STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

Division of Facilities Construction and Management

DFCM

STANDARD LOW BID PROJECT
Project Budgets Over $100,000

June 4, 2008

STUDENT CENTER ADDITION
UTAH VALLEY STATE COLLEGE

OREM, UTAH

DFCM Project Number 08217790

Axis Architects
352 South Denver Street, Suite 205
Salt Lake City, Utah 84111

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Current copies of the following documents are hereby made part of these contract documents by reference. These documents are available on the DFCM web site at http://dfcm.utah.gov or are available upon request from DFCM.

DFCM Supplemental General Conditions dated May 5, 2008
DFCM General Conditions dated May 25, 2005.
DFCM Application and Certification for Payment dated May 25, 2005.

Technical Specifications:	attached and dated June 2, 2008
Drawings:	attached and dated June 2, 2008

The Agreement and General Conditions dated May 25, 2005 have been updated from versions that were formally adopted and in use prior to this date. The changes made to the General Conditions are identified in a document entitled Revisions to General Conditions that is available on DFCM's web site at http://dfcm.utah.gov

NOTICE TO CONTRACTORS

Sealed bids will be received by the Division of Facilities Construction and Management (DFCM) for:

STUDENT CENTER ADDITION
UTAH VALLEY STATE COLLEGE – OREM, UTAH
DFCM PROJECT NO: 08217790

Bids will be in accordance with the Contract Documents that will be available on **June 4, 2008** and distributed in electronic format only on CDs from DFCM, 4110 State Office Building, Salt Lake City, Utah and on the DFCM web page at http://dfcm.utah.gov. For questions regarding this project, please contact Michael Ambre, DFCM, at 801-209-9104. No others are to be contacted regarding this bidding process. The construction estimate for this project is $280,000.00

A **mandatory** pre-bid meeting will be held at **11:30 on June 11, 2008** at the north entrance to the Student Center (UVSC Orem Campus). All bidders wishing to bid on this project are required to attend this meeting.

Bids will be received until the hour of **2:30PM on June 26, 2008** at DFCM, 4ll0 State Office Building, Salt Lake City, Utah 84114. Bids will be opened and read aloud in the DFCM Conference Room, 4110 State Office Building, Salt Lake City, Utah. NOTE: Bids must be received at 4110 State Office Building by the specified time.

A bid bond in the amount of five percent (5%) of the bid amount, made payable to the Division of Facilities Construction and Management on DFCM's bid bond form, shall accompany the bid.

The Division of Facilities Construction and Management reserves the right to reject any or all bids or to waive any formality or technicality in any bid in the interest of DFCM.

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT
Joanna Reese, Contract Coordinator
4110 State Office Building, Salt Lake City, Utah 84114

PROJECT DESCRIPTION

The scope of this project will include approximatly 2,700 sf of new space constructed on the east side of the student center. This space will include framing, electrical, mechanical, and interior finishes. The dock is located adjacent to the infill area. The drawings show additional concrete and structure to be added to the dock.

PROJECT SCHEDULE

PROJECT NAME: Student Center Addition – Utah Valley State College – Orem, Utah

DFCM PROJECT NO. 08217790

Event	Day	Date	Time	Place
Bidding Documents Available	Wednesday	June 4, 2008	12:00 Noon	DFCM 4110 State Office Bldg SLC, UT and the DFCM web site *
Mandatory Pre-bid Site Meeting	Wednesday	June 11, 2008	11:30 AM	North entrance to the Student Center (UVSC Campus – Orem)
Last Day to Submit Questions	Tuesday	June 17, 2008	12:00 Noon	*Michael Ambre*– DFCM mambre@utah.gov Fax 801-538-3267
Addendum Deadline (exception for bid delays)	Thursday	June 19, 2008	2:00 PM	DFCM web site *
Prime Contractors Turn In Bid and Bid Bond	Thursday	June 26, 2008	2:30 PM	DFCM 4110 State Office Bldg SLC, UT
Sub-contractor List Due	Friday	June 27, 2008	2:30 PM	DFCM 4110 State Office Bldg SLC, UT Fax 801-538-3677
Substantial Completion Date	Friday	November 14, 2008	5:00 PM	

* **NOTE: DFCM's web site address is http://dfcm.utah.gov**

BID FORM

NAME OF BIDDER _____ DATE _____

To the Division of Facilities Construction and Management
4110 State Office Building
Salt Lake City, Utah 84114

The undersigned, responsive to the "Notice to Contractors" and in accordance with the "Instructions to Bidders", in compliance with your invitation for bids for the **Student Center Addition – Utah Valley State College – Orem, Utah – DFCM Project No. 070217790** and having examined the Contract Documents and the site of the proposed Work and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of labor, hereby proposes to furnish all labor, materials and supplies as required for the Work in accordance with the Contract Documents as specified and within the time set forth and at the price stated below. This price is to cover all expenses incurred in performing the Work required under the Contract Documents of which this bid is a part:

I/We acknowledge receipt of the following Addenda: _____

For all work shown on the Drawings and described in the Specifications and Contract Documents, I/we agree to perform for the sum of:

_____ DOLLARS ($_____)
(In case of discrepancy, written amount shall govern)

I/We guarantee that the Work will be Substantially Complete by November 14, 2008, should I/we be the successful bidder, and agree to pay liquidated damages in the amount of **$350.00** per day for each day after expiration of the Contract Time as stated in Article 3 of the Contractor's Agreement.

This bid shall be good for 45 days after bid opening.

Enclosed is a 5% bid bond, as required, in the sum of _____

The undersigned Contractor's License Number for Utah is _____._____

Upon receipt of notice of award of this bid, the undersigned agrees to execute the contract within ten (10) days, unless a shorter time is specified in the Contract Documents, and deliver acceptable Performance and Payment bonds in the prescribed form in the amount of 100% of the Contract Sum for faithful performance of the contract.

The Bid Bond attached, in the amount not less than five percent (5%) of the above bid sum, shall become the property of the Division of Facilities Construction and Management as liquidated damages for delay and additional expense caused thereby in the event that the contract is not executed and/or acceptable l00% Performance and Payment bonds are not delivered within the time set forth.

Type of Organization:

_____
(Corporation, Partnership, Individual, etc.)

Any request and information related to Utah Preference Laws:

_____

Respectfully submitted,

_____
Name of Bidder

ADDRESS:

_____

_____

_____
Authorized Signature

INSTRUCTIONS TO BIDDERS

1. Drawings and Specifications, Other Contract Documents

Drawings and Specifications, as well as other available Contract Documents, may be obtained as stated in the Invitation to Bid.

2. Bids

Before submitting a bid, each contractor shall carefully examine the Contract Documents, shall visit the site of the Work; shall fully inform themselves as to all existing conditions and limitations; and shall include in the bid the cost of all items required by the Contract Documents. If the bidder observes that portions of the Contract Documents are at variance with applicable laws, building codes, rules, regulations or contain obvious erroneous or uncoordinated information, the bidder shall promptly notify the DFCM Representative and the necessary changes shall be accomplished by Addendum.

The bid, bearing original signatures, must be typed or handwritten in ink on the Bid Form provided in the procurement documents and submitted in a sealed envelope at the location specified by the Invitation to Bid prior to the deadline for submission of bids.

Bid bond security, in the amount of five percent (5%) of the bid, made payable to the Division of Facilities Construction and Management, shall accompany bid. THE BID BOND MUST BE ON THE BID BOND FORM PROVIDED IN THE PROCUREMENT DOCUMENTS IN ORDER TO BE CONSIDERED AN ACCEPTABLE BID.

If the bid bond security is submitted on a bid bond form other than DFCM's required bid bond form, and the bid security meets all other legal requirements, the bidder will be allowed to provide an acceptable bid bond by the close of business on the next business day following notification by DFCM of submission of a defective bid bond security. **NOTE: A cashier's check cannot be used as a substitute for a bid bond.**

3. Contract and Bond

The Contractor's Agreement will be in the form found in the specifications. The Contract Time will be as indicated in the bid. The successful bidder, simultaneously with the execution of the Contract Agreement, will be required to furnish a performance bond and a payment bond, both bearing original signatures, upon the forms provided in the procurement documents. The performance and payment bonds shall be for an amount equal to one hundred percent (100%) of the contract sum and secured from a company that meets the requirements specified in the requisite forms. Any bonding requirements for subcontractors will be specified in the Supplementary General Conditions.

4. Listing of Subcontractors

Listing of Subcontractors shall be as summarized in the "Instructions and Subcontractor's List Form", which are included as part of these Contract Documents. The Subcontractors List shall be delivered to DFCM or faxed to DFCM at (801)538-3677 within 24 hours of the bid opening. Requirements for listing additional subcontractors will be listed in the Contract Documents.

DFCM retains the right to audit or take other steps necessary to confirm compliance with requirements for the listing and changing of subcontractors. Any contractor who is found to not be in compliance with these requirements is subject to a debarment hearing and may be debarred from consideration for award of contracts for a period of up to three years.

5. Interpretation of Drawings and Specifications

If any person or entity contemplating submitting a bid is in doubt as to the meaning of any part of the drawings, specifications or other Contract Documents, such person shall submit to the DFCM Project Manager a request for an interpretation thereof. The person or entity submitting the request will be responsible for its prompt delivery. Any interpretation of the proposed documents will be made only by addenda posted on DFCM's web site at http://dfcm.utah.gov. Neither the DFCM nor A/E will be responsible for any other explanations or interpretations of the proposed documents. A/E shall be deemed to refer to the architect or engineer hired by DFCM as the A/E or Consultant for the Project.

6. Addenda

Addenda will be posted on DFCM's web site at http://dfcm.utah.gov. Contractors are responsible for obtaining information contained in each addendum from the web site. Addenda issued prior to the submittal deadline shall become part of the bidding process and must be acknowledged on the bid form. Failure to acknowledge addenda may result in disqualification from bidding.

7. Award of Contract

The Contract will be awarded as soon as possible to the lowest, responsive and responsible bidder, based on the lowest combination of base bid and acceptable prioritized alternates, provided the bid is reasonable, is in the interests of the State of Utah to accept and after applying the Utah Preference Laws in U.C.A. Title 63, Chapter 56. DFCM reserves the right to waive any technicalities or formalities in any bid or in the bidding. Alternates will be accepted on a prioritized basis with Alternate 1 being highest priority, Alternate 2 having second priority, etc.

8. DFCM Contractor Performance Rating

As a contractor completes each DFCM project, DFCM, the architect/engineer and the using agency will evaluate project performance based on the enclosed "DFCM Contractor Performance Rating" form. The ratings issued on this project will not affect this project but may affect the award on future projects.

9. Licensure

The Contractor shall comply with and require all of its subcontractors to comply with the license laws as required by the State of Utah.

10. Permits

In concurrence with the requirements for permitting in the General Conditions, it is the responsibility of the Contractor to obtain the fugitive dust plan requirements from the Utah Division of Air Quality and the SWPPP requirements from the Utah Department of Environmental Quality and submit the completed forms and pay any permit fee that may be required for this specific project. Failure to obtain the required permit may result in work stoppage and/or fines from the regulating authority that will be the sole responsibility of the Contractor. Any delay to the project as a result of any such failure to obtain the permit or noncompliance with the permit shall not be eligible for any extension in the Contract Time.

11. Right to Reject Bids

DFCM reserves the right to reject any or all Bids.

12. Time is of the Essence

Time is of the essence in regard to all the requirements of the Contract Documents.

13. Withdrawal of Bids

Bids may be withdrawn on written request received from bidder prior to the time fixed for opening. Negligence on the part of the bidder in preparing the bid confers no right for the withdrawal of the bid after it has been opened.

14. Product Approvals

Where reference is made to one or more proprietary products in the Contract Documents, but restrictive descriptive materials of one or more manufacturer(s) is referred to in the Contract Documents, the products of other manufacturers will be accepted, provided they equal or exceed the standards set forth in the drawings and specifications and are compatible with the intent and purpose of

the design, subject to the written approval of the A/E. Such written approval must occur prior to the deadline established for the last scheduled addenda to be issued. The A/E's written approval will be in an issued addendum. If the descriptive material is not restrictive, the products of other manufacturers specified will be accepted without prior approval provided they are compatible with the intent and purpose of the design as determined by the A/E.

15. Financial Responsibility of Contractors, Subcontractors and Sub-subcontractors

Contractors shall respond promptly to any inquiry in writing by DFCM to any concern of financial responsibility of the contractor, subcontractor or sub-subcontractor.

16. Debarment

By submitting a bid, the Contractor certifies that neither it nor its principals, including project and site managers, have been, or are under consideration for, debarment or suspension, or any action that would exclude such from participation in a construction contract by any governmental department or agency. If the Contractor cannot certify this statement, attach to the bid a detailed written explanation which must be reviewed and approved by DFCM as part of the requirements for award of the Project.

BID BOND

(Title 63, Chapter 56, U. C. A. l953, 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 _____, 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 $_____ (5% of the accompanying bid), being the sum of this Bond to which payment the Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that whereas the Principal has submitted to Obligee the accompanying bid incorporated by reference herein, dated as shown, to enter into a contract in writing for the_____ _____ Project.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that if the said principal does not execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the principal, then the sum of the amount stated above will be forfeited to the State of Utah as liquidated damages and not as a penalty; if the said principal shall execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the Principal, then this obligation shall be null and void. It is expressly understood and agreed that the liability of the Surety for any and all defaults of the Principal hereunder shall be the full penal sum of this Bond. The Surety, for value received, hereby stipulates and agrees that obligations of the Surety under this Bond shall be for a term of sixty (60) days from actual date of the bid opening.

PROVIDED, HOWEVER, that this Bond is executed pursuant to 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 same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the above bounden parties have executed this instrument under their several seals on the date indicated below, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

DATED this _____ day of _____, 20_____ .

Principal's name and address (if other than a corporation):

_____

_____

By:_____

Title: _____

Principal's name and address (if a corporation):

_____

_____

By:_____

Title: _____

(Affix Corporate Seal)

Surety's name and address:

_____

_____

By: _____

Attorney-in-Fact (Affix Corporate Seal)

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

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 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.

SUBCONTRACTORS LIST

FAX TO 801-538-3677

PROJECT TITLE: _____

Caution: You must read and comply fully with instructions.

TYPE OF WORK	SUBCONTRACTOR, "SELF" OR "SPECIAL EXCEPTION"	SUBCONTRACTOR BID AMOUNT	CONT. LICENSE #

We certify that:

1. This list includes all subcontractors as required by the instructions, including those related to the base bid as well as any alternates.
2. We have listed "Self" or "Special Exception" in accordance with the instructions.
3. All subcontractors are appropriately licensed as required by State law.

FIRM: _____

DATE: _____ SIGNED BY: _____

NOTICE: FAILURE TO SUBMIT THIS FORM, PROPERLY COMPLETED AND SIGNED, AS REQUIRED IN THESE CONTRACT DOCUMENTS, SHALL BE GROUNDS FOR OWNER'S REFUSAL TO ENTER INTO A WRITTEN CONTRACT WITH BIDDER. ACTION MAY BE TAKEN AGAINST BIDDERS BID BOND AS DEEMED APPROPRIATE BY OWNER. ATTACH A SECOND PAGE IF NECESSARY.

CONTRACTOR'S AGREEMENT

FOR:

_____
_____
_____

THIS CONTRACTOR'S AGREEMENT, made and entered into this ____ day of _____, 20__, by and between the DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT, hereinafter referred to as "DFCM", and _____, incorporated in the State of _____ and authorized to do business in the State of Utah, hereinafter referred to as "Contractor", whose address is _____.

WITNESSETH: WHEREAS, DFCM intends to have Work performed at _____ _____.

WHEREAS, Contractor agrees to perform the Work for the sum stated herein.

NOW, THEREFORE, DFCM and Contractor for the consideration provided in this Contractor's Agreement, agree as follows:

ARTICLE 1. SCOPE OF WORK. The Work to be performed shall be in accordance with the Contract Documents prepared by _____ and entitled "_____."

The DFCM General Conditions ("General Conditions") dated May 25, 2005 and Supplemental General Conditions dated May 5, 2008 ("also referred to as General Conditions") on file at the office of DFCM and available on the DFCM website, are hereby incorporated by reference as part of this Agreement and are included in the specifications for this Project. All terms used in this Contractor's Agreement shall be as defined in the Contract Documents, and in particular, the General Conditions.

The Contractor Agrees to furnish labor, materials and equipment to complete the Work as required in the Contract Documents which are hereby incorporated by reference. It is understood and agreed by the parties hereto that all Work shall be performed as required in the Contract Documents and shall be subject to inspection and approval of DFCM or its authorized representative. The relationship of the Contractor to the DFCM hereunder is that of an independent Contractor.

ARTICLE 2. CONTRACT SUM. The DFCM agrees to pay and the Contractor agrees to accept in full performance of this Contractor's Agreement, the sum of _____ _____ DOLLARS AND NO CENTS ($_____.00), which is the base bid, and which sum also includes the cost of a 100% Performance Bond and a 100%

Payment Bond as well as all insurance requirements of the Contractor. Said bonds have already been posted by the Contractor pursuant to State law. The required proof of insurance certificates have been delivered to DFCM in accordance with the General Conditions before the execution of this Contractor's Agreement.

ARTICLE 3. TIME OF COMPLETION AND DELAY REMEDY. The Work shall be Substantially Complete by _____. Contractor agrees to pay liquidated damages in the amount of $_____ per day for each day after expiration of the Contract Time until the Contractor achieves Substantial Completion in accordance with the Contract Documents, if Contractor's delay makes the damages applicable. The provision for liquidated damages is: (a) to compensate the DFCM for delay only; (b) is provided for herein because actual damages can not be readily ascertained at the time of execution of this Contractor's Agreement; (c) is not a penalty; and (d) shall not prevent the DFCM from maintaining Claims for other non-delay damages, such as costs to complete or remedy defective Work.

No action shall be maintained by the Contractor, including its or Subcontractor or suppliers at any tier, against the DFCM or State of Utah for damages or other claims due to losses attributable to hindrances or delays from any cause whatsoever, including acts and omissions of the DFCM or its officers, employees or agents, except as expressly provided in the General Conditions. The Contractor may receive a written extension of time, signed by the DFCM, in which to complete the Work under this Contractor's Agreement in accordance with the General Conditions.

ARTICLE 4. CONTRACT DOCUMENTS. The Contract Documents consist of this Contractor's Agreement, the Conditions of the Contract (DFCM General Conditions, Supplementary and other Conditions), the Drawings, Specifications, Addenda and Modifications. The Contract Documents shall also include the bidding documents, including the Invitation to Bid, Instructions to Bidders/ Proposers and the Bid/Proposal, to the extent not in conflict therewith and other documents and oral presentations that are documented as an attachment to the contract.

All such documents are hereby incorporated by reference herein. Any reference in this Contractor's Agreement to certain provisions of the Contract Documents shall in no way be construed as to lessen the importance or applicability of any other provisions of the Contract Documents.

ARTICLE 5. PAYMENT. The DFCM agrees to pay the Contractor from time to time as the Work progresses, but not more than once each month after the date of Notice to Proceed, and only upon Certificate of the A/E for Work performed during the preceding calendar month, ninety-five percent (95%) of the value of the labor performed and ninety-five percent (95%) of the value of materials furnished in place or on the site. The Contractor agrees to furnish to the DFCM invoices for materials purchased and on the site but not installed, for which the Contractor requests payment and agrees to

safeguard and protect such equipment or materials and is responsible for safekeeping thereof and if such be stolen, lost or destroyed, to replace same.

Such evidence of labor performed and materials furnished as the DFCM may reasonably require shall be supplied by the Contractor at the time of request for Certificate of Payment on account. Materials for which payment has been made cannot be removed from the job site without DFCM's written approval. Five percent (5%) of the earned amount shall be retained from each monthly payment. The retainage, including any additional retainage imposed and the release of any retainage, shall be in accordance with UCA 13-8-5 as amended. Contractor shall also comply with the requirements of UCA 13-8-5, including restrictions of retainage regarding subcontractors and the distribution of interest earned on the retention proceeds. The DFCM shall not be responsible for enforcing the Contractor's obligations under State law in fulfilling the retention law requirements with subcontractors at any tier.

