) Rammer and 12-in (304.8 mm) Drop.

- D. ASTM D1556 Density of Soil In Place by the Sand-Cone Method.
- E. ASTM D1557 Moisture-Density Relations of Soils and Soil Aggregate Mixtures using 10-pound rammer and 18-inch drop. (Modified Proctor).
- F. ASTM D1663 Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
- G. ASTM D2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- H. ASTM D2487 Classification of Soils for Engineering Purposes.
- I. ASTM D2901 Test Method for Cement Content of Freshly-Mixed Soil-Cement.
- J. ASTM D2922 Density of Soil and Soil Aggregate In Place by Nuclear Methods (Shallow Depth).
- K. ASTM D3017 Test Methods for Moisture Content.
- L. ASTM D4253 Test Methods for Maximum Index Density of Soils, using a Vibratory Table.
- M. ASTM D4254 Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.
- N. Federal Occupational Safety and Health Administration, *Federal Register*, Volume 37, No. 243, Sub-part P, Section 1926-652.

#### 1.05 DEFINITIONS

- A. Suitable Material: Excavated material from the site or imported material from off-site meeting the requirements of structural fill or non-structural fill material.
- B. Unsuitable Material: Excavated material from the site that does not meet the requirements of structural fill or non-structural fill. This material shall be removed from the site.
- C. Structural Fill: Fill placed on prepared sub grade in areas which will ultimately be subjected to structural loadings due to footing, floor slabs, pavements, etc.
- D. Non-structural Fill: Fill place on prepared sub grade outside of areas which will ultimately be subjected to structural loadings due to footing, floor slabs, pavements, etc.

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- E. Borrow Material: Material imported from off-site but made available at an Owner owned/designated site. It is anticipated that borrow material will meet the requirements for structural fill material. If the quantity of acceptable borrow material is not sufficient to complete the Work, the Contractor shall notify the Engineer in writing. The notification shall include an estimated quantity of material required to complete the Work and the Contractor's Geotechnical Engineer's explanation for non-complying material.

#### 1.06 SUBMITTALS

Submit the following to the Engineer:

- A. Certified sieve analysis of the following materials and samples of the materials when requested by the Engineer:
  - 1. bedding and initial backfill
  - 2. imported trench fill
  - 3. foundation material (if required)
- B. One optimum moisture-maximum density curve for each type of soil encountered or incorporated into the Work.
- C. Compaction testing results.
- D. For record purposes only and not for review or approval, submit shop drawings and data showing the intended plan for dewatering operations. Include locations and capacities of dewatering wells, well points, pumps, sumps, collection, and discharge lines, standby units, water disposal methods, monitoring and settlement measuring equipment, and data collection and dissemination. Submit, together with a copy of the approved UPDES permit, as applicable, not less than 15 days prior to start of dewatering operations.

### PART 2 - PRODUCTS

#### 2.01 FOUNDATION MATERIAL

Foundation material shall be granular well-graded material with a maximum aggregate size of 2 inches and not more than 5 percent passing the 200 sieve.

#### 2.02 BEDDING, PIPE ZONE, AND INITIAL BACKFILL MATERIAL

- A. Sanitary Sewer and Storm Drain: Bedding, pipe zone, and initial backfill material shall be

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clean free-draining well-graded crushed gravel with a maximum aggregate size of 1 inch. Crushed rock meeting the gradation requirements shown below shall be submitted for approval by the Engineer.

1-Inch Crushed Gravel

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1"	100
3/4"	90-100
1/2"	20-55
#4	0-1
#8	0-5

- B. Water, Gas, Electric, Telephone, or Buried Cables: Bedding, pipe zone, and initial backfill material shall be clean granular natural sand material, free from organic matter, conforming to the gradation requirements shown below:

3/8"	100
#4	35-100
#30	20-100

2.03 FINAL BACKFILL UNDER STRUCTURES, PAVEMENT, AND WALKS

- A. Fill and final backfill for utilities under and immediately adjacent to structures, pavement prisms, and walks shall be structural fill material consisting of clean, well-graded, non-expansive granular sand and gravel material imported from off-site with a maximum size of 3 inches, no greater than 35 percent passing the No. 200 sieve, and a liquid limit of no greater than 30 percent. The material shall be capable of attaining the required densities when compacted.
- B. Native material will be acceptable for final backfill under walks, pavement, or structures if it meets the requirements for structural fill material.

2.04 FINAL BACKFILL OUTSIDE OF STRUCTURES, PAVEMENT, AND WALKS

- A. Fill and final backfill for utilities not under or immediately adjacent to structures, pavement prisms, and walks, shall be suitable non-structural fill material consisting of excavated material from the site, free of topsoil, debris, trash, roots, and other organic matter, frozen material, and stones larger than 3 inches in any dimension. If an adequate quantity of non-structural material is not available at the site, provide imported fill or borrow material consisting of any cohesive or granular material free from

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topsoil, debris, trash, roots, and other organic matter, frozen material, and stones larger than 3 inches in any dimension. The material shall not contain excessive moisture and shall readily compact and support construction equipment.

- B. Whenever the native excavated material is determined by the Engineer to be unsuitable, imported acceptable material, meeting the requirements for material within rights-of-way, and capable of attaining the required densities shall be used.

## 2.05 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 inches wide, with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing, or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in the table below and shall bear a continuous printed inscription describing the specific utility.

<u>Tape Color</u>	<u>Utility</u>
Red	Electric
Yellow	Natural Gas, Oil, Dangerous Material
Orange	Telephone, Telegraph, Television, Police and Fire Communications
Blue	Potable Water System
Green	Industrial and Sanitary Sewer
Green & White	Compressed Air

## PART 3 - EXECUTION

### 3.01 PROTECTION

- A. Protect trees, shrubs, and lawn areas to receive planting, rock outcropping, and other

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features remaining as part of final landscaping.

- B. Protect bench marks and existing structures, roads, sidewalks, paving, and curbs against damage from vehicular or foot traffic.
- C. Protect excavations and workmen by shoring, bracing, sheet piling, underpinning, or by other methods, as required to prevent cave-ins or loose dirt from falling into excavations.
- D. Shore or otherwise support adjacent structure(s) which may be damaged by excavation work. This includes service lines, pipe chases, utilities, retaining walls, etc.
- E. Notify Engineer of any unexpected subsurface conditions. Discontinue work in the area until Engineer provides notification to resume work.

### 3.02 EXISTING UTILITIES

- A. The drawings show existing utilities and their locations insofar as they are known. Utility locations and sizes may vary from those shown. Underground utilities or improvements may exist which have not been shown on the plans. All reasonable precautions shall be taken to field locate, preserve, and protect any and all such improvements.

Any improvements damaged by the Contractor which are not indicated by the drawings shall be repaired by the Contractor. Compensation for such repairs shall be covered by a Field Change Order and will be negotiated with the Engineer before corrections are made. Any such improvements damaged by the Contractor which are on the drawings shall be repaired at the expense of the Contractor.

- B. Request various agencies or utility companies concerned to field-mark substructures and utilities before excavating.
- C. Where it is necessary to remove, replace, or relocate such improvements in order to execute the Work, coordinate with, and obtain approval from the utility company or agency concerned.
- D. If the Contractor damages any existing utility lines that are not shown, or if the locations of suspected utilities are not known to the Contractor, report immediately to the Engineer and the Owner of the utilities.

### 3.03 TRENCH EXCAVATING

- A. Obtain required permits from local or state agencies.

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- B. In areas requiring reseeding or sodding, strip topsoil to a minimum depth of 12 inches, or as directed by the Engineer, and stockpile away from trench and other excavated materials for reuse.
- C. Vertically cut existing pavement, sidewalk, curb and gutter, driveways, etc., along the lines forming the trench in such a manner as not to damage the adjoining pavement. Break up the portion to be removed, and remove from the site of the work immediately without causing damage to the pavement outside the limits of the trench.
- D. Perform trench excavation to the alignment and grade as shown on the drawings, or as required by the Engineer.
- E. As directed by the Engineer, when unsuitable foundation material is encountered at subgrade, remove unsuitable material and replace with foundation material. Contact Engineer prior to excavation of unsuitable material and placement of foundation material to gain authorization to do so.
- F. Place excavated material in a manner that will not endanger the work and will cause the least possible interference with public travel.
- G. Provide for uninterrupted flow of irrigation ditches, streams, wastewater, and storm drainage. Provide free access to all fire hydrants, water valves, meters, and drives.
- H. Keep excavation clear of water during the progress of the Work.
- I. The Contractor shall backfill, to existing grades, and barricade all trenches within roadways and parking areas at the close of each day, unless approved by the Engineer. No trenches shall be backfilled except in these areas until pipelines are properly tested.
- J. The use of a trench digging machine will be permitted except in places where machines may cause damage to existing structures, in which case, hand methods shall be employed.
- K. Place barriers along each excavation, at each end of excavations, along soft shoulder areas within roadways, and at other locations along the excavation as may be necessary or as required by the Engineer. Trenches shall be delineated night and day as required by applicable codes until backfilling is complete.
- L. Equipment with tracks which is to be used on pavement shall be equipped with suitable pads to prevent damage to the pavement. The Contractor shall be responsible for damage done to improved surfaces. Damaged surfaces shall be repaired or

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replaced by and at the expense of the Contractor in a manner satisfactory to the Engineer and at no additional cost to the Owner.

- M. Trenches, at the top of the initial backfill, shall be of necessary width for the proper laying of the pipe, but in no case shall the trench be less than 12 inches wider than the outside diameter of the pipe or more than two feet wider than the pipe outside diameter.
- N. Trenches shall not be excavated until the pipe to be laid therein is on the site and is scheduled to be placed. The bottom of the trenches shall be accurately graded to a depth of 6 inches below the bottom of the pipe to allow for placing of granular pipe zone bedding material.

Care shall be taken not to excavate below the depths indicated. Where bell and spigot pipe is used, the minimum cover depth shall be maintained over the bell as well as under the straight portion of the pipe. Over-excavation shall be backfilled in 6-inch lifts to the proper grade with foundation or bedding material, as required by the Engineer, and shall be thoroughly consolidated and compacted as specified at no additional cost to the Owner.

- O. Wasting of Material. Contractor shall remove and dispose of surplus, unsuitable and excess excavated material. Contractor shall secure waste sites for excess material. No additional payment shall be made for removal and disposal of material.

### 3.04 ROCK EXCAVATING

- A. Rock shall be defined as follows:

- 1. Rock excavation shall consist of solid material and obstructions encountered with a volume in excess of 2 cubic yard. Sidewalks, pavement, and curb and gutter that cannot be excavated with a track-mounted power excavator (equivalent to Caterpillar Model No, 215C LC, rated at not less than 115 HP flywheel power and 32,000-pound drawbar pull, and equipped with a short stick and a 42-inch wide, short tip radius rock bucket rated at .81 cubic yard (heaped) capacity) without systematic drilling and blasting shall be excluded.
- 2. Hard and compact materials such as cemented gravels, glacial till, fractured quartzites, and relatively soft or disintegrated rock will not be considered as rock excavation. Rock excavation will not be considered as such because of intermittent drilling, blasting or ripping that is performed merely to increase production.

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- B. Excavation of the material claimed as rock shall not be performed until the material has been classified and cross-sectioned by the Engineer.
- C. Rock payment lines are limited to the following:  
  
Six (6) inches below invert elevation of pipe and two feet wider than inside diameter of the pipe, but not more than three (3) feet maximum trench width.
- D. Excavate for and remove rock by the mechanical method.
  - 1. Cut away rock at excavation bottom to form level bearing surface.
  - 2. Remove shaled layers to provide sound and unshattered base for footings and foundations.
  - 3. Remove excavated material.
  - 4. For utility installations, cut away rock in bottom of trench to follow the proposed grade of the utility line. Eliminate sharp steps or protrusions.
- E. Provide for visual inspection of bearing surfaces and cavities formed by removed rock.
- F. Correct unauthorized rock removal in accordance with backfilling and compaction requirements of Section 330510.