ARTICLE 6. INDEBTEDNESS. Before final payment is made, the Contractor 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 General Conditions.

Contractor 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 Contractor in regard to any rights of Subcontractors (including suppliers) at any tier or any third parties prior to any payment by DFCM to Contractor.

ARTICLE 7. ADDITIONAL WORK. It is understood and agreed by the parties hereto that no money will be paid to the Contractor for additional labor or materials furnished unless a new contract in writing or a Modification hereof in accordance with the 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 Contractor's Agreement and the total sum due hereunder either by enlarging or restricting the scope of the Work.

ARTICLE 8. INSPECTIONS. The Work shall be inspected for acceptance in accordance with the General Conditions.

ARTICLE 9. DISPUTES. Any dispute, PRE or Claim between the parties shall be subject to the provisions of Article 7 of the General Conditions. DFCM reserves all rights to pursue its rights and remedies as provided in the General Conditions.

ARTICLE 10. TERMINATION, SUSPENSION OR ABANDONMENT. This Contractor's Agreement may be terminated, suspended or abandoned in accordance with the General Conditions.

ARTICLE 11. DFCM'S RIGHT TO WITHHOLD CERTAIN AMOUNT AND MAKE USE THEREOF. The DFCM may withhold from payment to the Contractor such amount as, in DFCM's judgment, may be necessary to pay just claims against the Contractor or Subcontractor 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 Contractor and payment so made by the DFCM shall be considered as payment made under this Contractor's Agreement by the DFCM to the Contractor. DFCM shall not be liable to the Contractor for any such payment made in good faith. Such withholdings and payments may be made without prior approval of the Contractor and may be also be prior to any determination as a result of any dispute, PRE, Claim or litigation.

ARTICLE 12. INDEMNIFICATION. The Contractor shall comply with the indemnification provisions of the General Conditions.

ARTICLE 13. SUCCESSORS AND ASSIGNMENT OF CONTRACT. The DFCM and Contractor, 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 Contractor’s Agreement. The Contractor shall not assign this Contractor’s Agreement without the prior written consent of the DFCM, nor shall the Contractor assign any moneys due or to become due as well as any rights under this Contractor’s Agreement, without prior written consent of the DFCM.

ARTICLE 14. RELATIONSHIP OF THE PARTIES. The Contractor accepts the relationship of trust and confidence established by this Contractor's Agreement and covenants with the DFCM to cooperate with the DFCM and A/E and use the Contractor's best skill, efforts and judgment in furthering the interest of the DFCM; to furnish efficient business administration and supervision; to make best efforts to furnish at all times an adequate supply of workers and materials; and to perform the Work in the best and most expeditious and economic manner consistent with the interests of the DFCM.

ARTICLE 15. AUTHORITY TO EXECUTE AND PERFORM AGREEMENT. Contractor and DFCM each represent that the execution of this Contractor's Agreement and the performance thereunder is within their respective duly authorized powers.

ARTICLE 16. ATTORNEY FEES AND COSTS. Except as otherwise provided in the dispute resolution provisions of the General Conditions, the prevailing party shall be entitled to reasonable attorney fees and costs incurred in any action in the District Court and/or appellate body to enforce this Contractor's Agreement or recover damages or any other action as a result of a breach thereof.

IN WITNESS WHEREOF, the parties hereto have executed this Contractor's Agreement on the day and year stated hereinabove.

CONTRACTOR: _____

_____
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 AVAILABILITY OF FUNDS:

_____
David D. Williams, Jr. Date
DFCM Administrative Services Director

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT

_____
Lynn A. Hinrichs Date
Assistant Director Construction Management

APPROVED AS TO FORM:
ATTORNEY GENERAL
May 5, 2008
By: Alan S. Bachman
Asst Attorney General

APPROVED FOR EXPENDITURE:

_____
Division of Finance Date

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: _____

Attorney-in-Fact (Seal)

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. l953, 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, l953, 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: _____

Attorney-in-Fact (Seal)

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

STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

Division of Facilities Construction and Management

DFCM

CERTIFICATE OF SUBSTANTIAL COMPLETION

PROJECT _____ PROJECT NO: _____

AGENCY/INSTITUTION _____

AREA ACCEPTED _____

The Work performed under the subject Contract has been reviewed on this date and found to be Substantially Completed as defined in the General Conditions; including that the construction is sufficiently completed in accordance with the Contract Documents, as modified by any change orders agreed to by the parties, so that the State of Utah can occupy the Project or specified area of the Project for the use for which it is intended.

The DFCM - (Owner) accepts the Project or specified area of the Project as Substantially Complete and will assume full possession of the Project or specified area of the Project at _____ (time) on _____ (date).

The DFCM accepts the Project for occupancy and agrees to assume full responsibility for maintenance and operation, including utilities and insurance, of the Project subject to the itemized responsibilities and/or exceptions noted below:

_____

_____

The Owner acknowledges receipt of the following closeout and transition materials:

As-built Drawings | O & M Manuals | Warranty Documents | Completion of Training Requirements

A list of items to be completed or corrected (Punch List) is attached hereto. The failure to include an item on it does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents, including authorized changes thereof. The amount of _____(Twice the value of the punch list work) shall be retained to assure the completion of the punch list work.

The Contractor shall complete or correct the Work on the list of (Punch List) items appended hereto within _____ ____calendar days from the above date of issuance of this Certificate. The amount withheld pending completion of the list of items noted and agreed to shall be: $_____. If the list of items is not completed within the time allotted the Owner has the right to be compensated for the delays and/or complete the work with the help of independent contractor at the expense of the retained project funds. If the retained project funds are insufficient to cover the delay/completion damages, the Owner shall be promptly reimbursed for the balance of the funds needed to compensate the Owner.

_____ by: _____

CONTRACTOR (include name of firm) (Signature) DATE

_____ by: _____

A/E (include name of firm) (Signature) DATE

_____ by: _____

USING INSTITUTION OR AGENCY (Signature) DATE

_____ by: _____

DFCM (Owner) (Signature) DATE

4110 State Office Building, Salt Lake City, Utah 84114 cc: Parties Noted
telephone 801-538-3018 • facsimile 801-538-3267 • http://dfcm.utah.gov DFCM, Director

STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

Division of Facilities Construction and Management

DFCM

General Contractor Performance Rating Form

Project Name:		DFCM Project#	
Contractor: (ABC Construction, John Doe, 111-111-1111)	A/E: (ABC Architects, Jane Doe, 222-222-2222)	Original Contract Amount:	Final Contract Amount:
DFCM Project Manager:		Contract Date:	
Completion Date:		Date of Rating:	

Rating Guideline	QUALITY OF PRODUCT OR SERVICES	COST CONTROL	TIMELINESS OF PERFORMANCE	BUSINESS RELATIONS
5-Exceptional	Contractor has demonstrated an exceptional performance level in any of the above four categories that justifies adding a point to the score. Contractor performance clearly exceeds the performance levels described as "Very Good"			
4-Very Good	Contractor is in compliance with contract requirements and/or delivers quality product/service.	Contractor is effective in managing costs and submits current, accurate, and complete billings	Contractor is effective in meeting milestones and delivery schedule	Response to inquiries, technical/service/ administrative issues is effective
3-Satisfactory	Minor inefficiencies/errors have been identified	Contractor is usually effective in managing cost	Contractor is usually effective in meeting milestones and delivery schedules	Response to inquires technical/ service/administrative issues is somewhat effective
2-Marginal	Major problems have been encountered	Contractor is having major difficulty managing cost effectively	Contractor is having major difficulty meeting milestones and delivery schedule	Response to inquiries, technical/service/administrative issues is marginally effective
1-Unsatisfactory	Contractor is not in compliance and is jeopardizing achievement of contract objectives	Contractor is unable to manage costs effectively	Contractor delays are jeopardizing performance of contract objectives	Response to inquiries, technical/service/administrative issues is not effective

1. Rate Contractors quality of workmanship, management of sub contractor performance, project cleanliness, organization and safety requirement.	**Score**
Agency Comments:	
A & E Comments:	
DFCM Project Manager Comments:	

2. Rate Contractor administration of project costs, change orders and financial management of the project budget.	Score
Agency Comments:	
A & E Comments:	
DFCM Project Manager Comments:	

3. Rate Contractor's performance and adherence to Project Schedule, delay procedures and requirements of substantial completion, inspection and punch-list performance.	Score
Agency Comments:	
A & E Comments:	
DFCM Project Manager Comments:	

4. Evaluate performance of contractor management team including project manager, engineer and superintendent also include in the rating team's ability to work well with owner, user agency and consultants.	Score
Agency Comments:	
A & E Comments:	
DFCM Project Manager Comments:	

5. Rate success of Contractor's management plan, completion of the plans mitigation of project risks and performance of value engineering concepts.	Score
Agency Comments:	
A & E Comments:	
DFCM Project Manager Comments:	

Signed by:	Date:	Mean Score

Additional Comments:

Project Manual

Axis Project Number **0721**
DFCM project Number: **08217790**

UVSC Student Center Addition

Dance Studio

JUNE 02, 2008

State of Utah–Department of Administrative Services

DIVISION OF FACILITIES CONSTRUCTION
AND MANAGEMENT

4110 State Office Building/Salt Lake City, Utah 84114/538–3018

Axis Architects

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SECTION 01 11 00 – SUMMARY June 2, 2008

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 SUMMARY

A. This Section includes the following:

1. Work covered by the Contract Documents.
2. Type of the Contract.
3. Work phases.
4. Work under other contracts.
5. Products ordered in advance.
6. Owner-furnished products.
7. Use of premises.
8. Owner's occupancy requirements.
9. Work restrictions.
10. Specification formats and conventions.

B. Related Sections include the following:

1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: UVSC Student Center Remodel.

1. Project Location: Located within the Student Center Building on the campus of UVSC in Orem, Utah.

B. Owner: UVSC.

C. Project Number: DFCM 08217790.

D. Architect: Axis Architects.

E. Construction Manager:

1. A Construction Manager will be engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for Construction between Owner and Contractor, according to a separate contract between Owner and Construction Manager.

2. Construction Manager for this Project is Project's Constructor. In Divisions 01 through 48 Sections, the terms "Construction Manager" and "Contractor" are synonymous.

F. The Work consists of the following:

1. The Work includes all of the work of Divisions 01 thru 48 for the UVSC Student Center Building remodel project.

1.4 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.5 WORK PHASES

A. The Work may be conducted in phases, with each phase substantially complete before beginning the next phase:

B. Before commencing Work of each phase, submit a schedule showing the sequence, commencement and completion dates, and move-out and -in dates of Owner's personnel for all phases of the Work.

1.6 WORK UNDER OTHER CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

B. Preceding Work: Owner will award separate contract(s) for other construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.

C. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.

D. Future Work: Owner will award separate contract(s) for the following additional work to be performed at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract.

1.7 PRODUCTS ORDERED IN ADVANCE

A. General: Owner has negotiated Purchase Orders with suppliers of material and equipment to be incorporated into the Work. Owner will assign these Purchase Orders to Contractor. Costs for receiving, handling, storage if required, and installation of material and equipment are included in the Contract Sum.

1. Contractor's responsibilities are same as if Contractor had negotiated Purchase Orders, including responsibility to renegotiate purchase and to execute final Purchase-Order agreements.

1.8 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Work includes providing support systems to receive Owner's equipment and making plumbing, mechanical, and electrical connections.

1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
3. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
7. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.
8. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
9. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
10. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.
11. Contractor shall install and otherwise incorporate Owner-furnished items into the Work.

1.9 USE OF PREMISES

A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.

B. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to Contract limits.

   a. Limit site disturbance, including earthwork and clearing of vegetation, to 40 feet (12.2 m) beyond building perimeter; 5 feet (1.5 m) beyond primary roadway curbs, walkways, and main utility branch trenches; and 25 feet (7.6 m) beyond pervious paving areas.

2. Owner Occupancy: Allow for Owner occupancy of Project site.
3. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1.10 OWNER'S OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy: Owner will occupy site and existing adjacent buildings 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 authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's 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 authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

C. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial 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 before Owner occupancy.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
3. Before partial 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 building.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.11 WORK RESTRICTIONS

A. On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours, except otherwise indicated.

B. Existing Utility Interruptions: 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 and Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

    a. Implied where a colon (:) is used within a sentence or phrase.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION 01 11 00

SECTION 01 23 00 - ALTERNATES June 2, 2008

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 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1 – Fire-Resistive Glazing:

1. Provide all material, equipment and labor as required to add window "C" and "D". Refer to floor plan Base Bid. This Alternate shall include all miscellaneous items including metal stud framing, gypsum board and paint for a complete and finished installation.

END OF SECTION 01 23 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES June 2, 2008

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 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections include the following:
   1. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
   2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
      a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change Architect.
   1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
   2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to

substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
   1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
   1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES June 2, 2008

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 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:
1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Division 01 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
   a. Application for Payment forms with Continuation Sheets.
   b. Submittals Schedule.
2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the Schedule of Values:
   a. Project name and location.
   b. Name of Architect.
   c. Architect's project number.
   d. Contractor's name and address.
   e. Date of submittal.
2. Arrange the Schedule of Values in tabular form with separate columns to indicate the

following for each item listed:
a. Related Specification Section or Division.
b. Description of the Work.
c. Name of subcontractor.
d. Name of manufacturer or fabricator.
e. Name of supplier.
f. Change Orders (numbers) that affect value.
g. Dollar value.
1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.
6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
   a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
8. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
   1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
   1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
   2. Include amounts of Change Orders and Construction Change Directives issued

before last day of construction period covered by application.

E. Transmittal: Submit 4 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
   1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
   1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.
   2. When an application shows completion of an item, submit final or full waivers.
   3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
   4. Waiver Delays: Submit each Application for Payment with Contractor's waiver of mechanic's lien for construction period covered by the application.
      a. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
   5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. List of subcontractors.
   2. Schedule of Values.
   3. Contractor's Construction Schedule (preliminary if not final).
   4. Products list.
   5. Schedule of unit prices.
   6. Submittals Schedule (preliminary if not final).
   7. List of Contractor's staff assignments.
   8. List of Contractor's principal consultants.
   9. Copies of building permits.
   10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
   11. Initial progress report.
   12. Report of preconstruction conference.
   13. Certificates of insurance and insurance policies.
   14. Performance and payment bonds.
   15. Data needed to acquire Owner's insurance.
   16. Initial settlement survey and damage report if required.

H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited,

to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION June 2, 2008

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 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General project coordination procedures.
   2. Conservation.
   3. Coordination Drawings.
   4. Administrative and supervisory personnel.
   5. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

C. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 01 Section "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
   2. Division 01 Section "Execution Requirements" 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 Contract closeout.

1.3 COORDINATION

A. Coordination: Coordinate construction operations included in various 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 with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

B. If necessary, 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 and activities of other contractors 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.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.

1.4 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Indicate relationship of components shown on separate Shop Drawings.
2. Indicate required installation sequences.
3. Refer to Division 23 Section "Basic Mechanical Materials and Methods" and Division 26 Section "Basic Electrical Materials and Methods" for specific Coordination Drawing requirements for mechanical and electrical installations.

B. Staff Names: Within 15 days of starting construction operations, submit a list of principal staff 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 and office telephone numbers. 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.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1. Include special personnel required for coordination of operations with other contractors.

1.6 PROJECT MEETINGS

A. General: 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: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3

days of the meeting.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
   a. Tentative construction schedule.
   b. Phasing.
   c. Critical work sequencing.
   d. Designation of responsible personnel.
   e. Procedures for processing field decisions and Change Orders.
   f. Procedures for processing Applications for Payment.
   g. Distribution of the Contract Documents.
   h. Submittal procedures.
   i. Preparation of Record Documents.
   j. Use of the premises.
   k. Responsibility for temporary facilities and controls.
   l. Parking availability.
   m. Office, work, and storage areas.
   n. Equipment deliveries and priorities.
   o. First aid.
   p. Security.
   q. Progress cleaning.
   r. Working hours.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction. Including, but no limited to: Demolition, concrete, masonry, excavation, mechanical, plumbing, electrical, steel erection and stud framing, roofing drywall and finish work.

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 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 Change Orders.
   d. Purchases.
   e. Deliveries.
   f. Submittals.
   g. Review of mockups.
   h. Possible conflicts.
   i. Compatibility problems.
   j. Time schedules.
   k. Weather limitations.
   l. Manufacturer's written recommendations.

m. Warranty requirements.
n. Compatibility of materials.
o. Acceptability of substrates.
p. Temporary facilities and controls.
q. Space and access limitations.
r. Regulations of authorities having jurisdiction.
s. Testing and inspecting requirements.
t. Required performance results.
u. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements.
4. 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. Progress Meetings: Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of Owner 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 conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. 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.
   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) Work hours.
      10) Hazards and risks.
      11) Progress cleaning.
      12) Quality and work standards.
      13) Change Orders.
      14) Documentation of information for payment requests.
3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
   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.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION June 2, 2008

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 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Contractor's Construction Schedule.
   2. Submittals Schedule.
   3. Daily construction reports.
   4. Material location reports.
   5. Field condition reports.
   6. Special reports.

B. Related Sections include the following:
   1. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
   2. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
   3. 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 activities are activities on the critical path. They 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. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Architect.

C. 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 Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.
   1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is

a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

H. Major Area: A story of construction, a separate building, or a similar significant construction element.

I. Milestone: A key or critical point in time for reference or measurement.

J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 SUBMITTALS

A. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Architect's and Construction Manager's final release or approval.

B. Contractor's Construction Schedule: Submit two opaque copies of initial schedule, large enough to show entire schedule for entire construction period.

C. CPM Reports: Concurrent with CPM schedule, submit three copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Total Float Report: List of all activities sorted in ascending order of total float.
3. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

D. Daily Construction Reports: Submit one copy at weekly intervals.

E. Material Location Reports: Submit two copies at monthly intervals.

F. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

G. Special Reports: Submit two copies at time of unusual event.

1.5 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, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from parties involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
   1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
   2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule or network diagram. Include submittals required during the first 60 days of construction. List those 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.

2.2 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. Major material deliveries.
   6. High and low temperatures and general weather conditions.
   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 or Work 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.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation on CSI Form 13.2A. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.3 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one (1) 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. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
   1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule monthly.
   2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
   3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Construction Manager, 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.

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES June 2, 2008

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 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections include the following:
1. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
2. Division 01 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
3. Division 01 Section "Closeout Procedures" for submitting warranties.
4. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
5. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
6. Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
7. Divisions 02 through 33 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect's responsive action.

B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. 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. 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.

B. Submittals Schedule: Provide a prioritized schedule of submittals.

C. Processing Time: Allow enough 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. Construction Manager will advise Contractor 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. 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, before being returned to Contractor.

D. Identification: Place a permanent label or title block on each submittal for identification.
   1. Indicate name of firm or entity that prepared each submittal on label or title block.
   2. Provide a space approximately 5" x 10" on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
   3. Include the following information on label for processing and recording action taken:
      a. Project name.
      b. Date.
      c. Name and address of Architect and Construction Manager.
      d. Name and address of Contractor or Subcontractor.
      e. Name and address of supplier.
      f. Name of manufacturer.
      g. Number and title of appropriate Specification Section.

E. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

F. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
   1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.

G. Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Construction Manager.
   1. Transmittal Form: Use regular transmittal form.
   2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

H. 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 "Conforms@.

I. 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.

J. Use for Construction: Use only final submittals with mark indicating "Conforms" taken by Architect and Construction Manager.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

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 printed 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 written recommendations.
      b. Manufacturer's product specifications.
      c. Manufacturer's installation instructions.
      d. Standard color charts.
      e. Manufacturer's catalog cuts.
      f. Wiring diagrams showing factory-installed wiring.
      g. Printed performance curves.
      h. Operational range diagrams.
      i. Mill reports.
      j. Standard product operation and maintenance manuals.
      k. Compliance with specified referenced standards.
      l. Testing by recognized testing agency.
      m. Application of testing agency labels and seals.
      n. Notation of coordination requirements.
   4. Submit Product Data before or concurrent with Samples.
   5. Number of Copies: Submit four (4) copies of Product Data, unless otherwise indicated. Architect will return two (2) copies. Mark up and retain one returned copy as a Project Record Document.

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.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Dimensions.
      b. Identification of products.
      c. Fabrication and installation drawings.
      d. Roughing-in and setting diagrams.
      e. Wiring Diagrams:
         1) Differentiate between manufacturer-installed and field-installed wiring.
         2) Show field-installed wiring, including power, signal, and control wiring.

f. Shopwork manufacturing instructions.
g. Templates and patterns.
h. Schedules.
i. Design calculations.
j. Compliance with specified standards.
k. Notation of coordination requirements.
l. Notation of dimensions established by field measurement.
m. Relationship to adjoining construction clearly indicated.
n. Seal and signature of Utah registered professional engineer if specified.
o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

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 1000 mm).
3. Number of Copies: Submit copies of each submittal, as follows:
   a. One set of reproducible vellums and five (5) copies.
   b. Must be reviewed, approved, stamped, signed and dated by Construction Manager.
   c. Show Specification Section Number (from Project Manual).
   d. Show Contractor's name, address, telephone and fax numbers and Contact Person.
   e. Construction Manager:
      1) Shall receive back his one set of reproducible vellum drawings and one print copy, as reviewed by the Architect and/or Engineer.
      2) Construction Manager is responsible for print sets and distribution of same.
      3) Shop Drawing originals belong to the Construction Manager and shall remain in his files.

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 appropriate 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 two (2) full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager,

will return one submittal 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 (3) sets of Samples. Architect will retain one (1) Sample set; remainder will be returned.
      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 (3) sets of paired units that show approximate limits of variations.

E. Product Schedule or List: 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.
   2. Number and name of room or space.
   3. Location within room or space.
   4. Number of Copies: Submit five (5) copies of product schedule or list, unless otherwise indicated. Architect will return three (3) copies.
      a. Mark up and retain one returned copy as a Project Record Document.

F. Delegated-Design Submittal: Comply with requirements in Division 01 Section “Quality Requirements”.

G. Submittals Schedule: Provide a prioritized schedule of submittals.

H. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, and telephone number of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.
   1. Number of Copies: Submit two (2) copies of each submittal, unless otherwise indicated. Architect will not return copies.
   2. Certificates and Certifications: Provide a notarized 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.
   3. Test and Inspection Reports: Comply with requirements specified in Division 1 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare 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.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

J. Material Test Reports: Prepare 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.

K. Product Test Reports: Prepare 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.

L. Research/Evaluation Reports: Prepare 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.

M. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section "Quality Requirements."

N. Preconstruction Test Reports: Prepare 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.

O. Compatibility Test Reports: Prepare 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.

P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, 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.

Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

R. Design Data: Prepare 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.

S. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

T. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

U. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

V. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit

to Architect.

1. Architect will not review submittals that include MSDSs and will return them with no action taken.

2.3 DELEGATED DESIGN

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 Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three (3) copies of a statement, 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.

PART 3 - EXECUTION

3.1 CONSTRUCTION MANAGER'S REVIEW

A. 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 review stamp before submitting to Architect.

B. Review Stamp: Stamp each submittal with a uniform, review stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's review, and statement certifying that submittal has been reviewed, checked, and reviewed 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 review stamp and will return them without action.

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 taken, as follows:

1. Final Unrestricted Release: When the Architect marks a submittal “Conforms” the work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
2. Final-But-Restricted Release: When the Architect marks a submittal “Re: Notes”, the work covered by the submittal may proceed provided it complies with the notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
3. Returned For Resubmittal: When the Architect marks a submittal “Revise and Resubmit”, do not proceed with work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according

to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.

a. Do not use, or allow others to use, submittals marked “Revise and Resubmit”, at the Project Site or elsewhere where work is in progress.

4. Returned For Alternate Submittal: When Architect marks a submittal “Does Not Conform”, do not proceed with work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Product was not appropriate or as specified. Prepare a new submittal according to the Contract Documents.

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 party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 33 00

SECTION 01 42 19 - DEFINITIONS AND STANDARDS June 2, 2008

PART 1 - GENERAL

1.1 SUMMARY

A. Definitions: Basic Contract definitions are included in the General Conditions.

1. Directed: Terms such as "directed", "requested", "authorized", "selected", "approved", "required", and "permitted" mean "directed by the Architect", "requested by the Architect", and similar phrases. However, no implied meaning shall be interpreted to extend the Architect's responsibility into the Contractor's area of construction supervision.
2. Approve: The term "approved," where used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the duties and responsibilities of the Architect as stated in General and Supplementary Conditions. Such approval shall not release the Contractor from responsibility to fulfill Contract requirements unless otherwise provided in the Contract Documents.
3. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."
4. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
5. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."

B. Specification Format and Conventions:

1. Specification Format: The Specifications are organized into Divisions and Sections using the 48-division format and CSI/CSC's "MasterFormat" numbering system.
   a. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.
   b. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.

2. Specification Content: The Specifications use certain conventions for style of language and the intended meaning of terms, words, and phrases when used in particular situations. These conventions are as follows.
   a. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
   b. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, hte indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
      1) 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.

C. Drawing Symbols:
   1. Graphic symbols: Where not otherwise noted, symbols are defined by "Architectural Graphic Standards," published by John Wiley & Sons, Inc., eighth edition.
      a. Mechanical/Electrical Drawings: Graphic symbols used on mechanical and electrical Drawings are generally aligned with symbols recommended by ASHRAE. Where appropriate, they are supplemented by more specific symbols recommended by technical associations including ASME, ASPE, IEEE, and similar organizations. Refer instances of uncertainty to the Architect for clarification before proceeding.

D. Industry Standards:
   1. Applicability of Standards: Except where 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. Such standards are made a part of the Contract Documents by reference. Individual Sections indicate which codes and standards the Contractor must keep available at the Project Site for reference.
   2. Publication Dates: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of date of Contract Documents.
   3. Conflicting Requirements: Where compliance with two or more standards is specified, and they establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Contract Documents indicate otherwise. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the Architect for a decision before proceeding.
   4. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.
      a. Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.
      b. Although copies of standards needed for enforcement of requirements also may, be included as part of required submittals, the Architect reserves the right to require the Contractor to submit additional copies as necessary for enforcement of requirements.
   5. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision.
      a. A copy of the CSI directory of Construction Industry Associations, Societies, and Institutes, and Abbreviations is on file in the office of the Architect.

END OF SECTION 01 42 19

SECTION 01 43 00 - QUALITY CONTROL SERVICES June 2, 2008

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for quality control services.

B. Quality control services include inspections and tests and related actions including reports, performed by independent agencies, governing authorities, and the Contractor. They do not include Contract enforcement activities performed by the Architect.

C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.
   1. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities.
   2. Inspections, test and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Document requirements.

D. Requirements for the Contractor to provide quality control services required by the Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

E. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-01 Specification Sections, apply to this Section.

1.2 RESPONSIBILITIES

A. Contractor Responsibilities:
   1. Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. Costs for these services shall be included in the Contract Sum.
      a. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Contractor=s responsibility, the Contractor shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services are included in the Contract Sum.
      b. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Owner=s responsibility, the Owner will employ and pay a qualified independent testing agency to perform those services.
   2. Retesting: The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and do not indicate compliance with Contract Document requirements, regardless of whether the original test was the Contractor's responsibility.
   3. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.
   4. Associated Services: The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary

services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include but are not limited to:

a. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
b. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.
c. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
d. Security and protection of samples and test equipment at the Project site.

B. Owner Responsibilities: The Owner will provide inspections, tests and similar quality control services specified to be performed by independent agencies and not by the Contractor, except where they are specifically indicated as the Contractor's responsibility or are provided by another identified entity. Costs for these services are not included in the Contract Sum.

1. The Owner will employ and pay for the services of an independent agency, testing laboratory or other qualified firm to perform services which are the Owner's responsibility.

C. Duties of the Testing Agency: The independent testing agency engaged to perform inspections, sampling and testing of materials and construction specified in individual Specification Sections shall cooperate with the Architect and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.

1. The agency shall notify the Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.
3. The agency shall not perform any duties of the Contractor.

D. Coordination: The Contractor and each agency engaged to perform inspections, tests and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. In addition the Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

1. The Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities.

1.3 SUBMITTALS

A. The independent testing agency shall submit a certified written report of each inspection, test or similar service, to the Architect, in duplicate

1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
2. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:

a. Date of issue.
b. Project title and number.
c. Name, address and telephone number of testing agency.
d. Dates and locations of samples and tests or inspections.
e. Names of individuals making the inspection or test.
f. Designation of the Work and test method.
g. Identification of product and Specification Section.
h. Complete inspection or test data.
i. Test results and an interpretations of test results.

j. Ambient conditions at the time of sample-taking and testing.
k. Name and signature of laboratory inspector.
l. Recommendations on retesting.

1.4 QUALITY ASSURANCE

A. Qualification for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, which are prequalified as complying with "Recommended Requirements for Independent Laboratory Qualification" by the American Council of Independent Laboratories, and which specialize in the types of inspections and tests to be performed.
   1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the State in which the Project is located.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 TESTS REQUIRED

A. Tests required may include but not be limited to the following:
   1. Soil compaction per IBC 1802.6.
   2. Concrete, per IBC 1704.4 and Table 1704.4.
   3. Welding, per IBC 1704.3 and Table 1704.3.
   4. High strength bolts, per IBC 1704.3.3.
   5. Structural masonry, per IBC 1704.5.
   6. Spray-on fireproofing, per IBC 1704.11.
   7. Smoke-control system, per IBC 1704.14.

3.2 REPAIR AND PROTECTION

A. General: Upon completion of inspection, testing, sample-taking and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes.
   1. Protect construction exposed by or for quality control service activities, and protect repaired construction.
   2. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing or similar services.

END OF SECTION 01 43 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS June 2, 2008

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 SUMMARY

A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.

B. Temporary utilities include, but are not limited to, the following:
1. Sewers and drainage.
2. Water service and distribution.
3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
4. Heating and cooling facilities.
5. Ventilation.
6. Electric power service.
7. Lighting.
8. Telephone service.
9. Facsimile machine.

C. Support facilities include, but are not limited to, the following:
1. Temporary roads and paving.
2. Dewatering facilities and drains.
3. Project identification and temporary signs.
4. Waste disposal facilities.
5. Field offices.
6. Storage and fabrication sheds.
7. Lifts and hoists.
8. Construction aids and miscellaneous services and facilities.
9. First aid station.

D. Security and protection facilities include, but are not limited to, the following:
1. Environmental protection.
2. Stormwater control.
3. Tree and plant protection.
4. Pest control.
5. Site enclosure fence.
6. Security enclosure and lockup.
7. Barricades, warning signs, and lights.
8. Covered walkways.
9. Temporary enclosures.
10. Temporary partitions.
11. Fire protection.

E. Related Sections include the following:
1. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.

2. Division 01 Section "Execution Requirements" for progress cleaning requirements.
3. Divisions 02 through 33 for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
1. Owner's construction forces.
2. Occupants of Project.
3. Architect.
4. Testing agencies.
5. Personnel of authorities having jurisdiction.

B. Sewer Service: Pay sewer service use charges for sewer usage, by all parties engaged in construction, at Project site.

C. Water Service: Pay water service use charges, whether metered or otherwise, for water used by all entities engaged in construction activities at Project site.

D. Electric Power Service: Pay electric power service use charges, whether metered or otherwise, for electricity used by all entities engaged in construction activities at Project site.

1.5 QUALITY ASSURANCE

A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
2. 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.

1.6 PROJECT CONDITIONS

A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
1. Temporary Use of Permanent Facilities: Installer of each permanent service shall 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.

B. Conditions of Use: The following conditions apply to use of temporary services and facilities

by all parties engaged in the Work:
1. Keep temporary services and facilities clean and neat.
2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.

B. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.76-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 rails.

C. Lumber and Plywood: Comply with requirements in Division 6 Section "Miscellaneous Carpentry."

D. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.

E. Water: Potable.

2.2 EQUIPMENT

A. General: Provide equipment suitable for use intended.

B. Field Offices: Prefabricated or mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.

C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

D. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

E. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.
1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F (7.2 to 12.7 deg C).

F. Heating Equipment: Unless Owner authorizes use of permanent heating 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, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use for type of fuel being consumed.

G. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

H. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

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.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. 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: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
   1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
   2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
   3. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.

B. Sewers and Drainage: Provide temporary connections to remove effluent that can be discharged lawfully.
   1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
   2. Connect temporary sewers to municipal system as directed by sewer department officials.
   3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
   4. Provide temporary filter beds, settlement tanks, separators, and similar devices to purify effluent to levels acceptable to authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction until permanent water service is in use. Sterilize temporary water piping before use.
   1. Provide rubber hoses as necessary to serve Project site.
   2. As soon as water is required at each level, extend service to form a temporary water- and fire-protection standpipe. Provide distribution piping. Space outlets so water can be reached with a 100-foot (30-m) hose. Provide one hose at each outlet.
   3. Where installations below an outlet might be damaged by spillage or leakage,

provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
   1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
   2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Provide separate facilities for male and female personnel.
   3. Drinking-Water Facilities: Provide bottled-water, drinking-water units.
      a. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F (7.2 to 12.7 deg C).

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 from that specified that will not have a harmful effect on completed installations or elements being installed.
   1. Maintain a minimum temperature of 50 deg F (10 deg C) in permanently enclosed portions of building for normal construction activities, and 65 deg F (18.3 deg C) for finishing activities and areas where finished Work has been 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 from that specified 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.

G. Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.
   1. Install power distribution wiring overhead and rise vertically where least exposed to damage.
   2. Connect temporary service to Owner's existing power source, as directed by electric company officials.

H. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
   1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
   2. Provide warning signs at power outlets other than 110 to 120 V.
   3. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or other traffic areas.
   4. Provide metal conduit enclosures or boxes for wiring devices.
   5. Provide 4-gang outlets, spaced so 100-foot (30-m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.

I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
   2. Provide one 100-W incandescent lamp per 500 sq. ft. (45 sq. m), uniformly distributed, for general lighting, or equivalent illumination.
   3. Provide one 100-W incandescent lamp every 50 feet (15 m) in traffic areas.
   4. Provide one 100-W incandescent lamp per story in stairways and ladder runs, located to illuminate each landing and flight.
   5. Install exterior-yard site lighting that will provide adequate illumination for construction operations, traffic conditions, and signage visibility when the Work is being performed.

J. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities. Install separate telephone line for each field office and first-aid station.
   1. Provide additional telephone lines for the following:
      a. In field office with more than two occupants, install a telephone for each additional occupant or pair of occupants.
      b. Provide a dedicated telephone line for each facsimile machine and computer with modem in each field office.
      c. Provide a separate telephone line for Owner's use.
      d. Install a telephone on every second or third story of construction.
   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 an answering machine or voice-mail service on superintendent's telephone.
   4. Provide a portable cellular telephone for superintendent's use in making and receiving telephone calls when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
   1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
   2. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
   3. Maintain support facilities until near Substantial Completion. 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 to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and paved areas within construction limits indicated on Drawings.
   1. Provide a reasonably level, graded, well-drained subgrade of satisfactory soil material, compacted to not less than 95 percent of maximum dry density in the top 6 inches (150 mm).
   2. Provide gravel paving course of subbase material not less than 3 inches (75 mm)

thick; roller compacted to a level, smooth, dense surface.

3. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.

D. Dewatering Facilities and Drains: Comply with requirements in applicable Division 2 Sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. 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 property nor endanger permanent Work or temporary facilities.
2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.
3. Remove snow and ice as required to minimize accumulations.

E. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.

1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated.
2. Prepare temporary signs to provide directional information to construction personnel and visitors.
3. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in sizes and thicknesses indicated. Support on posts or framing of preservative-treated wood or steel.
4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
5. Provide one 72" high x 96" wide project sign with text as follows:
   a. Name of Project - allow 2 line.
   b. Name of Owner - allow 2 lines.
   c. Owner=s Logo - allow 24" x 16" space.
   d. Name of Architect - allow 4 lines.
   e. Architect=s Logo - allow (2) 24" x 16" spaces.
   f. Name of Contractor - allow 2 lines.
   g. Contractor=s Logo - allow 24" x 16" space.
   h. Allow 24 additional lines.

F. Waste Disposal Facilities:

1. Establish a system for daily collection and disposal of waste or extraneous materials from all construction areas on site that may present a hazard to the project, its craftsmen and the expeditious construction of the work. The Contractor shall provide to the Owner a satisfactory method to assure clean-up is performed in a timely and expeditious fashion. Enforce requirements strictly. Do not hold collected materials at the site longer than 7 days during normal weather or 3 days when the daily temperature is expected to rise above 80 degrees F. Handle waste materials that are hazardous, dangerous, or unsanitary separately from other inert waste by containerizing appropriately. Dispose of waste material in a lawful manner.
   a. Burying or burning of waste materials on the site will not be permitted.
   b. Washing waste materials down sewers or into waterways will not be

permitted.

c. Provide rodent proof containers located on each floor level of construction work, to encourage depositing of lunch garbage and similar wastes by construction personnel.

2. The Owner reserves the right to withhold payments and perform the clean-up, if necessary, at the expense of the Contractor, if unsatisfactory clean-up efforts are not performed in a timely fashion.

G. Common-Use Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings of 12 persons at Project site. Keep office clean and orderly.

1. Furnish and equip offices as follows:

a. Desk and four chairs, four-drawer file cabinet, a plan table, a plan rack, and bookcase.

b. Provide a room of not less than 240 sq. ft. (18.0 sq. m) for Project meetings. Furnish room with conference table, 12 folding chairs, and 4-foot- (1.2-m-) square tack board.

2. Provide resilient floor covering and painted gypsum wallboard walls and acoustical ceiling. Provide operable windows with adjustable blinds and insect screens.

3. Provide an electric heater with thermostat capable of maintaining a uniform indoor temperature of 68 deg F (20 deg C). Provide an air-conditioning unit capable of maintaining an indoor temperature of 72 deg F (23 deg C).

4. Provide fluorescent light fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height. Provide 110- to 120-V duplex outlets spaced at not more than 12-foot (4-m) intervals, 1 per wall in each room.

H. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.

I. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

J. Temporary Stairs: Provide temporary stairs where ladders are not adequate.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.

B. Stormwater Control: Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of stormwater from heavy rains.

C. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.

D. Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest-control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Engage this pest-control service 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.

E. Site Enclosure Fence: Before construction operations begin, install chain-link enclosure fence with lockable entrance gates. Locate where indicated, or enclose entire Project site or portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.
   1. Set fence posts in concrete bases.
   2. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
   3. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

F. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

G. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.
   1. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8-inch-(16-mm-) thick exterior plywood.

H. Covered Walkway: Where required, erect a structurally adequate, protective, covered walkway for passage of persons along adjacent public street. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.

I. 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, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
   2. Vertical Openings: Close openings of 25 sq. ft. (2.3 sq. m) or less with plywood or similar materials.
   3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
   4. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
   5. Where temporary wood or plywood enclosure exceeds 100 sq. ft. (9.2 sq. m) in area, use fire-retardant-treated material for framing and main sheathing.

J. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
   1. Construct dustproof partitions of not less than nominal 4-inch (100-mm) studs, 5/8-inch (16-mm) gypsum wallboard with joints taped on occupied side, and 1/2-inch (13-mm) fire-retardant plywood on construction side.