### 3.05 STABILITY OF EXCAVATIONS

- A. Slope sides of excavations to comply with OSHA 29 CFR Part 1926 or latest revision. Provide and install trench support systems where sloping is not possible because of space restrictions or stability of material excavated.
- B. Provide proper support for all excavations to protect life, property, utilities, pavement, and the Work and to provide safe working conditions in the trench in accordance with Occupational Safety and Health Administration (OSHA) regulations, *Federal Register* Vol. 37, No. 243, Subpart P., Sec. 1926.652 or latest edition.
- C. Contractor shall be responsible to determine when and where the use of trench support is employed over the use of trench boxes or sloping the sides of the excavation to the angle of repose of the material being excavated. Contractor shall be responsible for the support system used. Support systems shall be in accordance with Section 02160 - Excavation Support Systems.
- D. Remove all timber and sheeting from excavations or trenching before backfilling. Cut sheeting off 2-feet below final grade if allowed by Engineer.

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- E. Contractor shall prevent damage to the existing improvements. Where existing improvements are damaged or affected as a result of the Contractor's work, the Contractor shall replace or repair such damage at no additional cost to the Owner.

### 3.06 DEWATERING

- A. Provide all equipment, labor, materials, tools, and incidentals necessary to design, construct, install, and operate dewatering facilities for construction of the Work.
- B. Do not discharge drainage water into storm drains unless approval by the governing agency and the Engineer is given. No discharge into sanitary sewers is allowed.
- C. Water shall not be allowed to flow through the pipe lines during construction.

### 3.07 BACKFILLING AND COMPACTING

- A. Assure that trenches are free of debris, snow, ice, and water and that ground surfaces are not in frozen condition.
- B. Backfill in a systematic manner and as soon as possible after pipeline installation and leak detection testing is complete.
- C. Compact materials in accordance with paragraph 3.14 Field Quality Control.
- D. Foundation. When unstable earth, muck, or other foundation material is encountered in the excavation, additional excavation shall be made as directed by the Engineer, and shall be replaced with foundation materials. A minimum of 12 inches below the pipe zone will be removed and backfilled with foundation material to give a stable sub grade.

No additional payment for foundation material will be made unless the Engineer is notified of the condition and approves the use of foundation materials.

In rock excavation where over-excavation occurs the excavation shall be backfilled with foundation material to 6 inches below the pipe zone.

- E. Bedding and Pipe Zone. Place bedding material to required thickness and consolidate or compact. Shovel-slice or rod the bedding in the haunch area to assure that the pipe remains true to grade, voids are eliminated beneath the pipe, and the bedding is properly compacted or consolidated.
- F. Initial Backfill. Place and compact initial backfill material simultaneously on each side of

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the pipe for the full width of the trench in layers of 6 inches or less, to a point 12 inches over the top of the pipe and in such a manner as not to injure, damage or disturb the pipe.

G. Final Backfill.

1. Under structures, pavement prisms, walks, and where specified by the Engineer, the backfill material shall be placed in continuous horizontal layers, not exceeding 6 inches in thickness or as required by Construction Manager. Adjust moisture content of fill or backfill material, as determined by ASTM D698, as necessary to  $\pm 2$  percent of optimum moisture as required to obtain specified degree of compaction. Utilize borrow material as available. Provide import structural fill material as required.
2. In all areas outside of structures, pavement prisms, and walks, place non-structural fill or backfill material in continuous horizontal layers not exceeding 12 inches in thickness degree of compaction. Moisten or aerate native materials as necessary to  $\pm 1$  to 3 percent of optimum moisture as determined by ASTM D698.

H. In areas where the pipe is placed near the existing ground surface, mound backfill material over pipe to a depth of 4 feet of cover, or as designated on the plans. Mounding shall be accomplished with consideration for drainage problems that may develop. Mounding shall only be used where shown on the plans.

I. Distribute the backfill material in such a manner as to avoid the formation of lenses or layers of material differing substantially in characteristics from surrounding material. Do not include any roots, sod, frozen material or other perishable or unsuitable material in backfill.

J. Whenever the excavated material is not suitable for backfill, furnish or transport from other areas within the project, suitable excavated material which meets the requirements for final backfill.

K. Remove from site and dispose of excess or undesirable excavated material not suitable or required for backfill in an appropriate acceptable manner.

L. Backfill for Appurtenances. After the manhole, catch basin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for seven (7) days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be placed in such a manner as to prevent

eccentric loading and excessive stress on the structure.

### 3.08 SPECIAL REQUIREMENTS

- A. Water Lines. Trenches shall be of a depth to provide a minimum cover of 5 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.
- B. Electrical Distribution System. Direct burial cable and conduit or duct line shall have a minimum cover of 24 inches from the finished grade, unless otherwise indicated.
- C. Gas Distribution. Trenches shall be excavated to the depth that will provide not less than 36 inches of cover. Trenches shall be graded as specified for pipe-laying requirements.
- D. Plastic Marking Tape. Warning tapes shall be installed directly above the pipe at a depth of 18 inches below finished grade unless otherwise shown or required by the Engineer.

### 3.09 SOIL STORAGE (STOCKPILE) AREAS

- A. Prepare areas to receive stockpile material. Clear and grub as necessary to prevent stockpiled material from contamination with unsuitable material.
- B. Provide adequate drainage for stockpiles and surrounding areas by means of temporary ditches, dikes or other approved methods.
- C. Stockpile suitable excavated material in an orderly manner, and at a distance from the bank of the excavation sufficient to avoid overloading or cave-ins.
- D. Protect stockpiled material from contamination with unsuitable excavated material that may destroy the quality of the suitable stockpiled material. Replace stockpiled material, not adequately protected, that becomes unsuitable with suitable material at no cost to the Owner.
- E. Do not place stockpile material in permanent fill material locations unless approved by the Engineer.
- F. When stockpile areas are no longer needed, prior to completion of the work, grade the stockpile area to original contours and abandon/fill temporary ditches.

### 3.10 BORROW AREAS

- A. Excavate borrow areas in such a manner as will afford adequate drainage.
- B. Transport overburden and spoils material to the designated spoil area or otherwise

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dispose of as directed by the Engineer.

- C. Operate borrow areas to minimize detrimental effects on natural environmental conditions.
- D. Maintain access roads as required to permit access.
- E. Slope sides of excavations or provide excavation support systems in accordance with Section 02160.
- F. Trim and drain borrow areas to neat lines after the excavation is complete.

3.11 COLD WEATHER

- A. Contractor shall remove and dispose of snow or ice from the construction area as necessary to perform the required work. The removal of additional deposits of snow shall not be cause for the Contractor to request an extension of contract time or additional payment.
- B. The Contractor shall provide cold weather protection materials and equipment, such as heaters and blankets, as required.
- C. Excavations, trenches, excavated material, and imported material shall be protected from frost or freezing, as necessary, until the excavation or trench has been backfilled.
- D. The presence of frozen material or material containing frost shall not be cause for the Contractor to request an extension of contract time or additional payment.
- E. The Contractor shall remove and dispose of frozen material that cannot be incorporated into the backfill.

3.12 FIELD QUALITY CONTROL

- A. Densities of in-place materials shall equal or exceed the minimum densities as indicated below when compared to the maximum dry density as determined by ASTM D698:

COMPACTION REQUIREMENTS		
Location or Use of Fill	Percentage of Maximum Density	
Foundation, bedding, and initial trench backfill or fill material	96	
Final fill and backfill beneath structures,		

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COMPACTION REQUIREMENTS		
Location or Use of Fill	Percentage of Maximum Density	
paved areas (including sidewalks and gravel roadways)	96	
Final fill and backfill, not beneath paved areas or structures	90	
Topsoil	80	
Overexcavation	95	

- B. Passing overexcavation tests are required on the fills and backfills at the following frequencies:
- Bedding - 1 Test per 200 L.F. of Trench
  - Initial Backfill - 1 Test per 200 L.F. of Trench
  - Final Backfill or Fill (outside pavement section) - 1 Test per 200 L.F. of Trench per lift
  - Final Backfill or Fill (under pavement section) - 1 Test per 50 L.F. of Trench per lift
  - Overexcavation - 1 Test per 50 L.F. of Trench per lift
- C. Densities of in-place material shall be as determined by ASTM D2922.
- D. Compaction tests not meeting specification requirements shall be retested, after recompaction, at Contractor's expense. The Engineer shall select the depth that the test is to be taken. The Contractor shall be responsible to dig all density testing pits at the location and depth requested. No additional payment will be made for test pits dug for compaction tests or for replacing and recompacting the backfill material.
- E. Fill or backfill not compacted to the required density will be removed, recompacted, and retested at the Contractor's expense until the requirements are met. The retesting shall be at the Contractor's expense.
- F. Any trenches and excavation pits improperly backfilled, or where settlement occurs, shall be reopened to the depth required for proper compaction, then refilled and compacted with the surface restored to the required grade and compaction, rounded over, and smoothed off or pavement sections restored.
- G. The Contractor shall be responsible for providing Proctor Density test results for backfill material, bedding material, and any special import backfill used. Prior to commencement of any construction the Contractor shall obtain samples of backfill

material for Proctor tests. Where existing material is to be used as backfill material the Contractor shall be responsible for providing the machinery and labor to obtain soils samples of the backfill material for Proctor tests. On this project at least one sample per 1000 feet of pipe to be installed shall be required.

Additional Proctor tests may be required if backfill material changes in characteristics. Proctor tests shall be run by a Owner-approved testing laboratory. The cost of obtaining soil samples and conducting Proctor tests shall be paid by the Contractor.

No pipeline installation will begin until written results of the Proctor tests for that area have been submitted to the Engineer. The Contractor shall use the Proctor test results for testing compaction of backfill material.

### 3.13 LIMITS OF CONSTRUCTION

The Contractor shall complete all work within the easement lines and rights-of-way as shown on the drawings or as directed by the Engineer. All corrections for disturbance, damage, or irregularity shall be the responsibility of the Contractor and shall hold the Owner harmless of all suits, liability and damages. All ditches, canals, and roadways shall be placed back into their original or better condition.

### 3.14 CLEAN UP

- A. Remove all excess material, debris, sheeting, etc. from the site upon completion of the Work and dispose of properly.
- B. Keep cleanup operations to within 500 feet of excavation at all times.
- C. Failure to keep the cleanup operations to within 500 feet of excavation shall be sufficient cause for the Engineer to stop forward progress of excavating equipment and hold progress payments until the cleanup is up to acceptable limits and standards.
- D. Any pavement, trees, shrubbery, fences, poles, or other property or structures damaged, removed, or disturbed by the Contractor, whether deliberately or through failure to carry out the requirements of the contract documents, state laws, municipal ordinances or the specific direction of the Engineer or through failure to employ usual and reasonable safeguards shall be replaced or repaired at the expense of the Contractor.

END OF SECTION 330510



## SECTION 334110

### STORM DRAIN SYSTEMS

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED

- A. Install storm drainage pipe, catch basins, manholes, and other appurtenances.
- B. Install roof drain lines and cleanouts to a point five (5) feet outside buildings and structures.
- C. Adjust catch basins and other appurtenances to finish grade.
- D. Flush and clean all storm drainage lines.

##### 1.02 RELATED WORK

Section 330510, Excavating, Backfilling, and Compacting for Utilities.

##### 1.03 QUALITY ASSURANCE

All products are subject, at the discretion of the Construction Manager, to inspection and approval at the plant of the manufacturer. Any material not meeting the requirements specified herein shall be rejected and shall be removed immediately from the vicinity of other material furnished for the project.