2. Insulate partitions to provide noise protection to occupied areas.
3. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
4. Protect air-handling equipment.
5. Weatherstrip openings.

K. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
   a. Field Offices: Class A stored-pressure water-type extinguishers.
   b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
   c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
2. Store combustible materials in containers in fire-safe locations.
3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
6. Develop and supervise an overall fire-prevention and first-aid fire-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.
7. 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 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may

have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS June 2, 2008

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 SUMMARY

A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include the following:
1. Division 01 Section "Definitions and Standards" for applicable industry standards for products specified.
2. Division 01 Section "Closeout Procedures" for submitting warranties for contract closeout.
3. Divisions 02 through 33 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Items purchased 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, or where indicated as a product substitution, 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. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," 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 other named manufacturers.

D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.4 SUBMITTALS

A. Product List: Submit a list, in tabular from, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
   1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
   2. Form: Tabulate information for each product under the following column headings:
      a. Specification Section number and title.
      b. Generic name used in the Contract Documents.
      c. Proprietary name, model number, and similar designations.
      d. Manufacturer's name and address.
      e. Supplier's name and address.
      f. Installer's name and address.
      g. Projected delivery date or time span of delivery period.
      h. Identification of items that require early submittal approval for scheduled delivery date.
   3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
      a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.
   4. Completed List: Within 60 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
   5. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.

B. 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 CSI Form 13.1A.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified material or product cannot be provided.
      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. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
      d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
      e. Samples, where applicable or requested.
      f. List of similar installations for completed projects with project names and

addresses and names and addresses of architects and owners.

g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

i. 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 lack of availability or delays in delivery.

j. Cost information, including a proposal of change, if any, in the Contract Sum.

k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.

l. 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 one week of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Acceptance: Change Order.

b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

C. 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, product selected shall be 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. Comply with manufacturer's written instructions.

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 ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store products to allow for inspection and measurement of quantity or counting of units.
6. Store materials in a manner that will not endanger Project structure.
7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
9. Protect stored products from damage.

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.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that 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. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures: Procedures for product selection include the following:

1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
   a. Substitutions may be considered, unless otherwise indicated.
2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
   a. Substitutions may be considered, unless otherwise indicated.
3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   a. Substitutions may be considered, unless otherwise indicated.
4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   a. Substitutions may be considered, unless otherwise indicated.
5. Available Products: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
7. Product Options: Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in "Product Substitutions" Article.
8. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Products" are included and also introduce or refer to a list of manufacturers' names, provide either the specified 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 provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
   a. Substitutions may be considered, unless otherwise indicated.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.
   a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors,

patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

B. 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:

1. 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.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.
10. 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.

2.3 COMPARABLE PRODUCTS

A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:

1. Evidence that the proposed product does not require extensive 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.

PART 3 - EXECUTION

(Not Used)

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION REQUIREMENTS June 2, 2008

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 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering and surveying.
   3. General installation of products.
   4. Progress cleaning.
   5. Starting and adjusting.
   6. Protection of installed construction.
   7. Correction of the Work.

B. Related Sections include the following:
   1. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
   2. Division 01 Section "Submittal Procedures" for submitting surveys.
   3. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
   4. 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.

1.3 SUBMITTALS

A. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
   1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: 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 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; and underground electrical services.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: 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 Interruptions: Do not interrupt utilities serving facilities occupied unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Architect and Owner not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Architect's and Owner's written permission.

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, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

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 land surveyor/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. 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.

D. 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.

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 as indicated in spaces without a suspended ceiling.

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. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
   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.

G. 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.

H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. 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 materials more than 7 days during normal weather or 3 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.

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: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

I. 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.

J. 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.

K. 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.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.8 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.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."
   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 01 73 00

SECTION 01 73 29 - CUTTING AND PATCHING June 2, 2008

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 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:
1. Division 01 Section "Selective Demolition" for demolition of selected portions of the building for alterations.
2. Division 07 Section "Through-Penetration Firestop Systems" for patching fire-rated construction.
3. Divisions 02 through 33 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
   a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 22, 23 and 26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 DEFINITIONS

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed.
1. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. 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, including but not limited to the following:
1. Primary operational systems and equipment.
2. Air or smoke barriers.

3. Fire-protection systems.
4. Control systems.
5. Communication systems.
6. Conveying systems.
7. Electrical wiring systems.
8. Operating systems of special construction in Division 13 Sections.

C. Miscellaneous Elements: Do not cut and patch the following elements or related 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.
1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces 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.
1. If possible, retain original Installer or fabricator to cut and patch exposed Work. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.

E. 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.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during 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 of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
   1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing 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.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services to occupied areas.

3.3 PERFORMANCE

A. 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 existing 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. Cutting: Cut existing 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 as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete/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 2 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.

C. 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 possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate 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 eliminate evidence of patching and refinishing.
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 existing 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, apply primer and intermediate paint coats 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 existing 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.

END OF SECTION 01 73 29

SECTION 01 77 00 - CLOSEOUT PROCEDURES June 2, 2008

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 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Inspection procedures.
   2. Warranties.
   3. Final cleaning.

B. Related Sections include the following:
   1. Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
   2. Division 01 Section "Execution Requirements" for progress cleaning of Project site.
   3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   4. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   5. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
   6. Divisions 02 through 33 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 in 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 photographs, 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 Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's 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 date of 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 videotapes.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor 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. Preparation: Submit three copies 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.
   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 Contractor.
e. Page number.

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. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
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 Contractor.

C. 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.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide 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 similar labels, 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 unusual operating conditions.

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.

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. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA June 2, 2008

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 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory.
   2. Emergency manuals.
   3. Operation manuals for systems, subsystems, and equipment.
   4. Maintenance manuals for the care and maintenance of products, materials, and finishes systems and equipment.

B. Related Sections include the following:
   1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
   2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
   3. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
   4. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. Initial Submittal: Submit 2 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return one copy of draft and mark whether general scope and content of manual are acceptable.

B. Final Submittal: Submit 2 of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
   1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate

information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:
   1. List of documents.
   2. List of systems.
   3. List of equipment.
   4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
   1. Title page.
   2. Table of contents.
   3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name, address, and telephone number of Contractor.
   6. Name and address of Architect.
   7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
   a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
   b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:
   1. Instructions on stopping.
   2. Shutdown instructions for each type of emergency.
   3. Operating instructions for conditions outside normal operating limits.
   4. Required sequences for electric or electronic systems.
   5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
   1. System, subsystem, and equipment descriptions.
   2. Performance and design criteria if Contractor is delegated design responsibility.
   3. Operating standards.
   4. Operating procedures.
   5. Operating logs.
   6. Wiring diagrams.
   7. Control diagrams.
   8. Piped system diagrams.
   9. Precautions against improper use.
   10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Equipment identification with serial number of each component.
   4. Equipment function.
   5. Operating characteristics.
   6. Limiting conditions.
   7. Performance curves.
   8. Engineering data and tests.
   9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:
   1. Startup procedures.
   2. Equipment or system break-in procedures.
   3. Routine and normal operating instructions.
   4. Regulation and control procedures.
   5. Instructions on stopping.
   6. Normal shutdown instructions.
   7. Seasonal and weekend operating instructions.
   8. Required sequences for electric or electronic systems.
   9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish.

Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Color, pattern, and texture.
   4. Material and chemical composition.
   5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
   1. Inspection procedures.
   2. Types of cleaning agents to be used and methods of cleaning.
   3. List of cleaning agents and methods of cleaning detrimental to product.
   4. Schedule for routine cleaning and maintenance.
   5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
   1. Standard printed maintenance instructions and bulletins.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
   1. Test and inspection instructions.

2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training videotape, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a

tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

1. Do not use original Project Record Documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."

G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS June 2, 2008

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 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.
   4. Record Submittals as requested by the Owner.

B. Related Sections include the following:
   1. Division 01 Section "Closeout Procedures" for general closeout procedures.
   2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Divisions 02 through 33 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set of marked-up Record

B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one copy of each Product Data submittal.
   1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

D. Record Shop Drawings: Provide copies of shop drawings or other submittals as requested by the Owner.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of white prints 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 prepare the 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 understandable drawing technique.
c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

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 or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
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 SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Note related Change Orders, Product Data, and Record Drawings where applicable.

2.3 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.

2.4 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.

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 and Owner=s reference during normal working hours.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING June 2, 2008

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 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.
   3. Demonstration and training videotapes.

B. Related Sections include the following:
   1. Division 01 Section "Project Management and Coordination" for requirements for preinstruction conferences.
   2. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

C. Unit Price for Instruction Time: Length of instruction time will be measured by actual time spent performing demonstration and training in required location. No payment will be made for time spent assembling educational materials, setting up, or cleaning up.

1.3 SUBMITTALS

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
   1. At completion of training, submit two complete training manual(s) for Owner's use.

B. Qualification Data: For firms and persons specified in AQuality 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.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

E. Demonstration and Training Videotapes: Submit two copies within seven days of end of each training module.
   1. Identification: On each copy, provide an applied label with the following information:
      a. Name of Project.
      b. Name and address of photographer.
      c. Name of Architect and Construction Manager.

d. Name of Contractor.
e. Date videotape was recorded.
f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

2. Transcript: Prepared on 8-1/2-by-11-inch (215-by-280-mm) paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding videotape. Include name of Project and date of videotape on each page.

1.4 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

B. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
1. Motorized doors, including overhead coiling doors and automatic entrance doors.
2. Equipment, including projection screens, loading dock equipment, food-service equipment, and residential appliances.
3. Fire-protection systems, including fire alarm and fire-extinguishing systems.
4. Intrusion detection systems.
5. Conveying systems, including elevators and wheelchair lifts.

6. Heat generation, including boilers, feedwater equipment, pumps and water distribution piping.
7. Refrigeration systems, including chillers, cooling towers, condensers, pumps and distribution piping.
8. HVAC systems, including air-handling equipment, air distribution systems and terminal equipment and devices.
9. HVAC instrumentation and controls.
10. Electrical service and distribution, including transformers, switchboards, panelboards, uninterruptible power supplies and motor controls.
11. Packaged engine generators, including transfer switches.
12. Lighting equipment and controls.
13. Communication systems, including intercommunication, surveillance, clocks and programming, voice and data and television equipment.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Operating standards.
   c. Regulatory requirements.
   d. Equipment function.
   e. Operating characteristics.
   f. Limiting conditions.
   g. Performance curves.
2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project Record Documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.

l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner, through Construction Manager, with at least 14 days' advance notice.

C. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEOTAPES

A. General: Engage a qualified commercial photographer to record demonstration and training videotapes. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
   1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Videotape Format: Provide high-quality VHS color videotape in full-size cassettes.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

D. Narration: Describe scenes on videotape by audio narration by microphone while videotape is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

END OF SECTION 01 79 00

DIVISION 02 – EXISTING CONDITIONS

Section 02 41 00 Selective Demolition

SECTION 02 41 00 - SELECTIVE DEMOLITION June 2, 2008

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 SUMMARY

A. This Section includes the following:
1. Demolition and removal of selected portions of a building or structure.
2. Repair procedures for selective demolition operations.

B. Related Sections include the following:
1. Division 01 Section "Summary" for use of the premises and phasing requirements.
2. Division 01 Section "Cutting and Patching" for cutting and patching procedures for selective demolition operations.
3. Division 23 Sections for demolishing, cutting, patching, or relocating mechanical items.
4. Division 26 Sections for demolishing, cutting, patching, or relocating electrical items.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Historic 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 Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1.5 SUBMITTALS

A. Qualification Data: For firms and persons specified in "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.

B. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

C. Schedule of Selective Demolition Activities: Indicate the following:
   1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
   2. Interruption of utility services.
   3. Coordination for shutoff, capping, and continuation of utility services.
   4. Use of elevator and stairs.
   5. Locations of temporary partitions and means of egress.
   6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

E. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

F. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

D. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
   1. Inspect and discuss condition of construction to be selectively demolished.
   2. Review structural load limitations of existing structure.
   3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

1.7 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. Maintain access to existing walkways, corridors, and other adjacent occupied or used

facilities.

1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

C. Owner assumes no responsibility for condition of areas to be selectively demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site will not be permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

A. Use repair materials identical to existing materials.

1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
2. Use materials whose installed performance equals or surpasses that of existing materials.

B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Engage a professional engineer to survey condition of building to determine whether

removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.

B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
   1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.

C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
   1. Owner will arrange to shut off indicated utilities when requested by Contractor.
   2. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
   3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

D. Utility Requirements: Refer to Division 22, 23 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

B. Pest Control: Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during selective demolition operations.

C. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
   2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
   3. Protect existing site improvements, appurtenances, and landscaping to remain.
   4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

D. Temporary Facilities: Provide temporary barricades and other protection required to prevent

injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.

E. Temporary Enclosures: Provide temporary enclosures for protection of existing building and 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, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

F. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

G. Temporary Shoring: Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.

B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.
10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

B. Existing Facilities: Comply with Owner's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

C. Removed and Salvaged Items: Comply with the following:
1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items: Comply with the following:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

F. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

G. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

H. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

I. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
   1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

J. Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable Division 7 Section for new roofing requirements.

K. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 PATCHING AND REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
   1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

C. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

D. Floors and Walls: Where walls or partitions that are demolished 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 existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
   2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
   3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

E. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION 02 41 00

DIVISION 03 - CONCRETE

Section 03 30 00	Cast-in-Place Concrete
Section 03 33 00	Cast-in-Place Architectural Concrete

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE June 2, 2008

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 specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

B. Cast-in-place concrete includes the following:
1. Foundations and footings.
2. Slabs-on-grade.
3. Walls, columns, and beams.
4. Interior utility equipment pads and bases.

C. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 02 Section "Portland Cement Concrete Paving" for concrete paving and walks will be bid in a future bid package.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 01 Specification Sections.

B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, and others as requested by Architect.

C. Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures.
1. Include shop drawings for all walls indicating locations for all rustication lines. Indicate that all joints in the plywood forms occur at these rustication lines.

D. Laboratory test reports for concrete materials and mix design test.

E. Material certificates in lieu of material laboratory test reports when permitted by Architect. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the most current version of the following codes, specifications, and standards, except where more stringent requirements are shown

or specified:

1. ACI 301 "Specifications for Structural Concrete for Buildings".
2. ACI 305 “Hot Weather Concreting.”
3. ACI 306.1 “Standard Specification for Cold Weather Concreting.”
4. ACI 311 "Recommended Practice For Concrete Inspection".
5. ACI 315 "Manual Of Standard Practice For Detailing Concrete Reinforcement".
6. ACI 318 "Building Code Requirements for Reinforced Concrete".
7. ACI 347 "Recommended Practice For Concrete Formwork".
8. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".

B. Concrete Testing Service: Engage a testing agency acceptable to Architect to perform material evaluation tests and to design concrete mixes.

1. Field Quality Control: The Owner will engage a testing laboratory to perform quality control testing during construction.
2. Materials and installed work may require testing and retesting at any time during progress of Work. Retesting of rejected materials for installed Work, shall be done at Contractor's expense.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Forms shall have sufficient wall thickness and or bracing to resist wet concrete loads without deformation.

B. Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 mg/l volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

C. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed, except use ASTM A706, grade 60 as noted on drawings.

B. Steel Wire: ASTM A 82, plain, cold-drawn steel.

C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

D. Welded-Wire Fabric: ASTM A185

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I/II (Low Alkali)

B. Fly Ash: ASTM C618, Type F, except maximum loss on ignition is limited to 1% with maximum variation of 0.5%.

C. Normal-Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.
   1. For exposed exterior surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.

D. Water: Potable.

E. Admixtures, General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures and containing no calcium chloride.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Air-Mix or Perma-Air, Euclid Chemical Co.
      b. Darex AEA or Daravair, W.R. Grace & Co.
      c. MB-VR or Micro-Air, Master Builders, Inc.
      d. Sealtight AEA, W.R. Meadows, Inc.
      e. Sika AER, Sika Corp.

G. Water-Reducing Admixture: ASTM C 494, Type A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Eucon WR-75, Euclid Chemical Co.
      b. WRDA, W.R. Grace & Co.
      c. Pozzolith Normal or Polyheed, Master Builders, Inc.
      d. Plastocrete 161, Sika Corp.

H. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Super P, Anti-Hydro Co., Inc.
      b. Eucon 37, Euclid Chemical Co.
      c. WRDA 19 or Daracem, W.R. Grace & Co.
      d. Rheobuild or Polyheed, Master Builders, Inc.
      e. Sikament 300, Sika Corp.

I. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Accelguard 80, Euclid Chemical Co.
      b. Polarset, W.R. Grace & Co.
      c. Pozzutec 20, Master Builders, Inc.

J. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Eucon Retarder 75, Euclid Chemical Co.
      b. Daratard-17, W.R. Grace & Co.
      c. Pozzolith R, Master Builders, Inc.
      d. Plastiment, Sika Corporation.

2.4 RELATED MATERIALS

A. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Eucobar, Euclid Chemical Co.
      b. E-Con, L&M Construction Chemicals, Inc.
      c. Confilm, Master Builders, Inc.

B. Bonding Agent: Acrylic or Styrene Butadiene base.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. "J-40 Bonding Agent"; Dayton Superior Corp.
      b. "Everbond"; L & M Construction Chemicals.
      c. "Hornweld"; A.C. Horn, Inc.
      d. "Sonocrete"; Sonneborn-Rexnord.
      e. "Acrylic Bondcrete"; The Burke Co.
      f. "SBR Latex"; Euclid Chemical Co.
      g. "Daraweld C"; W.R. Grace
      h. "Proweld Acrylic"; Prokrete Industries

C. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements. Provide pressure injectable type where conditions require same.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Euco Epoxy System #452 or #620, Euclid Chemical Co.
      b. Concresive Standard Liquid, Master Builders, Inc.
      c. Rezi-Weld 1000, W.R. Meadows, Inc.
      d. Epcon System Ceramic 6 Epoxy, ITW Redhead/Ramset.
      e. Sikadur 32 Hi-Mod, Sika Corp.

D. Mortar Patching Material: Prepackaged material suitable for use on dry or damp surfaces.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Emaco R350, Master Builders, Inc.
      b. SikaRepair 223, Sika Corp.

2.5 PROPORTIONING AND DESIGNING MIXES

A. Prepare design mixes for each type and strength of concrete by laboratory trial batch method as specified in ACI 301. Use an independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
   1. Do not use the same testing agency as that used for field quality control testing.

B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Architect.

C. Design mixes to provide concrete with the following properties as indicated on drawings:
   1. Water-cement ratio = water/(cement + fly ash).
   2. Normal weight concrete shall have a total weight of between 145 and 155 lbs. per cu.ft.
   3. Light Weight concrete shall have a total dry weight not exceeding 110 lbs. per cu. ft.
   4. 4000 psi, 28-day compressive strength; water-cement ratio, 0.45 maximum.
   5. 3000 psi, 28-day compressive strength; water-cement ratio, 0.50 maximum.

D. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows
   1. Ramps, slabs, and sloping surfaces: Not more than 3 inches (75 mm).
   2. Reinforced foundation systems and all site walls: Not less than 1 inch (25 mm) and not more than 4 inches (100 mm).
   3. Concrete containing high-range water-reducing admixture (superplasticizer): Not more than 8 inches (200 mm) after adding admixture to site-verified 2 - 3 inch (50 - 75 mm) slump concrete.
   4. Other concrete: Not more than 4 inches (100 mm).

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in Work.

F. Concrete mixes shall be proportioned to minimize drying shrinkage. Use the largest coarse aggregate size practical and proportion mix designs to minimize total water content.

2.6 ADMIXTURES

A. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.

B. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).

C. High-range water-reducing admixture may be used in concrete with water-cement ratios below 0.50.

D. Use air-entraining admixture where indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:
   1. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure:
      a. 6.0 percent for 1 inch (25 mm) maximum aggregate.
      b. 6.5 percent for 3/4 inch (19 mm) maximum aggregate.