##### 1.04 REFERENCES

- A. ASTM A48                      Gray-Iron Castings
- B. ASTM C76                      Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
- C. ASTM C150                      Specification for Portland Cement
- D. ASTM C443                      Joints for Concrete Sewer and Culvert Pipe, Using Rubber Gasket
- E. ASTM C478                      Pre-cast Reinforced Concrete Manhole Sections
- F. ASTM D2321                      Standard Recommended Practice for underground Installation of Flexible Thermoplastic Sewer Pipe

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- G. ASTM D3034 Type PSM Polyvinyl Chloride Sewer Pipe and Fittings
- H. AWWA C600 Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances
- I. ANSI A21.10 Gray and Ductile Iron Fittings 2-inch through 48-inch for Water and Other Liquids
- J. ANSI A21.11 Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings
- K. ANSI A21.50 Thickness Design of Ductile-Iron Pipe
- L. ANSI A21.51 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids

#### 1.05 SUBMITTALS

- A. Submit for review and approval, data on fabricated grates and frames to be used, including dimensions, weights, manufacturer, product number, and other related information.
- B. All reinforced pre-cast concrete structures shall be submitted for review and approval with suitable detail to show all necessary dimensions and reinforcing.

#### PART 2 - PRODUCTS

##### 2.01 PIPE

###### A. Storm Drains

- 1. High Density Polyethylene (Smooth Interior Corrugated). AASHTO M-294 Type S, Advanced Drainage Systems ADS N-12 or approved equal.
  - a. Joints. Push-on rubber gasket
  - b. Fittings. Polyvinyl Chloride (PVC), ASTM D3034, cell classification SDR, and joints to meet pipe requirements for PVC piping.
- 2. Reinforced Concrete Pipe. ASTM C76, Type II cement, bell and spigot joints with rubber compression gaskets conforming to ASTM C443. Class III or as indicated on the drawings. In addition to the requirements of the referenced standards above,

pipe shall not be installed prior to seven (7) days from the date of manufacture as marked on each pipe.

3. Polyvinyl Chloride (PVC). ASTM D3034, SDR 35, unless otherwise indicated on the drawings.
    - a. Cell Classification. 12454B
    - b. Joints. Solvent cement or bell and spigot with integral bell elastomeric gasket joint.
    - c. Fittings. ASTM D3034, cell classification SDR, and joints to meet pipe requirements for PVC piping
- B. Roof Drain Laterals, 4-inch, 6-inch, 8-inch diameter. Pipe for roof drain laterals shall be same type as provided for storm drains.
1. Concrete. ASTM C14, Class 3 unless otherwise indicated on the drawings.
    - a. Cement. ASTM C150, Portland Cement Type II (or IIA)
    - b. Joints. ASTM C443, Bell and Spigot Type
  2. High Density Polyethylene (Smooth Interior Corrugated, double-wall). Advanced Drainage Systems ADS N-12 or approved equal.
    - a. Joints. Push-on rubber gasket
    - b. Fittings. Polyvinyl Chloride (PVC), cell classification SDR, and joints to meet pipe requirements for PVC piping.
    - c. Perforations, where required on the drawings: corrugation valleys only; ASTM F405 and F667.
  3. Polyvinyl Chloride (PVC). ASTM D3034, SDR 35, unless otherwise indicated on the drawings.
    - a. Cell Classification. 12454B
    - b. Joints. Solvent cement or bell and spigot with integral bell elastomeric gasket joint
    - c. Fittings. ASTM D3034, cell classification SDR, and joints to meet pipe requirements for PVC piping.

## 2.02 CONCRETE

- A. All concrete for construction of inlet boxes, catch basins, and appurtenances shall be in accordance with Section 03300 - Cast-In-Place Concrete.

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- B. Mix shall contain not less than 6½ bags of Type II cement per cubic yard. Maximum aggregate size shall be 1¾ inches.

#### 2.03 MORTAR (GROUT)

- A. Mortar for jointing inlet boxes shall be one (1) part Portland Cement and not less than one (1) part nor more than 1½ part plaster sand, mixed with the least amount of water necessary to provide a workable mortar.

#### 2.04 REINFORCING STEEL

Reinforcement shall be Grade 60, in accordance with Section 03200 - Concrete Reinforcement.

#### 2.05 CATCH BASINS

- A. Catch Basins. Pre-cast or cast-in-place concrete conforming to the drawings.
- B. The use of pre-cast catch basins shall be subject to approval by the Contractor. Subcontractor shall submit shop drawings for each type of pre-cast box. Coordination for elevations shall remain the Subcontractor's responsibility.
- C. Cast-Iron Frame and Grated Covers. ASTM A48, Class 30, of uniform quality, free from blow holes, porosity, hard spots and shrinkage defects, with non-rocking, machined bearing surfaces between frame and cover. The frame and cover shall be cleaned and painted with an asphalt coating prior to delivery to the site. Frame and grates shall meet AASHTO HS-20 loading requirements.

Frame and grate covers shall be heavy-duty type as noted on the plan.

- D. Grout. Non-shrink.

#### 2.06 CATCH BASINS (GUTTER TYPE)

- A. Inlet Boxes. Pre-cast or cast-in-place concrete conforming to the drawings.
- B. The use of pre-cast inlet boxes shall be subject to approval by the Contractor. Subcontractor shall submit show drawings for each type of pre-cast box. Coordination for elevations shall remain the Subcontractor's responsibility.

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- C. Cast-Iron Frame and Grate. ASTM A48, Class 30, of uniform quality, free from blow holes, porosity, hard spots, and shrinkage defects with non-rocking, machined bearing surfaces between ring and cover. The ring and cover shall be cleaned and painted with an asphalt coating prior to delivery to the site.

Frame and grates shall be heavy-duty type as noted on the plan.