   2. Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 4 percent air.

E. Use of additional specified admixtures for water-reducing and set-control is at Contractor's option, at no additional expense to Owner, subject to Architect's approval prior to inclusion in mix designs. Use approved admixtures in strict compliance with manufacturer's directions.

2.7 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.
   1. Materials handling, batching, and mixing shall conform to applicable provisions of ASTM C 94, except delete references to allowing additional water to be added to material with insufficient slump.
   2. When air temperature is between 85 deg F (29 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60

minutes.

3. Furnish delivery tickets with each load of concrete delivered to site. In addition to the requirements of ASTM C 94 Section 16.1, provide the following information on delivery tickets:
   a. Date and time of dispatch.
   b. Proportions of all materials used.
   c. Approximate location of final deposit in structure.
   d. Scale weight of load.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials with placement of forms and reinforcing steel.

3.2 FORMS

A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:
   1. Provide Class A tolerances for concrete surfaces exposed to view.
   2. All footing shall be formed.

B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste. Coordinate with structural steel supplier for placement of embedded steel items and bolts.

C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.

D. Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.

E. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

F. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.3 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as herein specified.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Architect.

D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Splice reinforcing bars in accordance with ACI 318. Splice only where required or permitted by drawings, or where authorized by Architect.

3.4 JOINTS

A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Architect. Refer to Section 03 33 00.

B. Provide keyways at least 1-1/2 inches deep in construction joints in walls and slabs and between walls and footings. Accepted bulkheads designed for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as indicated otherwise. Do not continue reinforcement through sides of strip placements.

D. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

E. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.
   1. Use 15 lb. building paper for isolation joints.

F. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 1/4 inch wide by one-fourth of slab depth or inserts 1/4 inch wide by one-fourth of slab depth, unless otherwise indicated.
   1. Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
   2. Contraction joints may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
   3. If joint pattern is not shown, provide joints not exceeding 10 feet in either direction

and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).

4. Joint sealants material is specified in Division 07 Sections of these specifications.

3.5 INSTALLING EMBEDDED ITEMS

A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

B. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.6 PREPARATION OF FORM SURFACES

A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement.

B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

C. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.7 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work cooperate with such trades in setting such work.

B. General: Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and

other embedded items without causing segregation of mix.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placement of a panel or section is completed.
   1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
   2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
   3. Maintain reinforcing in proper position during concrete placement.

F. Cold-Weather Placement: Comply with provisions of 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 air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 55 deg F and not more than 75 deg F at point of placement.
   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.

G. Hot-Weather Placement: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified. Hot weather is defined as air temperature exceeding 90 deg F (32 deg C), or any combination of temperature, humidity and wind velocity which causes a rate of evaporation in excess of 0.2 pounds per square foot per hour as determined by ACI C 305R figure 2.1.5.
   1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
   2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
   3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
   4. Use water-reducing retarding admixture (type D) when required by high temperatures, low humidity, or other adverse placing conditions.

3.8 FINISH OF FORMED SURFACES

A. Rough Form Finish: Formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.
   1. Smooth Rubbed Finish: Provide smooth rubbed finish to concrete surfaces, which

have received smooth form finish treatment, not later than one day after form removal.

a. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring 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.

3.9 MONOLITHIC SLAB FINISHES

A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.

1. After placing slabs, plane surface to tolerances for floor flatness (F) of 15 and floor levelness (F) of 13. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rakes.

C. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both, Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of F 18 - F 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

D. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.

1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of F 20 - F 17. Grind smooth surface defects which would telegraph through applied floor covering system.

E. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

F. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.

3.11 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
   1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
   2. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.
   1. Provide moisture curing by following methods.
      a. Keep concrete surface continuously wet by covering with water.
      b. Continuous water-fog spray.
      c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
   2. Provide moisture-cover curing as follows:
      a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   3. Provide curing and sealing compound to exposed interior slabs and to exterior slabs, walks, and curbs, as follows:
      a. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
      b. Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to Architect.
   4. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
   5. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.
   6. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

7. Sealer and Dustproofer: Apply a second coat of specified curing and sealing compound only to surfaces given a first coat.

3.12 REMOVAL OF FORMS

A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members, at Contractor's expense.

C. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports. Apply curing to formed surfaces upon removal of forms and continue curing.

3.13 REUSE OF FORMS

A. Re-Used of Forms:
1. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
2. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

3.14 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with repair mortar immediately after removing forms, when acceptable to Architect. Refer to Section 03331 for specific requirements.

B. Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive and mortar.

3.15 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. General: The Owner will employ a testing agency to perform tests and to submit test reports.

B. Sampling and testing for quality control during concrete placement may include the following, as directed by Architect.
1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
   a. Slump: ASTM C 143; one test at point of discharge for every third load. Also verify initial slump when HRWR (superplasticizer) is used.
   b. Air Content: ASTM C 173, volumetric method for lightweight or normal

weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each set of compressive strength test specimens.

c. Concrete Temperature: Test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and each time a set of compression test specimens is made.

d. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders (plus additional cylinders as required by contractor for post-tensioned concrete) for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.

e. Compressive-Strength Tests: ASTM C 39; one set for each 50 cubic yards, or fraction thereof, of each concrete class placed in any one day,or for each 5000 sq. ft. of surface area placed; one specimens tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

f. Slump, air and temperature of concrete used for suspended slabs at parking garage, including exhibition suspended floor slab, shall be tested at point of discharge for every load.

g. All steel elements shall be fabricated on premises of a fabricator registered and approved by the building officials per section 1701.7 of the U.B.C.

2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

3. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

C. Test results will be reported in writing to Architect and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

D. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION 03 30 00

SECTION 03 33 00 - CAST-IN-PLACE ARCHITECTURAL CONCRETE June 2, 2008

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 specifies cast-in-place architectural concrete, including formwork, reinforcement accessories, concrete materials, concrete mix design, placement procedures, and finishes.

B. Related Sections include the following:
1. Division 02 Section "Cement Concrete Pavement" for concrete pavement and flatwork finishes.
2. Division 03 Section "Concrete Work" for structural and general cast-in-place concrete construction, including formed and unformed finishes.
3. Division 07 Section "Joint Sealants" for elastomeric joint sealants in contraction and other joints in cast-in-place architectural concrete.

1.3 DEFINITION

A. Cast-in-Place Architectural Concrete: Concrete that is exposed to view on surfaces of the completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie location and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

D. Samples: For each of the following materials:
1. Form-facing panel.
2. Form-release agent.
3. Form ties.
4. Form liners.
5. Cement.
6. Coarse- and fine-aggregate gradations.
7. Chamfers and rustications.
8. Curing compound.

E. Material Test Reports: From a qualified testing agency indicating and interpreting test results

of the following for compliance with requirements indicated, based on comprehensive testing of current materials:
1. Cementitious materials and aggregates.
2. Admixtures.
3. Curing compounds.

F. Placement Schedule: Submit concrete placement schedule before start of architectural concrete placement operations. Include location of all joints including construction joints.

G. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced cast-in-place architectural concrete contractor who has specialized in installing cast-in-place architectural concrete similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. ACI Standards: Comply with ACI 303.1, "Specification for Cast-in-Place Architectural Concrete"; ACI 301, "Specification for Structural Concrete"; and ACI 117, "Specifications for Tolerances for Concrete Construction and Materials," unless more stringent provisions are indicated.

D. Sample Panels: Before casting architectural concrete, produce sample panels to demonstrate the approved range of selections made under sample Submittals. Produce a minimum of 3 sets of full-scale sample panels, cast vertically, approximately 48 by 48 by 6 inches (1200 by 1200 by 150 mm) minimum, to demonstrate the expected range of finish, color, and texture variations.
1. Locate panels as indicated or, if not indicated, as directed by Architect.
2. Demonstrate methods of curing aggregate exposure, sealers, and coatings, as applicable.
3. In presence of Architect, damage part of an 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.
4. Maintain sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
5. Demolish and remove sample panels when directed.

E. Mockups for Columns: 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. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
3. 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.
4. Obtain Architect's approval of mockups before casting architectural concrete.

5. 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 Meetings."

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. 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.

B. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.

C. Rustication Strips: Metal, rigid plastic, or dressed wood with sides beveled and back kerfed; nonstaining.

D. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch (19 by 19 mm), minimum; nonstaining.

E. Form Joint Tape: Compressible foam tape, pressure sensitive, AAMA 810.1, minimum 1/4 inch (6 mm) thick.

F. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or S, Grade NS, that adheres to form joint substrates.

G. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration from wood of set-retarding chemicals.

H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.

I. Form Ties: Factory-fabricated, 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 that, when removed, will leave holes not larger than 1 inch (25 mm) in diameter on concrete surface.

2.2 REINFORCEMENT ACCESSORIES

A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

2.3 CONCRETE MATERIALS

A. Portland Cement: Refer to Section 03 30 00 - Concrete Work.

B. Normal-Weight Coarse Aggregate: Refer to Section 03 30 00 - Concrete Work.

C. Water: Potable, complying with ASTM C 94 except free of wash water from mixer washout operations.

D. Chemical Admixtures: Refer to Section 03 30 00 - Concrete Work.

2.4 CURING MATERIALS

A. Clear, Waterborne, Liquid Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.5 REPAIR MATERIALS

A. Refer to Section 03 30 00 - Concrete Work.

2.6 CONCRETE MIXES

A. Refer to Section 03 30 00 - Concrete Work.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver cast-in-place architectural concrete according to ASTM C 94, 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 90 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. In addition to ACI 303.1 limits on form-facing panel deflection, limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
   1. Class A, 1/8 inch (3 mm).

C. 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. Do not use rust-stained, steel, form-facing material.

D. 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.

E. Chamfer exterior corners and edges of cast-in-place architectural concrete.

F. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement.

G. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

H. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

I. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent mortar leaks.

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 REINFORCEMENT AND INSERTS

A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for fabricating and installing steel reinforcement.

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 walls 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, provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
   1. Schedule form removal to maintain surface appearance that matches approved sample panels.

B. 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.

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 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. Use bulkhead forms with keys of plywood, wood, or expanded galvanized steel sheet, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete. Align construction joint within rustications attached to form-facing material.

3. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
4. Use bonding agent 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, 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. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.

D. Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators 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 concrete mix constituents to segregate.

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 air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
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 indicated and approved in concrete mix designs.

F. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to 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. Cover steel reinforcement with water-soaked burlap so steel temperature will not

exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 FINISHES, GENERAL

A. Architectural Concrete Finish: Match sample panel.

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.

C. Maintain uniformity of special finishes over construction joints, unless otherwise indicated.

3.7 AS-CAST FORMED FINISHES

A. 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 defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm) in height. Do not apply rubbed finish to smooth-formed finish.

B. Form-Liner Finish: Produce a textured surface free of pockets, streaks, and honeycombs, and of uniform appearance, color, and texture.

3.8 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures according to ACI 301.

B. Begin curing immediately after removing forms from concrete. Cure 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 "Concrete Work" 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 03 33 00

DIVISION 04 - MASONRY

Section 04 21 13 Brick Masonry Assemblies

SECTION 04 21 13 - BRICK MASONRY ASSEMBLIES June 2, 2008

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 unit masonry assemblies consisting of the following:
1. Architectural face brick.
2. Mortar and grout.
3. Reinforcing steel.
4. Masonry joint reinforcement.
5. Miscellaneous masonry accessories.

B. Related Sections include the following:
1. Division 07 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.
2. Division 07 Section "Firestopping" for firestopping at tops of masonry walls and at openings in masonry walls.

C. Products installed, but not furnished, under this Section include the following:
1. Steel lintels and shelf angles for unit masonry, furnished under Division 05 Section "Metal Fabrications."
2. Manufactured reglets in masonry joints for metal flashing, furnished under Division 07 Section "Sheet Metal Flashing and Trim."
3. Hollow-metal frames in unit masonry openings, furnished under Division 08 Section "Steel Doors and Frames."

1.3 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops the following net-area compressive strengths (f'm) at 28 days. Determine compressive strength of masonry by testing masonry prisms according to ASTM C 1314.
1. For Brick Unit Masonry: Not less than f'm = 8000 psi (55.2 MPa).

1.5 SUBMITTALS

A. Product Data: For each different masonry unit, accessory, and other manufactured product specified.

B. Shop Drawings: Show fabrication and installation details for the following:
1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
   1. Each type of masonry unit required.
      a. Include test results, measurements, and calculations establishing net-area compressive strength of masonry units.
   2. Mortar complying with property requirements of ASTM C 270.
   3. Grout mixes complying with compressive strength requirements of ASTM C 476. Include description of type and proportions of grout ingredients.

D. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
   1. Each type of masonry unit required.
      a. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.
   2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
   3. Each combination of masonry unit type and mortar type. Include statement of net-area compressive strength of masonry units, mortar type, and net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
   4. Each material and grade indicated for reinforcing bars.
   5. Each type and size of joint reinforcement.
   6. Each type and size of anchor, tie, and metal accessory.

E. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the testing indicated, as documented according to ASTM E 548.

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, through one source from a 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 one manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.
   1. Concrete Masonry Unit Test: For each concrete masonry unit indicated, per ASTM C 140.
   2. Mortar Test: For mortar properties per ASTM C 270.
   3. Grout Test: For compressive strength per ASTM C 1019.

E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Meetings."

1.7 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. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 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 and hold cover securely in place.
   2. Protection shall remain in place until final weatherproof covering has been installed.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 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 coverings spread 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 Section 2104.3 of the International Building Code.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.

1. When ambient temperature exceeds 100 deg F (38 deg C), or 90 deg F (32 deg C) with a wind velocity greater than 8 mph (13 km/h), do not spread mortar beds more than 48 inches (1200 mm) ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.2 ARCHITECTURAL FACE BRICK

A. General: Provide shapes indicated and as follows for each form of brick required:
   1. Provide units without cores or frogs and with exposed surfaces finished for ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces.

B. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
   1. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
   2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

C. Hollow Brick: ASTM C 652, Grade SW, Class H60V (void areas between 40 and 60 percent of gross cross-sectional area), Type HBX, and as follows:
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 8000 psi (55.2 MPa).
   2. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
   3. Surface Coloring: Brick with surface coloring, other than flashed or sand-finished brick, shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet (3 m).
   4. Size: Manufactured to the following actual dimensions:
      a. Modular: 3-1/2 to 3-5/8 inches (89 to 92 mm) wide by 2-1/4 inches (57 mm) high by 7-1/2 to 7-5/8 inches (190 to 194 mm) long.
   5. Color and Texture: As selected by Architect from manufacturer=s full range of colors and textures to match existing masonry.

2.3 MORTAR AND GROUT MATERIALS

A. 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.

B. Hydrated Lime: ASTM C 207, Type S.

C. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

D. Aggregate for Grout: ASTM C 404.

E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

F. 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 the units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.

G. Water: Potable.

2.4 REINFORCING STEEL

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M; ASTM A 616/A 616M, including Supplement 1; or ASTM A 617/A 617M, Grade 60 (Grade 400).

2.5 MASONRY JOINT REINFORCEMENT

A. General: ASTM A 951 and as follows:
1. Hot-dip galvanized, carbon-steel wire for both interior and exterior walls.
2. Wire Size for Side Rods: W1.7 or 0.148-inch (3.8-mm) diameter.
3. Wire Size for Cross Rods: W1.7 or 0.148-inch (3.8-mm) diameter.
4. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units where indicated.

B. For single-wythe masonry, provide either ladder or truss type with single pair of side rods and cross rods spaced not more than 16 inches (407 mm) o.c.

2.6 ADJUSTABLE MASONRY-VENEER ANCHORS

A. General: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to metal studs, and as follows:
1. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).

B. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie section and a metal anchor section complying with the following requirements:
1. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches (70 mm) wide by 3 inches (75 mm) high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.
   a. Plate 1-1/4 inches (32 mm) wide by 6 inches (150 mm) long with strap 5/8 inch (16 mm) wide by 3-5/8 inches (92 mm) long; slot clearance formed between face of plate and back of strap shall not exceed diameter of wire tie by more than 1/32 inch (0.8 mm).

2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.0677-inch-(1.7-mm-) thick, steel sheet, galvanized after fabrication.

C. Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 (4.8-mm) diameter by length required to penetrate steel stud flange by not less than 3 exposed threads, and with the following corrosion protective coating:
1. Organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.

2.7 MISCELLANEOUS ANCHORS

A. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, 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, Class C; of diameter and length indicated and in the following configurations:
1. Nonheaded bolts, bent in manner indicated.

B. Postinstalled Anchors: Anchors as described below, with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
1. Type: Expansion anchors.
2. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
3. For Postinstalled Anchors in Concrete: Capability to sustain, without failure, a load equal to four times the loads imposed.
4. For Postinstalled Anchors in Grouted Masonry Units: Capability to sustain, without failure, a load equal to six times the loads imposed.

2.8 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Fabricate from the following metal complying with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim" and below:
1. Copper: 10-oz./sq. ft. (3-kg/sq. m) weight or 0.0135 inch (0.34 mm) thick for fully concealed flashing; 16-oz./sq. ft. (5-kg/sq. m) weight or 0.0216 inch (0.55 mm) thick elsewhere.
2. Fabricate metal drip edges from sheet metal indicated above. Extend at least 3 inches (75 mm) into wall and 1/2 inch (13 mm) out from wall, with a hemmed outer edge bent down 30 degrees.

B. Contractor's Option for Concealed Flashing: For flashing partly exposed to the exterior, use metal flashing specified above. For flashing not exposed to the exterior, use the following, unless otherwise indicated:
1. Copper-Laminated Flashing: Manufacturer's standard laminated flashing consisting of 5-oz./sq. ft. (1.5-kg/sq. m) sheet copper bonded with asphalt between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by the flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 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.

B. Preformed Control-Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
   1. Styrene-Butadiene-Rubber Compound: ASTM D 2000, Designation M2AA-805.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch (9-mm) OD by 4 inches (100 mm) long.

E. Cavity Drainage Material: Not less than 1-inch- (25-mm-) thick, free-draining mesh; made from polyethylene strands and shaped to avoid being clogged by mortar droppings.

2.10 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of 1/2-cup (0.14-L) dry measure tetrasodium polyphosphate and 1/2-cup (0.14-L) dry measure laundry detergent dissolved in 1 gal. (4 L) of water.

2.11 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.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, type as indicated.

C. Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required. Limit pigments to the following percentages of cement content by weight:
   1. For mineral-oxide pigments and portland cement-lime mortar, not more than 10 percent.

D. Grout for Unit Masonry: Comply with ASTM C 476, type as indicated.

E. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's directions.

2.12 INFILTRATION BARRIER

A. Building Wrap: ASTM E 1677, Type I air retarder; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      a. DuPont (E. I. du Pont de Nemours and Company); Tyvek CommercialWrap.
   2. Water-Vapor Permeance: Not less than 200 g through 1 sq. m of surface in 24 hours per ASTM E 96, Desiccant Method (Procedure A).
   3. Allowable UV Exposure Time: Not less than three months.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.13 SOURCE QUALITY CONTROL

A. Owner will engage a qualified independent testing agency to perform source quality-control testing indicated below:
   1. Payment for these services will be made by Owner.
   2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

B. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
   2. Verify that substrates are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.
   4. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

3.2 INSTALLATION, GENERAL

A. Thickness: Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this Section and in other Sections of the Specifications.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.

D. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, 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. Wetting of Brick: Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq.

in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying.

G. Cover sheathing with infiltration barrier as follows:
   1. Install in accordance with Manufacturer=s instructions over exterior sheathing. Seal joints and penetrations through air infiltration barrier with specified tape prior to installation of finish material. Air infiltration barrier shall be air tight and free from holes, tears, and punctures. All window and door penetrations shall be taped.
   2. Apply infiltration barrier to cover upstanding flashing with 4-inch overlap.

3.3 CONSTRUCTION TOLERANCES

A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

B. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.

C. 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), nor 1/2 inch (12 mm) maximum.

D. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet (6 mm in 6 m), nor 1/2 inch (12 mm) maximum.

E. 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).

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: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
   1. One-half running bond with vertical joint in each course centered on units in courses above and below.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches (50 mm). 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: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified under this and other

Sections of the Specifications. Fill in solidly with masonry around built-in items.

F. Fill space between hollow-metal 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 in the joint below and rod mortar or grout into core.

H. Fill cores in hollow concrete masonry units with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. At fire-rated partitions, install firestopping in joint between top of partition and underside of structure above to comply with Division 7 Section "Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow masonry units as follows:
   1. With full mortar coverage on horizontal and vertical face shells.
   2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
   3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.
   1. Tool exposed joints as follows, unless otherwise indicated:
      a. Smooth/standard face masonry, Kerfed/honed face masonry, and Split-Face masonry: Slightly concave using a jointer larger than joint thickness.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
   1. Space reinforcement not more than 16 inches (406 mm) o.c.
   2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.
      a. Reinforcement above is in addition to continuous reinforcement.

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
   1. Fasten anchors through sheathing to wall framing with metal fasteners of type indicated.
   2. Embed tie sections in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.
   3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   4. Space anchors as indicated, but not more than 18 inches (458 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around the perimeter.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joints in unit masonry where indicated. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. Form control joints in concrete masonry as follows:
   1. Install preformed control-joint gaskets designed to fit standard sash block.

C. Build in horizontal, pressure-relieving joints where indicated; construct joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 7 Section "Joint Sealants."
   1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb, unless otherwise indicated.

3.10 FLASHING, WEEP HOLES, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Unless otherwise indicated, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

C. Install flashing as follows:
   1. At masonry-veneer walls, extend flashing from exterior face of veneer, through veneer, up face of sheathing at least 8 inches (200 mm), and behind air-infiltration barrier or building paper.
   2. At lintels and shelf angles, extend flashing a minimum of 4 inches (100 mm) into masonry at each end. At heads and sills, extend flashing 4 inches (100 mm) at ends

and turn flashing up not less than 2 inches (50 mm) to form a pan.

3. Extend sheet metal flashing 1/2 inch (13 mm) beyond face of masonry at exterior and turn flashing down to form a drip.

D. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:

1. Use round plastic tubing to form weep holes.
2. Space weep holes formed from plastic tubing 48 inches (1200 mm) o.c.

3.11 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.

1. Construct formwork to conform to shape, line, and dimensions shown. Make it 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 temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements of ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.

1. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.12 FIELD QUALITY CONTROL

A. Owner will engage a qualified independent testing agency to perform field quality-control testing indicated below.

1. Payment for these services will be made by Owner.
2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

B. Testing Frequency: Tests and Evaluations listed in this Article will be performed during construction for each 5000 sq. ft. (465 sq. m) of wall area or portion thereof.

C. Mortar properties will be tested per ASTM C 780. Test mortar for mortar air content, water-repellent admixture and compressive strength.

D. Grout will be sampled and tested for compressive strength per ASTM C 1019.

E. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

3.13 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.

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, polyethylene film, or waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
   5. Clean brick by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution.

3.14 MASONRY WASTE DISPOSAL

A. Excess Masonry Waste: Remove excess masonry waste and legally dispose of off Owner's property.

END OF SECTION 04 21 13

DIVISION 05 - METALS

Section 05 12 00	Structural Steel
Section 05 31 00	Steel Deck
Section 05 41 00	Cold-Formed Metal Framing
Section 05 50 00	Metal Fabrications
Section 05 52 13	Pipe and Tube Railings

SECTION 05 12 00 - STRUCTURAL STEEL June 2, 2008

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of structural steel work is shown on drawings, including schedules, notes and details to show size and location of members, typical connections, and type of steel required.

B. Related Sections:
1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.
2. Miscellaneous Metal Fabrications are specified elsewhere in Division 05.

C. Definitions: Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings.

1.2 SUBMITTALS

A. Product Data: Submit producer's or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).
1. High-strength bolts (each type), including nuts and washers.
2. Structural steel primer paint.
3. Shrinkage-resistant grout.

B. Shop Drawings: Submit shop drawings, including complete details and schedules for fabrication and assembly of structural steel members, procedures and diagrams.
1. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS A2.1 and A2.4 symbols, and show size, length, and type of each weld.
   a. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of others sections.

C. Test Reports: Submit copies of reports of tests conducted on shop and field bolted and welded connections. Include data on type(s) of tests conducted and test results.

D. Surveys: Submit certified copies of each survey conducted by a registered professional engineer, showing elevations and locations of base plates and anchor bolts to receive structural steel, and final elevations and locations for major members. Indicate discrepancies between actual installation and contract documents.

1.3 QUALITY ASSURANCE

A. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
1. Promptly remove and replace materials or fabricated components which do not comply.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.
   1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:
      a. Category: Category Cbd, complex steel building structures.
   2. Fabricators without AISC Certification shall provide special inspectors and conduct special inspections as required by Authorities having jurisdication.
   3. Other Certifications, other than AISC, may be acceptable but must be submitted and approved by Authorities having jurisdication prior to fabrication of any steel.

C. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.

D. Promptly notify Architect whenever design of members and connections for any portion of structure are not clearly indicated.

E. Codes and Standards:
   1. Comply with provisions of following, except as otherwise indicated:
      a. AISC "Code of Standard Practice for Steel Buildings and Bridges", AISC "Code of Standard Practice for Steel Buildings and Bridges", excluding the following: Section 1.5.1, Section 3.3 (first sentence and last sentence), Section 3.4, Section 4.2, Section 4.2.1, Section 4.2.2, Section 6.3.2, Section 7.5.4, and Section 7.11.5.
   2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including "Commentary" and Supplements thereto as issued.
   3. AISC "Specifications for Architecturally Exposed Structural Steel".
   4. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
   5. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel".
   6. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".

F. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".
   1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests within the last 12 months.
   2. If recertification of welders is required, retesting will be Contractor's responsibility.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.
   1. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not to delay work.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Approved Manufacturers: Subject to compliance with requirements, provide one of the following:
   1. Non-shrink Non-metallic Grout.
      a. Euco N.S.; Euclid Chemical Co.
      b. Masterflow 713; Master Builders
      c. Five Star Grout; U.S. Grout Corp.

2.2 MATERIALS

A. Metal Surfaces, General: For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.

B. Wide Flange Structural Steel Shapes: ASTM A 572 or ASTM A 992, Grade 50 enhanced.
   1. Other Structural Steel Shapes, Plates and Bars: ASTM A 36.

C. Cold-Formed Steel Tubing: ASTM A 500, Grade B.

D. Hot-Formed Steel Tubing: ASTM A 501.
   1. Steel Pipe: ASTM A 53, Type E or S, Grade B; or ASTM A 501.
      a. Finish: Black, except where indicated to be galvanized.

E. Steel Castings: ASTM A 27, Grade 65-35, medium-strength carbon steel.

F. Anchor Bolts: ASTM A 307, headed type unless otherwise indicated.

G. Unfinished Threaded Fasteners: ASTM A 307, Grade A, regular low-carbon steel bolts and nuts.
   1. Provide hexagonal heads and nuts for all connections.
   2. Provide either hexagonal or square, heads and nuts, except use only hexagonal units for exposed connections.

H. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:
   1. Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A 325.
   2. Direct tension indicator washers may be used at Contractor's option.

I. Electrodes for Welding: Comply with AWS Code.

J. Structural Steel Primer Paint: SSPC - Paint 13.

K. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean, uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum water required for placement and hydration.

L. Non-metallic Shrinkage-Resistant Grout: Pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CE-CRD-C621.

2.3 FABRICATION

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.
   1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
   2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. Connections: Weld or bolt shop connections, as indicated.
   1. Bolt field connections, except where welded connections or other connections are indicated.
   2. Provide high-strength threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.
   3. Provide unfinished threaded fasteners for only bolted connections of secondary framing members to primary members (including purlins, girts, and other framing members taking only nominal stresses) and for temporary bracing to facilitate erection.

C. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" (RCRBSJ).

D. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

E. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Where possible shop weld shear connectors, spaced as shown, to beams and girders in composite construction. Use automatic end welding of headed stud shear connectors in accordance with manufacturer's printed instructions.

2.4 SHOP PAINTING

A. General: Shop paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel which is partially exposed on exposed portions and initial 2" of embedded areas only.

B. Do not paint surfaces which are to be welded or high-strength bolted with friction-type connections.

C. Apply 2 coats of paint to surfaces which are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:

1. SP-1 "Solvent Cleaning".
2. At all exposed exterior steel and exposed interior steel prepare surface in accordance with commercial blast cleaning SSPC-SP6 with median surface profile of 1.5 to 2.0 mils.

E. Painting: Provide a one-coat shop applied paint system complying with Steel Structures Painting Council (SSPC)-Paint System Guide No. 7.00. Refer to Section 09900, Painting, for specific primer required on identified steel items.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surveys: Employ a registered professional engineer or land surveyor for accurate erection of structural steel. Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Architect. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been agreed upon with Architect.

3.2 ERECTION

A. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds. Do not shore cambered steel beams unless otherwise indicated on drawings.
1. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.

B. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

C. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout. Install high strength washers under nuts at all anchor bolts.

D. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
1. Comply with manufacturer's instructions.

E. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure within specified AISC tolerances.
2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at

time of erection and mean temperature at which structure will be when completed and in service.

3. Splice members only where indicated and accepted on shop drawings.

F. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.

G. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

1. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

H. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to Architect. Finish gas-cut sections equal to a sheared appearance when permitted.

I. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

3.3 QUALITY CONTROL

A. Testing Agency: Owner will employ and pay a qualified independent testing agency to perform field quality-control testing services specified in this section.

B. Testing agency shall conduct and interpret tests and state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.

C. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

D. Testing agency may inspect structural steel at plant before shipment; however, Architect reserves right, at any time before final acceptance, to reject material not complying with specified requirements.

E. Correct deficiencies in structural steel work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as may be necessary to reconfirm any non-compliance of original work, and as may be necessary to show compliance of corrected work.

F. Shop Bolted Connections: Inspect or test in accordance with AISC specifications.

G. Shop Welding: Inspect and test during fabrication of structural steel assemblies, as follows:

1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
2. Perform visual inspection of all welds.
3. Perform tests of welds as follows. Inspection procedures listed are to be used at Contractor's option.
   a. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T".
   b. Ultrasonic Inspection: ASTM E 164.

4. Inspection of shop welding is not required if the fabricator complies with Section 1704.2.2 of the 2006 IBC.

H. Field Bolted Connections: Inspect in accordance with 2006 IBC Section 1704.3.3.

I. Field Welding: Inspect and test during erection of structural steel as follows:
1. Comply with 2006 IBC Section 1704.3 and Table 1704.3.
2. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
3. Perform visual inspection of all welds.
4. Perform tests of welds as follows:
   a. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T".
   b. Ultrasonic Inspection: ASTM E 164.

3.4 CLEANUP

A. Refer to Section 01700.

END OF SECTION 05 12 00

SECTION 05 31 00 - STEEL DECK June 2, 2008

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 deck.

B. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction.

C. Product Certificates: Signed by steel deck manufacturers certifying that products furnished comply with requirements.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. Product Test Reports: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:
   1. Mechanical fasteners.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

C. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those steel deck units tested for fire resistance per ASTM E 119 by a testing and inspection agency acceptable to authorities having jurisdiction.
   1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
   2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

D. AISI Specifications: Calculate structural characteristics of steel deck according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members."

E. FM Listing: Provide steel roof deck evaluated by FM and listed in FM's "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

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.

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:
   1. Steel Deck:
      a. BHP Steel Building Products USA Inc.
      b. Consolidated Systems, Inc.
      c. Nucor Corp.; Vulcraft Div.
      d. Roof Deck, Inc.
      e. United Steel Deck, Inc.
      f. Verco Manufacturing Co.
      g. Wheeling Corrugating Co.; Div. of Wheeling-Pittsburgh Steel Corp.

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. 29, and the following:
   1. Prime-Painted Steel Sheet: ASTM A 611, Grade C minimum, shop primed with gray or white baked-on, lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664.
   2. Deck Profile: Type B.
   3. Profile Depth: 1-1/2 inches and as scheduled.
   4. Design Uncoated-Steel Thickness: Per plan.
   5. Span Condition: Triple span or more as indicated.
   6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 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. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel

screws, No. 10 (4.8 mm) minimum diameter.

D. Rib Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. 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.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

G. 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.

H. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

I. Repair Paint: Lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664.

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. 29, 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 decking 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.
   1. Align cellular deck panels for entire length of cell runs and align cells at ends of abutting panels.

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 decking.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, 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. 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, but 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 at locations and spacings as indicated on the drawings.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals as indicated on the drawings.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
   1. End Joints: Lapped 2 inches (51 mm) minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof decking and weld flanges to top of deck. Space welds not more than 12 inches (305 mm) apart with at least 1 weld at each corner.

E. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

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 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing agency to perform field quality-control testing.

B. Field welds will be subject to inspection.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 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.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 41 00 - COLD-FORMED METAL FRAMING June 2, 2008

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. Exterior wall framing.

B. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for masonry shelf angles and connections.
   2. Division 09 Section "Non-Load-Bearing Steel Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension 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. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Wall Framing: Horizontal deflection of 1/360 of the wall height.
   3. 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).
   4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure.

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.

1.4 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. 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.

C. Welding certificates.

D. Qualification Data: For professional engineer..

E. 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.

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. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

D. 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."

E. 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.

F. 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."

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 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:
   1. Allied Studco..
   2. California Expanded Metal Products Company.
   3. Dietrich Metal Framing; a Worthington Industries Company.
   4. MarinoWare; a division of Ware Industries.
   5. SCAFCO Corporation.

2.2 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: ST33H, ST230H and as required by structural performance.
   2. Coating: G60, Z180, A60, ZF180, AZ50, AZ150, or GF30, ZGF90.

B. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: 50 (340), Class 1 or 2 and as required by structural performance.
   2. Coating: G90 (Z275).

2.3 EXTERIOR 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: 0.0478 inch (1.21 mm) (18 gauge).
   2. Flange Width: Not less than 1-5/8 inches (41 mm).

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: 0.0598 inch (1.52 mm) (16 gauge).
   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: 0.0478 inch (1.21 mm) (18 gauge).
   2. Flange Width: Not less than 1-5/8 inches (41 mm).

D. Vertical Deflection Clips: Manufacturer's standard 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.

2.4 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. Anchor clips.
   4. End clips.
   5. Gusset plates.
   6. Stud kickers, knee braces, and girts.
   7. Hole reinforcing plates.
   8. Backer plates.

2.5 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 36, threaded carbon-steel headless, hooked bolt 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.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035

B. 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.

C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

D. 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.

2.7 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. 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 7 Section "Building 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 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: As shown on Shop Drawings.

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: Not more than 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. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

F. 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.

G. 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.

H. Install horizontal bridging in stud system, spaced not more than 48 inches (1220 mm) as indicated on Shop Drawings. Fasten at each stud intersection.
   1. 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.

I. 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 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.

3.6 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.

END OF SECTION 05 41 00

SECTION 05 50 00 - METAL FABRICATIONS June 2, 2008

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. Loose bearing and leveling plates.
2. Loose steel lintels.
3. Shelf angles.
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. Miscellaneous metal trim.
8. Pipe bollards.

B. Related Sections include the following:
1. Division 5 Section "Structural Steel" for structural-steel framing system components.
2. Division 6 Section "Miscellaneous Carpentry" for metal framing anchors and other rough hardware.

1.3 SUBMITTALS

A. Product Data: For the following:
1. Paint products.
2. Grout.

B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
1. Provide templates for anchors and bolts specified for installation under other Sections.

C. Welding Certificates: Copies of certificates for welding procedures and personnel.

D. Qualification Data: For firms and persons specified in "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.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing metal fabrications 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.

B. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   2. AWS D1.2, "Structural Welding Code--Aluminum."
   3. AWS D1.3, "Structural Welding Code--Sheet Steel."
   4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 PROJECT CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

1.6 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. 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: For metal fabrications 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.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.

C. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

D. Slotted Channel Framing: Cold-formed metal channels with flange edges returned toward web and with 9/16-inch- (14.3-mm-) wide slotted holes in webs at 2 inches (51 mm) o.c.
   1. Width of Channels: 1-5/8 inches (41 mm).
   2. Depth of Channels: 1-5/8 inches (41 mm).
   3. Metal and Thickness: Uncoated steel complying with ASTM A 570, Grade 33; 0.0677-inch (1.7-mm) minimum thickness.
   4. Finish: Rust-inhibitive, baked-on, acrylic enamel.

E. Stainless Steel: Grade and type designated below for each form required:

1. Wire Rope: Specially fabricated 1-by-19 wire rope that is drawn through a die after laying to produce a smooth outer surface; made from wire complying with ASTM A 492, Type 316.
2. 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.

F. Turnbuckles/Clevises: C-1035, SA-182-F-11, Stainless steel, stub ends - hot rolled steel, galvanized finish. Provide clevis pins meeting load requirements of the rod.
1. Equal to: Cleveland City Forge.

G. Malleable-Iron Castings: ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).

H. Gray-Iron Castings: ASTM A 48, Class 30 (ASTM A 48M, Class 200), unless another class is indicated or required by structural loads.

I. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

J. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 ALUMINUM

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy 6063-T6.

B. Provide aluminum architectural shapes and extrusions, ASTM alloy 6063-T52, for glazing channels and pockets. Equal to J.G. Braun Company, 800-323-4072.

2.4 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
1. Refer to Section 09900 - Painting for specific primer required on identified steel items.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FASTENERS

A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, 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.

D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Wood Screws: Flat head, carbon steel, ASME B18.6.1.

G. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).

H. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).

I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below 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.
   1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

J. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

2.6 GROUT

A. 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.

2.7 CONCRETE FILL

A. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 4000 psi (26.67 MPa), unless otherwise indicated.

2.8 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. 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. Shear and punch metals cleanly and accurately. Remove burrs.

C. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise

indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. 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.

E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up 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.

I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

J. Remove sharp or rough areas on exposed traffic surfaces.

K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.9 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates after fabrication.

2.10 LOOSE STEEL LINTELS

A. Fabricate loose structural-steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Weld adjoining members together to form a single unit where indicated.

C. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm), unless otherwise indicated.

D. Galvanize loose steel lintels located in exterior walls.

2.11 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete. Align expansion joints in angles with indicated control and expansion joints in cavity-wall exterior wythe.

C. Galvanize shelf angles to be installed in exterior walls.

D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.12 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.

B. Fabricate units from structural-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 retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
   1. Fabricate units from slotted channel framing where indicated.
   2. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long at 24 inches (600 mm) o.c., unless otherwise indicated.
   3. Furnish inserts if units must be installed after concrete is placed.

C. Galvanize miscellaneous framing and supports in the following locations:
   1. Exterior locations and where miscellaneous items will be concealed from view.

2.13 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from structural-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. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c., unless otherwise indicated.

C. Galvanize miscellaneous steel trim in the following locations:
   1. Exterior.

2.14 PIPE BOLLARDS

A. Fabricate pipe bollards from Schedule 40 steel pipe.
   1. Cap bollards with 1/4-inch- (6-mm-) minimum steel plate.

B. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch (6-mm) thick steel plate welded to bottom of sleeve.

C. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch (6-mm) wall-thickness steel tubing with an OD 1/16 inch (1.5 mm) less than ID of bollards. Match drill sleeve and bollard for 1/2-inch (12-mm) steel machine bolt.

2.15 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.

2.16 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
   1. ASTM A 123, for galvanizing steel and iron products.
   2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. 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 metal fabrications:
   1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.17 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.

B. 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.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. 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.

E. 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.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 SETTING 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.

3.3 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, if any.