## 2.07 MANHOLES

- A. Concrete Pre-Cast Sections. ASTM C478, 48-inch inside diameter unless otherwise noted on the drawings.

1. Cement. ASTM C150 Portland Cement Type IIA Modified or Type V
2. Base Section. Base riser with integral floor
3. Cone Section. Concentric cone
4. Pipe connectors
  - a. Flexible rubber boot. ASTM C023 with stainless steel clamping and retaining bands.
  - b. Pipe stubs. Same material, class, and requirements as connecting piping.

- B. Cast-in-Place Base Section

1. Concrete
  - a. Use 28-day minimum compressive strength, 3000 psi.
  - b. Use minimum 5½ bags of cement per cubic yard.
  - c. Use Type IIA Modified or Type V cement conforming to ASTM C150.
2. Pipe Connectors. Use pipe stubs of same material, class, and requirements as connecting piping.

- C. Grade Rings. ASTM C478, Type IIA Modified or Type V cement conforming to ASTM C150.

- D. Frame and Cover. ASTM A48, Class 35 Gray-Iron

1. Use non-vented covers with a pick hole for opening.
2. Use low-profile waffle pattern cover.
3. Use cover with the words "STORM DRAIN."
4. Use frame and cover with machined bearing surfaces.
5. Use non-slotted frame.
6. Repair of defects in castings by welding or other methods will not be permitted.

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7. Acceptable Manufacturers D&L Supply. A 1181 WP
8. Grout. Non-shrink type.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Prior to excavating for storm drain lines, verify locations of existing utilities. Notify Contractor of any conflicts with proposed alignment and grade.
- B. Line and Grade. Establish the line and grade of the storm drain line. A laser designated for such work shall be used to establish line and grade. The length of line between laser set-ups shall not exceed 500 feet. Other methods for maintaining line and grade must be approved by Contractor prior to construction.
- C. Prior to installation, inspect all pipes, manholes, and appurtenances for cracks, defects, or imperfections, and verify compliance with the specifications. Remove all defective material from the site.

#### 3.02 EXCAVATING, BACKFILLING, AND COMPACTING

Refer to Section 330510 - Excavating, Backfilling, and Compacting for Utilities.

#### 3.03 PIPE LAYING

- A. Lay pipe to line and grade indicated.
- B. After being cleaned and inspected for soundness, each piece of pipe shall be laid on the previously graded trench bottom or bedding material, as required, after the bell hole has been excavated.
- C. Lay bell and spigot type pipe with the bell end upgrade. Pipe laying shall proceed upgrade.
- D. Trenches shall be dewatered and under no circumstances shall pipe be laid in water, nor shall the pipe be laid under unsuitable weather or trench conditions.
- E. Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing, or other material shall be placed in the pipe.

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- F. At times when pipe laying is not in progress or at other times during construction as directed by the Contractor, the open end of the pipe shall be closed by a watertight plug or other means approved by the Contractor.
- G. Pipe installation and jointing for the various types of pipe specified shall be according to these specifications and the manufacturer's recommendations.
  - 1. Concrete Pipe. Manufacturer's recommendations.
  - 2. Ductile-Iron Pipe. AWWA C600 and manufacturer's recommendations.
  - 3. High density Polyethylene (HDPE) Pipe. ASTM D2321
  - 4. Polyvinyl Chloride (PVC) Pipe. ASTM D2321

#### 3.04 INSTALLATION OF ROOF DRAIN LATERAL PIPING

- A. Pipe installation and joining for the various types of pipe specified shall be according to these specifications and the manufacturer's recommendations.
- B. Install piping at a grade of two (2) percent minimum and make connections to the storm drainage system at or above spring line or at elevation indicated on the drawings. Provide four (4) feet minimum cover if available.
- C. Install cleanouts when indicated, five (5) feet from buildings and in accordance with the drawings. Risers shall be the same size and material as the piping.

#### 3.05 CATCH BASIN INSTALLATION

- A. Install catch basins at location and grades indicated.
- B. Pre-cast boxes. Place so as to be uniformly supported in proper alignment. Place compacted bedding material under pre-cast boxes if required to provide uniform and stable support.
- C. Cast-in-place boxes. Constructed in accordance with the drawings.
- D. Grade adjustment. Set catch basin or inlet box to final grade only after final elevation of pavement, gutter, ditch, or sidewalk in which it is to be placed has been established.
- E. Pipe connection. Grout openings in walls of pre-cast boxes with non-shrink grout after pipe and castings have been placed to their final position.
- F. Pre-cast boxes shall be placed and aligned to provide vertical sides.

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- G. Grade rings. A maximum of 12 inches of grade rings will be allowed. If possible, one (1) grade ring should generally be installed on catch basins located in landscaped areas.
- H. Joints and lift holes. All lift holes and joints between pre-cast boxes, grade rings, or castings shall be sealed by placing a continuous bead of bitumastic material sufficient to fill the void in the joint prior to joining the items.
- I. Frame and cover installation
  - 1. In roadways. Top of casting shall be set parallel to and  $\frac{1}{2}$  to  $\frac{3}{4}$  inch below finished road surface. Castings shall be fully and uniformly supported. Wedges or shims used to elevate castings shall be brick or metal with concrete placed for uniform support.
  - 2. Off road. Top of castings shall be set as indicated on drawings.
- J. Any catch basins displaced or damaged prior to final acceptance shall be removed and replaced to conform to these specifications at the Subcontractor's expense.