B. 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 at girders supported on concrete or masonry, install as specified above for setting and grouting bearing and leveling plates.

3.4 INSTALLING PIPE BOLLARDS

A. Anchor bollards in place with concrete footings. Support and brace bollards in position in footing excavations until concrete has been placed and cured.

B. Anchor internal sleeves for removable bollards in place with concrete footings. Support and brace sleeves in position in footing excavations until concrete has been placed and cured.
   1. Place removable bollards over internal sleeves and secure with 1/2-inch (12-mm) machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner will furnish padlocks.

C. Fill bollards solidly with concrete, mounding top surface.
   1. Do not fill removable bollards with concrete.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed 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. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS June 2, 2008

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. Steel pipe and tube handrails and railings.

1.3 PERFORMANCE REQUIREMENTS

A. General: In engineering handrails and railings to withstand structural loads indicated, determine allowable design working stresses of handrail and railing materials based on the following:
   1. Structural Steel: AISC S335, "Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary."
   2. Cold-Formed Structural Steel: AISI SG-673, Part I, "Specification for the Design of Cold-Formed Steel Structural Members."

B. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for handrails, railings, anchors, and connections:
   1. Top Rail of Guards: Capable of withstanding the following loads applied as indicated:
      a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
      b. Uniform load of 50 lbf/ft. (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf/ft. (1460 N/m) applied vertically downward.
      c. Concentrated and uniform loads above need not be assumed to act concurrently.
   2. Handrails Not Serving As Top Rails: Capable of withstanding the following loads applied as indicated:
      a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
      b. Uniform load of 50 lbf/ft. (730 N/m) applied in any direction.
      c. Concentrated and uniform loads above need not be assumed to act concurrently.
   3. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.
      a. Load above need not be assumed to act concurrently with loads on top rails in determining stress on guard.

C. Thermal Movements: Provide handrails and 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.

D. 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. Grout, anchoring cement, and paint products.

B. Shop Drawings: Show fabrication and installation of handrails and railings. Include plans, elevations, sections, component 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. Samples for Selection: Manufacturer's color charts showing the full range of colors available for products with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, prepared on components indicated below and of same thickness and metal indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. Assembled sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Sample need not be full height.

E. Qualification Data: For firms and persons specified in "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.

F. Product Test Reports: From a qualified testing agency indicating products comply with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of handrail and railing through one source from a single manufacturer.

1.6 STORAGE

A. Store handrails and railings in a dry, well-ventilated, weathertight place.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify handrail and railing dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating handrails and

railings without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate installation of anchorages for handrails and 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.

1.9 SCHEDULING

A. Schedule installation so handrails and railings are mounted only on completed walls. Do not support temporarily by any means that does not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS

A. General: Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.

B. Steel and Iron: Provide steel and iron in the form indicated, complying with the following requirements:
   1. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:
      a. Black finish, unless otherwise indicated.
      b. Galvanized finish for exterior installations and where indicated.
      c. Type F, or Type S, Grade A, standard weight (Schedule 40), unless another grade and weight are required by structural loads.
   2. Steel Tubing: Cold-formed steel tubing, ASTM A 500, Grade A, unless another grade is required by structural loads.
   3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
   4. Iron Castings: Malleable iron complying with ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).

C. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.2 WELDING MATERIALS, FASTENERS, AND ANCHORS

A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Fasteners for Anchoring Handrails and Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring handrails and railings to other types of construction indicated and capable of withstanding design loads.
   1. For steel handrails, railings, and fittings, use plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
   2. For stainless-steel handrails and railings, use fasteners fabricated from Type 304 or Type 316 stainless steel.

C. Fasteners for Interconnecting Handrail and Railing Components: Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
   1. Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, unless otherwise indicated.

D. Cast-in-Place and Postinstalled Anchors: Anchors of type indicated below, 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.
   1. Expansion anchors.

2.3 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

B. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.

C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION

A. General: Fabricate handrails and 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 handrails and 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. Form changes in direction of railing members as follows:
   1. By bending.
   2. By radius bends of radius indicated.
   3. By any method indicated above, applicable to change in direction involved.

D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member

throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

E. Welded Connections: Fabricate handrails and railings for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose. Weld connections 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 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.

F. Nonwelded Connections: Fabricate handrails and railings by connecting members with concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
   1. Fabricate splice joints for field connection using an epoxy structural adhesive where this is manufacturer's standard splicing method.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.

H. Provide inserts and other anchorage devices for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.

I. For railing posts set in concrete, provide preset sleeves of steel not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (12 mm) greater than outside dimensions of post, and steel plate forming bottom closure.

J. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

K. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

L. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.

M. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.

N. Fabricate joints that will be exposed to weather in a watertight manner.

O. Close exposed ends of handrail and railing members with prefabricated end fittings.

P. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of railing and wall is 1/4 inch (6 mm) or less.

Q. 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.

2.6 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 handrails and railings.

2.7 STEEL FINISHES

A. Galvanized Handrails and Railings: Hot-dip galvanize exterior steel and iron handrails and railings to comply with ASTM A 123. Hot-dip galvanize hardware for exterior steel and iron handrails and railings to comply with ASTM A 153/A 153M.

B. 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.

C. For galvanized handrails and railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

D. For nongalvanized steel handrails and 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: After galvanizing, thoroughly clean handrails and railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.

F. 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 handrails and railings:
   1. Exteriors (SSPC Zone 1B): SSPC-SP 6, "Commercial Blast Cleaning."
   2. Interiors (SSPC Zone 1A): SSPC-SP 7, "Brush-off Blast Cleaning."

G. Apply shop primer to prepared surfaces of handrail and railing components, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
   1. Do not apply primer to galvanized surfaces.
   2. Stripe paint edges, corners, crevices, bolts, and welds.
   3. Delete shop primer where railings are indicated to receive a clear coat finish.

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 to install handrails and railings. Set handrails and railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.
   1. Do not weld, cut, or abrade surfaces of handrail and 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 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. Corrosion Protection: Coat concealed surfaces that will be in contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

D. Adjust handrails and railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of handrails and railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. 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 one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Cover anchorage joint with flange of same metal as post, attached to post as follows:
   1. By set screws.

B. 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 steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

C. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ANCHORING RAILING ENDS

A. Anchor railing ends into concrete and masonry with round flanges connected to railing ends and anchored into wall construction with postinstalled anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces.
   1. Connect flanges to railing ends using nonwelded connections.

3.6 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.

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 steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

3.7 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

B. 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 handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the 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 05 52 13

DIVISION 06 - WOOD AND PLASTICS

Section 06 10 53 Miscellaneous Carpentry

SECTION 06 10 53 - MISCELLANEOUS CARPENTRY June 2, 2008

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. Rooftop equipment bases and support curbs.
   2. Wood furring, grounds, nailers, and blocking.
   3. Sheathing.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:
   1. For each type of preservative-treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
   2. For waterborne-treated products, include statement that moisture content of treated materials was reduced to levels indicated before shipment to Project site.

C. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with performance requirements indicated.

D. Warranty of chemical treatment manufacturer for each type of treatment.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.
   1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
   1. NELMA - Northeastern Lumber Manufacturers Association.
   2. RIS - Redwood Inspection Service.
   3. SPIB - Southern Pine Inspection Bureau.
   4. WCLIB - West Coast Lumber Inspection Bureau.
   5. WWPA - Western Wood Products Association.

C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
   1. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece.

D. 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.
   1. Provide dressed lumber, S4S, unless otherwise indicated.
   2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.
   1. Do not use chemicals containing chromium or arsenic.
   2. For exposed items indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

B. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. (4.0 kg/cu. m). After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:
   1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

C. Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to a minimum retention of 0.40 lb/cu. ft. (6.4 kg/cu. m).

2.3 FIRE-RETARDANT TREATMENT BY PRESSURE PROCESS

A. General: Where fire-retardant-treated wood is indicated, pressure impregnate lumber and plywood with fire-retardant chemicals to comply with AWPA C20 and C27, respectively, for treatment type indicated; identify "fire-retardant-treated wood" with appropriate classification marking of Underwriters Laboratories, Inc., U.S. Testing, Timber Products Inspection, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Current Evaluation/Research Reports: Provide fire-retardant- treated wood for which a current model code evaluation/research report exists that is acceptable to authorities having jurisdiction and that evidences compliance of fire-retardant-treated wood for application indicated.

B. Interior Type A: For interior locations use fire-retardant chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:
   1. No reduction takes place in bending strength, stiffness, and fastener holding capacities below values published by manufacturer of chemical formulation that are based on tests by a qualified independent testing laboratory of treated wood products identical to those indicated for this Project under elevated temperature and humidity conditions simulating installed conditions.
   2. No other form of degradation occurs due to acid hydrolysis or other causes related to manufacture and treatment.
   3. No corrosion of metal fasteners results from their contact with treated wood.

C. Exterior Type: Use for exterior locations and where indicated.

D. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

E. Products: Subject to compliance with requirements, provide one of the following:
   1. Interior Type A Fire-Retardant-Treated Wood:
      a. "Dricon," Hickson Corporation.
      b. "Pyro-Guard," Hoover Treated Wood Products.
      c. "Flameproof LHC-HTT," Osmose Wood Preserving Co, Inc.
   2. Exterior Type Fire-Retardant-Treated Wood:
      a. "Exterior Fire-X," Hoover Treated Wood Products.

2.4 DIMENSION LUMBER

A. General: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.
   1. Grade: Standard, Stud, or No. 3.
   2. Species: Hem-fir; WCLIB or WWPA.

2.5 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

C. Moisture Content: 19 percent maximum for lumber items are not specified to receive wood preservative treatment.

D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

2.6 WOOD-BASED STRUCTURAL-USE PANELS

A. Structural-Use Panel Standards: Provide either all-veneer, mat-formed, or composite panels

complying with DOC PS 2, "Performance Standard for Wood-Based Structural-Use Panels," unless otherwise indicated. Provide plywood panels complying with DOC PS 1, "U.S. Product Standard for Construction and Industrial Plywood," where plywood is indicated.

B. Trademark: Factory mark structural-use panels with APA trademark evidencing compliance with grade requirements.
   1. Span Ratings: Provide panels with span ratings required to meet "Code Plus" provisions of APA Form No. E30, "APA Design/Construction Guide: Residential & Commercial."

C. Miscellaneous Concealed Plywood: C-C Plugged Exterior, thickness as indicated but not less than 1/2 inch (12.7 mm).

D. Miscellaneous Exposed Plywood: A-D Interior, thickness as indicated but not less than 1/2 inch (12.7 mm).

E. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with grade, C-D Plugged Exposure 1, in thickness indicated or, if not otherwise indicated, not less than 15/32 inch (11.9 mm) thick.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. Where miscellaneous carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.

B. Nails, Wire, Brads, and Staples: FS FF-N-105.

C. Power-Driven Fasteners: CABO NER-272.

D. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

2.8 METAL FRAMING ANCHORS

A. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and as follows:
   1. Research or Evaluation Reports: Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for Project.
   2. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.

B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 (ASTM A 653M, Z180) coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.

C. Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges at least 85 percent of joist depth.
   1. Thickness: 0.064 inch (1.6 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.

C. Fit carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

D. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

E. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.

F. Countersink nail heads on exposed carpentry work and fill holes with wood filler.

G. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

A. Install where shown and where required for screeding or attaching other work. Cut and shape to required size. Coordinate locations with other work involved.

B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 WOOD FURRING

A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.4 INSTALLATION OF STRUCTURAL-USE PANELS

A. General: Comply with applicable recommendations contained in APA Form No. E30, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.
   1. Comply with "Code Plus" provisions of above-referenced guide.

END OF SECTION 06 10 53

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

Section 07 13 26	Self-Adhering Sheet Waterproofing
Section 07 19 00	Water Repellents
Section 07 21 00	Building Insulation
Section 07 53 23	EPDM Membrane Roofing
Section 07 60 00	Sheet Metal Flashing and Trim
Section 07 84 00	Through-Penetration Firestop Systems
Section 07 92 00	Joint Sealants
Section 07 95 13	Architectural Joint Systems

SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING June 2, 2008

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. Rubberized-asphalt sheet waterproofing.

B. Related Sections include the following:
   1. Division 7 Section "Joint Sealants" for joint-sealant materials and installation.

1.3 PERFORMANCE REQUIREMENTS

A. Provide waterproofing that prevents the passage of water.

1.4 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.

D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

E. Sample Warranty: Copy of special waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting waterproofing.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who is authorized, approved, or licensed by waterproofing manufacturer to install manufacturer's products.

B. Source Limitations: Obtain waterproofing materials, protection course, and molded-sheet drainage panels through one source from a single manufacturer.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review requirements for waterproofing, including surface preparation specified under other Sections, 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.

1.6 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.

1.7 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.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Written warranty, signed by waterproofing manufacturer agreeing to replace waterproofing material that does not comply with requirements or that does not remain watertight during 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 after date of Substantial Completion.

B. Special Installer's Warranty: Written waterproofing Installer's warranty, signed by Installer, covering Work of this Section, for warranty period of two years.
   1. Warranty includes removing and reinstalling protection board, and drainage panels, on plaza decks.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. Rubberized-Asphalt Sheet Waterproofing:
      a. Carlisle Corporation, Carlisle Coatings & Waterproofing Div.; CCW 701.
      b. W. R. Grace & Co.; Bituthene.
      c. T. C. Miradri; Miradri.

2.2 RUBBERIZED-ASPHALT SHEET WATERPROOFING

A. Rubberized-Asphalt Sheet: 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. Physical Properties: As follows, measured per standard test methods referenced:
   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.

2.3 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. Sheet Strips: Self-adhering, rubberized-asphalt composite sheet strips of same material and thickness as sheet waterproofing.

E. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity.

F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick, predrilled at 9-inch (225-mm) centers.

G. Protection Course: Semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:

1. Thickness: 1/4 inch (6 mm), nominal.
2. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for type of protection course.

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.

F. Bridge and cover expansion joints and discontinuous joints with overlapping sheet strips.
   1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

G. 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.

H. 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 RUBBERIZED-ASPHALT SHEET APPLICATION

A. Install self-adhering sheets according to waterproofing manufacturer's written instructions and 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, rubberized-asphalt 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. Horizontal Application: Apply sheets from low point to high point to ensure that side laps shed water.

E. Apply continuous sheets over sheet strips bridging substrate cracks, construction, and contraction joints.

F. Seal exposed edges of sheets at terminations not concealed by metal counterflashings or ending in reglets with mastic or sealant.

G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheets extending 6 inches (150 mm) beyond repaired areas in all directions.

H. Correct deficiencies in or remove sheet waterproofing that does not comply with requirements, repair substrates, reapply waterproofing, and repair sheet flashings.

3.4 PROTECTION COURSE INSTALLATION

A. Install protection course with butted joints over waterproofing membrane before starting subsequent construction operations.

1. Molded-sheet drainage panels Insulation drainage panels Board insulation may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer.

3.5 PROTECTION AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed drainage panels from damage due to ultraviolet 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.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 13 26

SECTION 07 19 00 - WATER REPELLENTS June 2, 2008

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 clear water-repellent coatings for the following vertical and nontraffic horizontal surfaces:
   1. Architectural face brick.

B. Related Sections include the following:
   1. Division 03 Sections for concrete work including floor sealers and curing agents.
   2. Division 04 Sections for brick, and concrete unit masonry.
   3. Division 07 Section "Joint Sealants" for joint sealants.
   4. Division 09 Section "Painting" for paints and coatings.

1.3 PERFORMANCE REQUIREMENTS

A. Provide water repellents with the following properties based on testing manufacturer's standard products, according to test methods indicated, applied to substrates simulating Project conditions using same materials and application methods to be used for Project.
   1. Absorption: Minimum 98 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.
      a. Brick: ASTM C 67.
      b. Concrete Unit Masonry: ASTM C 140.
   2. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.
   3. Water Penetration and Leakage through Masonry: Maximum 98 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E 514.
   4. Durability: Maximum 5 percent loss of water repellency after 2500 hours of weathering in comparison to specimens before weathering, per ASTM G 53.
   5. Permeability: Minimum 80 percent breathable in comparison of treated and untreated specimens, per ASTM D 1653.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's specifications, surface preparation and application instructions, recommendations for water repellents for each surface to be treated, and protection and cleaning instructions. Include data substantiating that materials are recommended by manufacturer for applications indicated and comply with requirements.

B. Samples: Of each substrate indicated to receive water repellent, 12 inches square, with specified repellent treatment applied to half of each sample.

C. Applicator Certificates: Signed by manufacturer certifying that the applicator complies with requirements.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who employs only persons trained and approved by water repellent manufacturer for application of manufacturer's products.

1.6 TEST PANELS

A. Field Samples: Select multiple representative surfaces for each substrate to receive water repellents. Apply water repellent to each substrate, with either partial or full coverage as directed and in accordance with provisions in this Section. Comply with application requirements of this Section.
   1. Obtain Architect's approval of field samples before applying water repellents.
   2. Maintain field samples during construction in an undisturbed condition as a standard for judging the completed Work.

B. Clean test panel area following substrate manufacture=s guidelines and recommended products for cleaning.

C. After substrate has dried, rilem tube testing shall be done by manufactures representative, to determine coverage rates.

D. Before full-scale application, review manufacturer's product data sheets to determine the suitability of each product for the specific surfaces. Apply each water repellent to test panels to determine number of applications, coverage rates, compatibility, effectiveness, surface preparation, application procedures, and desired results.

E. Apply water repellents to test panels in accordance with manufacturer's written instructions. Allow 48 hours or until test panels are thoroughly dry before evaluating final appearance and results. A final rilem tube test shall be done to determine if desired finish has been accomplished. Do not begin full-scale application until test panels are inspected and approved by the Architect and the Manufacturer.

F. Test Panel Requirements:
   1. Size: Minimum 4 feet by 4 feet each.
   2. Locations: As determined by the Architect.
   3. Number: As required to completely test each water repellent with each type of substrate to be protected.

1.7 PROJECT CONDITIONS

A. Weather and Substrate Conditions: Do not proceed with application of water repellent under any of the following conditions, except with written instruction of manufacturer:
   1. Ambient temperature is less than 40 deg F.
   2. Concrete surfaces and mortar have cured for less than 28 days.
   3. Rain or temperatures below 40 deg F are predicted within 24 hours.
   4. Application is earlier than 24 hours after surfaces have been wet.
   5. Substrate is frozen or surface temperature is less than 40 deg F.
   6. Windy condition exists that may cause water repellent to be blown onto vegetation or surfaces not intended to be coated.

1.8 WARRANTY

A. General Warranty: The special warranty specified in this Article 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. Special Warranty: Submit a written warranty, executed by the applicator and water repellent manufacturer, covering materials and labor, agreeing to repair or replace materials that fail to provide water repellency within the specified warranty period. Warranty does not include deterioration or failure of coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new joints and cracks in excess of 1/16 inch (1.5 mm) wide, fire, vandalism, or abuse by maintenance equipment.
   1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. Silane-Siloxane Blend: Total active ingredients by weight less than 12% with 312 g/l VOCs or less.
      a. Hydrozo, Enviroseal Double 7 for Brick as manufactured by Chemrex, Inc.

2.2 WATER REPELLENTS

A. Material Compatibility: Provide primers, undercoats, and finish-coat materials 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.

B. Material Quality: Provide manufacturer's highest grade of the various high-performance coatings specified. Materials not displaying manufacturer's product identification are not acceptable.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Silane/Siloxane Blends: Consisting of silanes and siloxanes blended to achieve a particular penetration and protection on a specific substrate with total active ingredients by weight less than 12%.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to repellent manufacturer's written instructions, to ensure surface is sufficiently dry.