### 3.06 MANHOLE INSTALLATION

- A. Install manholes at locations and grades indicated.
- B. Pre-cast bases. Place so as to be fully and uniformly supported in proper alignment. Place compacted bedding material under pre-cast base if required to provide uniform and stable support.
- C. Cast-in-place base. Provide a continuous pour of the concrete with at least 6 inches of concrete below the invert of the manhole and at least 6 inches radially outside of the outside diameter of the pre-cast riser section. The concrete shall also extend a minimum of 6 inches above the bottom of the riser section around the outside of the manhole.
  - 1. Support bottom pre-cast riser section on concrete blocks and adjust to proper alignment and grade prior to pouring the cast-in-place base.
  - 2. The pre-cast riser section shall not bear directly on any of the pipes.
  - 3. Grout all joints between cast-in-place concrete and pre-cast sections and pipe with non-shrink grout after concrete has cured.
- D. Inverts

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1. Construct smooth and uniform changes in flow direction with the longest radius possible.
  2. Provide cross-sectional shape of the invert channels to match the lower halves of the inflow and outflow pipes.
  3. Extend pipes into the manhole a maximum of three (3) inches from the inside of the manhole wall.
- E. Place and align pre-cast sections to provide vertical sides.
- F. Grade rings. Provide manhole wall sections to allow for a maximum of 12 inches of grade rings on manholes located in roadways. Provide adequate manhole wall sections to avoid the use of grade rings or manholes located off roadways.
- G. Joints and lift holes. Seal all joints between pre-cast base, riser and cone sections, grade rings and castings by placing a continuous bead of mastic sealant in the joint prior to joining the items, and touching up the mastic sealant, adding additional mastic sealant as required to form a smooth, watertight joint both inside and outside with mastic sealant. In all cases, a watertight manhole is required.
- H. Ring and cover installation
1. In roadways. Set top of casting parallel to and  $\frac{1}{2}$  to  $\frac{3}{4}$  inch below finish road surface. Support castings fully and uniformly. Use brick or metal wedges or shims to finely adjust castings to grade. Place concrete around wedges and shims for uniform support.
  2. Off road. Top of casting shall be set approximately 6 inches above finish grade unless otherwise indicated or directed by the Contractor.
- I. Any manhole displaced or damaged prior to final acceptance shall be removed and replaced to conform to these specifications at the Subcontractor's expense.

### 3.07 FIELD QUALITY CONTROL

Visual inspection will be performed on all installed storm drain lines prior to acceptance. The Contractor will perform a visual inspection of all installed storm drain lines and manholes to assure conformance with the specifications. All sections of storm drain line will be "lamped" to insure that the line is straight, of uniform grade, and free of all dirt, debris, and obstructions. All broken, misaligned, or displaced pipe and manholes or other defects

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revealed during this visual inspection shall be corrected at the Subcontractor's expense. The Subcontractor shall furnish suitable assistance to the contractor for visual inspections.

### 3.08 CLEANING

- A. The interior of all storm drain lines, manholes, catch basins, and other appurtenances shall be cleaned of all dirt, debris, or other foreign material. Cleaning shall be by flushing, jetting, or other approved means to remove such foreign material.
- B. Connections between new construction and the existing system shall be plugged to prevent any debris from the new construction or from cleaning operations from entering the existing system. Any debris entering the existing system shall be removed at no expense to the construction manager.

END OF SECTION 334110

## SECTION 3351 10

### NATURAL GAS DISTRIBUTION

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. This Section includes piping, valves, and service regulators for natural gas distribution outside the building.
- B. See Division 23 Section "Fuel Gas Piping" for natural gas piping inside the building.

##### 1.2 DEFINITIONS

- A. Gas Main: Utility's natural gas piping.
- B. Gas Distribution: Piping from gas main to individual service-meter assemblies.
- C. Point of Delivery: Piping outlet from service-meter assembly.
- D. Natural Gas Piping: Piping that conveys natural gas from point of delivery to natural gas utilization devices inside the building.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working-Pressure Ratings:
  - 1. Piping and Valves: 100 psig (690 kPa) minimum, unless otherwise indicated.
  - 2. Service Regulators: 65 psig (450 kPa) 100 psig (690 kPa) minimum, unless otherwise indicated.
  - 3. Service Meters: 5 psig (34.5 kPa) 10 psig (69 kPa) 20 psig (138 kPa) 65 psig (450 kPa) minimum, unless otherwise indicated.

##### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. PE pipe and fittings.
  - 2. Valves.
  - 3. Service regulators. Indicate pressure ratings and capacities.
- B. Shop Drawings: For natural gas service piping and service meter assembly. Include plans, elevations, sections, details, and attachments to other work.

- C. Field quality-control test reports.
- D. Operation and maintenance data.

#### 1.5 QUALITY ASSURANCE

- A. Comply with requirements of utility supplying natural gas and with authorities having jurisdiction for natural gas systems.
- B. Comply with ANSI Z223.1 or NFPA 54 or AGA IFGC for materials, installation, testing, inspection, and purging.

#### 1.6 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

#### 2.2 PIPES AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B; Schedule 40, black.
  - 1. Malleable-Iron Fittings: ASME B16.3, Class 150, standard pattern, with threads complying with ASME B1.20.1.
  - 2. Steel Flanges and Flanged Fittings: ASME B16.5.
  - 3. Unions: ASME B16.39, Class 150, black malleable iron; female pattern; brass-to-iron seat; ground joint.
- B. PE Pipe: ASTM D 2513, SDR 11.
  - 1. PE Fittings: ASTM D 2683, socket type or ASTM D 3261, butt type with dimensions matching ASTM D 2513, SDR 11, PE pipe.

- C. Transition Fittings: Manufactured pipe fitting with one PE pipe end for heat-fusion connection to PE pipe and with one ASTM A 53/A 53M, Schedule 40, steel pipe end for threaded connection to steel pipe.
- D. Service-Line Risers: Manufactured PE pipe fitting with PE pipe inlet for heat-fusion connection to underground PE pipe; PE pipe riser section with protective-coated, anodeless, steel casing and threaded outlet for threaded connection to aboveground steel piping.
- E. Components, Tapes, Gaskets, and Bolts and Nuts: Suitable for natural gas and as recommended by piping manufacturer.

## 2.3 VALVES

- A. Valves, General: Manual operation, suitable for natural gas service, and with 100-psig (690-kPa) minimum working-pressure rating.
- B. Threaded Valves, NPS 1 (DN 25) and Smaller: Include listing by agency acceptable to authorities having jurisdiction.
- C. Nonlubricated, Tapered Plug Valves: Brass or cast-iron body, with brass tapered plug; lever operation; and complying with ASME B16.33, MSS SP-78, UL 842. Include lever .
  - 1. Available Manufacturers:
    - a. Essex Brass.
    - b. Lyall, R. W. & Company, Inc.
    - c. McDonald, A. Y. Mfg. Co.
    - d. Mueller Company.
    - e.
- D. Lubricated, Tapered Plug Valves: Cast-iron body, with lubricated, brass tapered plug; lever operation; and complying with ASME B16.33, MSS SP-78, UL 842. Include lever and locking device.
  - 1. Available Manufacturers:
    - a. Mueller Company.
    - b. National Meter.
    - c. Nordstrom Valves, Inc.
- E. Lubricated Plug Valves: Cast-iron body, with lubricated, tapered, or cylindrical plug; lever operation; and complying with ASME B16.38, MSS SP-78, UL 842.
  - 1. Available Manufacturers:

- a. Milliken Valve Co., Inc.
- b. Nordstrom Valves, Inc.
- c. Olson Technologies, Inc.; Homestead Valve Div.
- d. R & M Energy Systems; Flow Control Div.
- e. Walworth Company (The).

F. PE Valves: Made for gas distribution, with nut or flat head for key operation; and complying with ASME B16.40, UL 842.

1. Available Manufacturers:

- a. Kerotest Manufacturing Corp.
- b. Lyall, R. W. & Company, Inc.
- c. Nordstrom Valves, Inc.
- d. Perfection Corporation; Gas Products Div.

G. Earthquake Valves: ASCE 25 , mechanical-operation and automatic-shutoff type with operating-pressure rating at least as great as system pressure.

1. Pipe Connections:

- a. NPS 2 (DN 50) and Smaller: Threaded.
- b. NPS 2-1/2 (DN 65) and Larger: Flanged.

2. Available Manufacturers:

- a. Pacific Seismic Products, Inc.
- b. Quake Defense, Inc.; Emergency Fail-Safe Systems.
- c. Safe T Quake.
- d. Seismic Safety Products, Inc.
- e. US QuakeKoso Canada, Inc.

## 2.4 SPECIALTIES

- A. Valve Boxes: Cast-iron, two-section box. Include top section with cover with "GAS" lettering, bottom section with base to fit over valve and barrel 5 inches (125 mm) in diameter, and adjustable cast-iron extension of length required for depth of bury. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head and with stem of length required to operate valve.
- B. Service Regulators: Natural gas service regulator complying with ANSI B109.4 or DIR 006.3-listed for service regulators.

1. Construction: Single-stage, steel-jacketed, corrosion-resistant diaphragm type. Include atmospheric vent and elevation compensator.
  2. Pipe Connections: Threaded.
  3. Available Manufacturers:
    - a. American Meter Co.
    - b. Fisher Controls International.
    - c. Invensys Energy Metering.
    - d. National Meter.
    - e. Schlumberger Limited.
- C. Concrete Bases: Precast concrete made of 4000-psi- (20.7-MPa-) minimum, 28-day compressive strength reinforced concrete; at least 4 inches (100 mm) thick and 4 inches (100 mm) larger in each dimension than supported item, unless otherwise indicated.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.
- B. Close equipment shutoff valves before turning off gas to premises or piping section.
- C. Inspect natural gas piping according to fuel gas code to determine that natural gas utilization devices are turned off in piping section affected.
- D. Comply with fuel gas code requirements for prevention of accidental ignition.

#### **3.2 PIPING APPLICATIONS**

- A. Flanges, unions, and transition and special fittings with pressure ratings same as or higher than system pressure rating may be used, unless otherwise indicated.
- B. Aboveground Piping: Steel pipe, malleable-iron fittings, and threaded joints.
- C. Underground Piping: PE pipe, PE fittings, and heat-fusion joints.
- D. Underground-to-Aboveground Piping Connections: Service-line riser.
- E. PE-to-Steel Piping Connections: Transition fitting.

#### **3.3 VALVE APPLICATIONS**

- A. Drawings indicate types of shutoff valves to be used. If specific types are not indicated, the following requirements apply:
  - 1. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping gas mains.
  - 2. Underground: Use PE valves.
  - 3. Aboveground, NPS 2 (DN 50) and Smaller: Lubricated tapered plug valves.

### 3.4 INSTALLATION

- A. Install underground, natural gas distribution piping buried at least 36 inches (900 mm) below finished grade.
- B. Install underground, PE, natural gas distribution piping according to ASTM D 2774.
- C. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- D. Terminate service-regulator horizontal vents or horizontal vent piping with reducing-elbow fittings with large end as outlet. Install fitting outlet turned down with corrosion-resistant insect screen in outlet.
- E. Install PE shutoff valves on branch connections to existing underground, natural gas distribution piping. Install valves with valve boxes.
- F. Install metal shutoff valves on aboveground, natural gas distribution piping.
- G. Install earthquake valves aboveground, outside building, and according to listing applications.
- H. Refer to Division 2 Section "Piped Utilities -- Basic Materials and Methods" for basic piping joint construction.
- I. Connect gas distribution piping to natural gas source and extend to service-meter assemblies and points indicated. Connect to building's natural gas piping if it is installed; otherwise, terminate piping with caps, plugs, or flanges, as required for piping material. Refer to Division 15 Section "Fuel Gas Piping" for natural gas piping inside the building.
- J. Install unions adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.

- K. Do not use natural gas distribution piping as grounding electrode.
- L. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on or near each service regulator, service meter, and earthquake valve.
  - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- M. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tape over natural gas distribution piping during backfilling of trenches for piping.

### 3.5 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas distribution according to requirements of fuel gas code and utility.
- B. Repair leaks and defective valves and specialties and retest system until no leaks exist.
- C. Report results in writing.
- D. Verify correct pressure settings for service regulators.

END OF SECTION 335110