1. Clay Brick Masonry: Clean clay brick masonry per ASTM D 5703.

B. Test for pH level, according to water repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.

C. Protect adjoining work, including 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 plants and grass.

D. Coordination with Sealants: 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 used in the work.

E. Test Application: Before performing water-repellent work, including bulk purchase and delivery of products, prepare a small application in an unobtrusive location that has been fully cleaned and in a manner approved by Architect to demonstrate the final effect (visual, physical, and chemical) of planned application. Proceed with work only after Architect approves test application or as otherwise directed.
   1. Revisions of planned application, if any, as requested by Architect, will be by Change Order if they constitute a departure from requirements of Contract Documents at the time of contracting.

3.2 APPLICATION

A. Application rate shall be in accordance with manufacturer=s written recommendations and in accordance with proper coverage rates for warranty requirements.

B. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.
   1. Precast Work: At Contractor's option, first application of water repellent on precast concrete units may be completed before installing units. Mask sealant-bond surfaces to prevent water repellent from migrating onto joint surfaces.

C. Apply a second saturation spray 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.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of a factory-authorized technical service representative to inspect and approve the substrate before application and to instruct the applicator on the product and application method to be used.

3.4 CLEANING

A. Protective Coverings: Remove protective coverings from adjacent surfaces and other protected areas.

B. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged

by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

3.5 EXTERIOR SCHEDULE

A. General: Provide the following systems for the various substrates, as indicated.

1. MASONRY SEALER (Architectural Face Brick)

   1st/2nd Coat: Hydrozo Enviroseal Double 7 for Brick.
   Apply two (2) uniform pinhole free, continuous flood coats at rate of 100-175 sq. ft. per gallon and in accordance with test application coverage rate. Test application rate shall govern where a discrepancy occurs.

END OF SECTION 07 19 00

SECTION 07 21 00 - BUILDING INSULATION June 2, 2008

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. Foundation wall insulation (supporting backfill).
   2. Concealed building insulation.
   3. Radiant barriers.
   4. Safing insulation.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 07 Section "Membrane Roofing" for insulation specified as part of roofing construction.
   2. Division 09 Section indicated below for insulation installed as part of metal-framed wall and partition assemblies:
      a. "Gypsum Board Assemblies."

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data for each type of insulation product specified.

C. Product test reports from and based on tests performed by a qualified independent testing agency evidencing compliance of insulation products with specified requirements including those for thermal resistance, fire-test-response characteristics, water-vapor transmission, water absorption, and other properties, based on comprehensive testing of current products.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated on Drawings or specified elsewhere in this Section as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
   1. Surface-Burning Characteristics: ASTM E 84.
   2. Fire-Resistance Ratings: ASTM E 119.
   3. Combustion Characteristics: ASTM E 136.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by 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 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 plastic insulating materials to Project site before installation time.
   3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering insulation products that may be incorporated in the work include, but are not limited to, the following:
   1. Extruded-Polystyrene Board Insulation:
      a. Amoco Foam Products Company.
      b. DiversiFoam Products.
      c. Dow Chemical Co.
      d. UC Industries, Inc.; Owens-Corning Co.
   2. Glass-Fiber Insulation:
      a. CertainTeed Corporation.
      b. Knauf Fiber Glass GmbH.
      c. Owens-Corning Fiberglas Corporation.
      d. Johns Manville Corporation.

2.2 INSULATING MATERIALS

A. General: Provide insulating materials that comply with requirements and with referenced standards.
   1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.

B. Extruded-Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation formed from polystyrene base resin by an extrusion process using hydrochlorofluorocarbons as blowing agent to comply with ASTM C 578 for type and with other requirements indicated below:
   1. Type IV, 1.60-lb/cu. ft. (26-kg/cu. m) minimum density, unless otherwise indicated.
   2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 75 and 450, respectively.
   3. Recycled Content: Not less than 50 percent blend of postconsumer and recovered polystyrene resins.

C. Unfaced Mineral-Fiber Blanket Insulation: Thermal insulation combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665, Type I (blankets without membrane facing).

1. Mineral-Fiber Type: Fibers manufactured from glass.
2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 25 and 50, respectively.

D. Faced Mineral-Fiber Blanket Insulation: ASTM C 665, Type III (blankets with reflective membrane facing), Class A (membrane-faced surface with a flame spread of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil-scrim-kraft, foil-scrim, or foil-scrim-polyethylene vapor-retarder membrane on one face; consisting of fibers manufactured from glass.

E. Sound Attenuation Blankets: ASTM C 665, Type I; semi-rigid mineral fiber blanket without membrane, Class 25 flame-spread. Furnish in 2-3/4", 4" and 6" thicknesses. Provide minimum thickness as required to achieve a minimum 50 STC in all walls.

2.3 SAFING INSULATION AND ACCESSORIES

A. Slag-Wool-Fiber Board Safing Insulation: Semirigid boards designed for use as fire stop at openings between edge of slab and exterior wall panels, produced by combining slag-wool fibers with thermosetting resin binders to comply with ASTM C 612, Type IA and IB; nominal density of 4 lb/cu. ft. (64 kg/cu. m); passing ASTM E 136 for combustion characteristics; thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).

B. Calking Compound: Material approved by manufacturer of safing insulation for sealing joint between foil backing of safing insulation and edge of concrete floor slab against penetration of smoke.

C. Safing Clips: Galvanized steel safing clips approved by manufacturer of safing insulation for holding safing insulation in place.

2.4 VAPOR RETARDERS

A. Reinforced-Polyethylene Vapor Retarders: 2 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).

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.

C. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
1. Reinforced-Polyethylene Vapor Retarders:
   a. DURA-SKRIM 6WW; Raven Industries, Inc.
   b. Griffolyn T-65; Reef Industries, Inc., Griffolyn Div.

2.5 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.6 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of

holding insulation, of thickness indicated, securely in position indicated with self-locking washer in place; and complying with the following requirements:

1. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
2. Spindle: Copper-coated low carbon steel, fully annealed, 0.105 inches (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. Where spindles will be exposed to human contact after installation, protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap.

C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

D. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Adhesively Attached, Spindle-Type Anchors:
   a. TACTOO Insul-Hangers; AGM Industries, Inc.
   b. Spindle Type Gemco Hangers; Gemco.
2. Anchor Adhesives:
   a. TACTOO Adhesive; AGM Industries, Inc.
   b. Tuff Bond Hanger Adhesive; Gemco.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or that interfere with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, unsoiled, and has not been exposed at any time to ice and snow.

C. Extend insulation in thickness indicated 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. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF PERIMETER INSULATION

A. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

B. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection board. Set in adhesive according to written instructions of insulation manufacturer.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

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. Seal joints between closed-cell (nonbreathing) insulation 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. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
   1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

D. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:
   1. Use blanket widths and lengths that fill cavities formed by framing members. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
   2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

E. Install board insulation on concrete or masonry 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. 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.
   3. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

F. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.6 INSTALLATION OF SAFING INSULATION

A. Install safing insulation to fill gap between edge of concrete floor slab and back of exterior spandrel panels on safing clips spaced as needed to support insulation, but not further apart than 24 inches (610 mm) o.c. Cut safing insulation wider than gap to be filled to ensure compression fit and seal joint between insulation and edge of slab with calking approved by safing insulation manufacturer for this purpose. Leave no voids in completed installation.

3.7 INSTALLATION OF VAPOR RETARDERS

A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder 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 not less than 2 wall studs. Fasten vapor retarders to framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches (406 mm) o.c.

C. Seal overlapping joints in vapor retarders with adhesives or vapor-retarder tape according to vapor retarder manufacturer's instructions. Seal butt joints and fastener penetrations with vapor-retarder tape. Locate all joints over framing members or other solid substrates.

D. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor retarder manufacturer.

E. 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 retarder.

F. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.8 PROTECTION

A. General: 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 07 21 00

SECTION 07 53 23 - EPDM MEMBRANE ROOFING June 2, 2008

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. Loosely laid and ballasted membrane roofing system.
2. Roof insulation.

B. Related Sections include the following:
1. Division 06 Section "Miscellaneous 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 "Joint Sealants."
4. Division 22 Section "Plumbing Specialties" for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 and glossary of 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: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. FMG Listing: Provide roofing membrane, base flashings, and component materials that comply with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.
1. Fire/Windstorm Classification: Class 1A-90.
2. Hail Resistance: SH.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. 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. Insulation fastening patterns.

C. Samples for Verification: For the following products:
1. 12-by-12-inch (300-by-300-mm) square of sheet roofing, of color specified, including T-shaped side and end lap seam.
2. 12-by-12-inch (300-by-300-mm) square of roof insulation.
3. 10 lb (4.5 kg) of aggregate ballast in color and gradation indicated.
4. 12-inch (300-mm) length of metal termination bars.
5. 12-inch (300-mm) length of battens.
6. Six insulation fasteners of each type, length, and finish.
7. Six roof cover fasteners of each type, length, and finish.

D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
1. Submit evidence of meeting performance requirements.

F. Qualification Data: For Installer and manufacturer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.

H. Maintenance Data: For roofing system to include in maintenance manuals.

I. Warranties: Special warranties specified in this Section.

J. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.

B. Manufacturer Qualifications: A qualified manufacturer that has UL listing/FMG approval for membrane roofing system identical to that used for this Project.

C. Source Limitations: Obtain components for membrane roofing system approved by roofing membrane manufacturer.

D. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.

E. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference

at Project site. Comply with requirements for preinstallation conferences in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roof deck construction and roofing system including, but not limited to, the following:

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.

F. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:

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, 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 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. Failure includes roof leaks.

1. Special warranty includes roofing membrane, base flashings, roofing accessories, roof insulation, fasteners, walkway products 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 against all leaks, on warranty form at end of Section 01770 – Closeout Procedures, signed by Installer, covering Work of this Section, including all components of membrane roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Five years from date of Substantial Completion.

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. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
2. 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.

2.2 EPDM ROOFING MEMBRANE

A. EPDM Roofing Membrane: ASTM D 4637, Type I, nonreinforced uniform, flexible sheet made from EPDM, and as follows:

1. Available Manufacturers:
   a. Carlisle SynTec Incorporated.

b. Firestone Building Products Company.
c. GenFlex Roofing Systems.
d. Mule-Hide Products Co., Inc.
e. Johns Manville International, Inc.

2. Thickness: 60 mils (1.5 mm), nominal.
3. Exposed Face Color: Black.

2.3 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
   1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.

C. Bonding Adhesive: Manufacturer's standard bonding adhesive.

D. Seaming Material: Manufacturer's standard synthetic-rubber polymer primer and 3-inch- (75-mm-) wide minimum, butyl splice tape with release film.

E. Lap Sealant: Manufacturer's standard single-component sealant, color to match roofing membrane.

F. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

G. 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.

H. Metal Battens: Manufacturer's standard aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch (25 mm) wide by 0.05 inch (1.3 mm) thick, prepunched.

I. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

J. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.4 ROOF INSULATION

A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
   1. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48), unless otherwise indicated.
   2. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

B. Cellulosic-Fiber Board Insulation: For tapered applications, provide ASTM C 208, Type II, Grade 2, fibrous-felted, rigid insulation boards of wood fiber or other cellulosic-fiber and water-resistant binders, asphalt impregnated, chemically treated for deterioration.

1. Available Manufacturers:
   a. Carlisle SynTec Incorporated.
   b. Celotex Corporation.
   c. Firestone Building Products Company.
   d. GAF Materials Corp.
   e. Georgia-Pacific Corporation.

C. Polyisocyanurate Board Insulation: Rigid, cellular polyisocyanurate thermal insulation with core formed by using HCFCs as blowing agents to comply with ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces. Provide in thickness as required to achieve a completed minimum certified Aaged@ value of R-24, when tested according to LTTR-CAN/ULC-S770.
   1. Available Manufacturers:
      a. Atlas Roofing Corporation.
      b. Carlisle SynTec Incorporated.
      c. Firestone Building Products Company.
      d. Johns Manville International, Inc.
      e. RMAX.

D. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48), unless otherwise indicated.

E. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes as required and where indicated for sloping to drain. Fabricate to slopes indicated.

F. Polyisocyanurate insulation shall be installed in two (2) layers with the total thickness meeting the minimum specified R-Value. Where cellulosic-fiber board tapered insulation, crickets, saddles, tapered edge strips, or other insulation shapes are indicated, the cellulosic-fiber board shall be placed between the layers of polyisocyanurate insulation.

2.5 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric mat, water permeable and resistant to ultraviolet degradation, type and weight as recommended by roofing system manufacturer for application.

2.6 AGGREGATE BALLAST

A. Aggregate Ballast: Provide aggregate ballast that will withstand weather exposure without significant deterioration and will not contribute to membrane degradation, of the following type and size:
   1. Aggregate Type: Smooth, washed, riverbed gravel or other acceptable smooth-faced stone.
   2. Size: ASTM D 448, Size 4, ranging in size from 3/4 to 1-1/2 inches (19 mm to 38 mm).
   3. Size: ASTM D 448, Size 2, ranging in size from 1-1/2 to 2-1/2 inches (38 mm to 63

mm).

4. Size: ASTM D 448, Size 3, ranging in size from 1 to 2 inches (25 mm to 50 mm).

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 set and braced and that roof drains 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 5 Section "Steel Deck."
   4. 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 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 manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches (50 mm) or greater, install 2 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.

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 FMG's "Approval Guide" for specified Windstorm Resistance Classification.

3.4 LOOSELY LAID AND BALLASTED ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.

B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing membranes, without stretching, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Mechanically fasten or adhere perimeter of roofing membrane according to requirements in ANSI/SPRI RP-4.

E. Apply roofing membrane with side laps shingled with slope of deck where possible.

F. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.

G. Leave seams uncovered until inspected by membrane roofing system manufacturer.

H. Repair tears, voids, and lapped seams in roofing that does not meet requirements.

I. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

J. Install roofing membrane and auxiliary materials to tie in to existing roofing.

K. Install protection mat over roofing membrane, overlapping a minimum of 6 inches (150 mm). Install an additional protection mat layer at projections, pipes, vents, and drains, overlapping a minimum of 12 inches (300 mm).

L. Aggregate Ballast: Apply aggregate ballast uniformly over roofing membrane at the rate required by membrane roofing system manufacturer, but not less than the following, spreading with care to minimize possibility of damage to membrane roofing system. Lay ballast as roofing membrane is installed, leaving roofing membrane ballasted at the end of the workday.
   1. Ballast Weight: Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m).
   2. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m), at corners and perimeter; Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m), elsewhere.

3.5 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 bonding adhesive to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
   1. Notify Architect or Owner 48 hours in advance of date and time of inspection.

B. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 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.

END OF SECTION 07 53 23

SECTION 07 60 00 - SHEET METAL FLASHING AND TRIM June 2, 2008

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 and trim.
3. Formed wall flashing and trim.
4. Formed equipment support flashing.

B. Related Sections include the following:
1. Division 04 Section "Unit Masonry Assemblies" for installing through-wall flashing, reglets, and other sheet metal flashing and trim.
2. Division 06 Section "Miscellaneous Carpentry" for wood nailers, curbs, and blocking.
3. Division 07 Section "Thermoplastic Membrane Roofing@ for installing sheet metal flashing and trim integral with roofing membrane.
4. Division 07 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 1: For velocity pressures of 21 to 30 lbf/sq. ft. (1.00 to 1.44 kPa): 60-lbf/sq. ft. (2.87-kPa) perimeter uplift force, 90-lbf/sq. ft. (4.31-kPa) corner uplift force, and 30-lbf/sq. ft. (1.44-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 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.

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. 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 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 Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
   2. 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. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality, mill phosphatized for field painting.

B. Prepainted, Metallic-Coated Steel Sheet: 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 3-Coat System: Manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil (0.038 mm); complying with physical properties and coating performance requirements of AAMA 2605, except as modified below:
            a) Humidity Resistance: 2000 hours.
            b) Salt-Spray Resistance: 2000 hours.
         2) Color: As selected by Architect from manufacturer's full range including deep tone colors.

C. Lead Sheet: ASTM B 749, Type L51121, copper-bearing lead sheet.

D. Zinc Sheet: Electrolytic, 99 percent pure zinc alloyed with 1 percent titanium and copper.
   1. Finish: Bright rolled.

2.3 UNDERLAYMENT MATERIALS

A. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.

B. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

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.
   4. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

C. Solder for Lead: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

D. Solder for Zinc: ASTM B 32, 60 percent lead and 40 percent tin with low antimony, as recommended by manufacturer.

E. Burning Rod for Lead: Same composition as lead sheet.

F. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

G. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer 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, heavy bodied for hooked-type expansion joints with limited movement.

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.

2.5 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. Fry Reglet Corporation.
   2. Material: Galvanized steel, 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. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
   5. 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.

6. 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 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 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 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.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Seams: Comply with SMACNA “Architectural Sheet Metal Manual”, (Sixth Edition, September 2003) Figure no. 3-2 and 3-3 as applicable to specific installations.

1. Standing Seams: Provide double lock standing seams (detail no. 25, figure no. 3-3), with finish not less than 1-1/4" high.

F. 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 sealant concealed within joints.

G. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

H. 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" for application but not less than thickness of metal being secured.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: 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: Standing seams.
2. Fabricate copings from the following material:
   a. Prepainted, Metallic-Coated Steel: 0.0396 inch (1.0 mm) thick.

B. Base Flashing: Fabricate from the following material:

1. Galvanized Steel: 0.0276 inch (0.7 mm) thick.

C. Counterflashing: Fabricate from the following material:

1. Galvanized Steel: 0.0217 inch (0.55 mm) thick.

D. Flashing Receivers: Fabricate from the following material:
   1. Galvanized Steel: 0.0217 inch (0.55 mm) thick.

E. Roof-Penetration Flashing: Fabricate from the following material:
   1. Galvanized Steel: 0.0276 inch (0.7 mm) thick.

F. Roof-Drain Flashing: Fabricate from the following material:
   1. Lead: 4.0 lb/sq. ft. (1.6 mm thick), hard tempered.

2.8 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12 foot (3.6 m) long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings. Form with 2-inch- (50-mm-) high end dams. Fabricate from the following material:
   1. Zinc: 0.040 inch (1.0 mm) thick.

B. Openings Flashing in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high end dams. Fabricate from the following material:
   1. Prepainted, Metallic-Coated Steel: 0.0217 inch (0.55 mm) thick.

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following material:
   1. Galvanized Steel: 0.0276 inch (0.7 mm) thick.

2.10 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 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 excessive 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 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 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.

H. Seal joints with elastomeric 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: Clean surfaces to be soldered, removing oils and foreign matter. Pretin

edges of sheets to be soldered to a width of 1-1/2 inches (38 mm) except where pretinned surface would show in finished Work.

1. Do not solder prepainted, metallic-coated steel sheet.
2. Pretinning is not required for lead.
3. Where surfaces to be soldered are lead coated, do not tin edges, but wire brush lead coating before soldering.
4. 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.

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.

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 16-inch (400-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 16-inch (400-mm) centers.
2. Anchor interior leg of coping with screw fasteners and washers at 18-inch (450-mm) centers.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric 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 elastomeric sealant.

1. Secure in a waterproof manner by means of snap-in installation and sealant.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Seal with elastomeric 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. Through-Wall Flashing: Installation of formed through-wall flashing is specified in Division 4 Section "Unit Masonry Assemblies."

C. Reglets: Installation of reglets is specified in Division 3 Section "Cast-in-Place Concrete and in 4 Section "Unit Masonry Assemblies."

D. Openings Flashing in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

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 elastomeric 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 07 60 00

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 through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:
1. Floors.
2. Roofs.
3. Walls and partitions.
4. Smoke barriers.

B. The Contractor is responsible for providing code compliant firestop systems complying with all Local codes for all penetrations and aesthetic requirements of the Project where exposed to view.

C. Related Sections include the following:
1. Division 03 Section "Cast-in-Place Concrete" for construction of openings in concrete slabs and walls.
2. Division 07 Section "Building Insulation" for safing insulation and accessories.
3. Division 07 Section "Sprayed Fire-Resistive Materials."
4. Division 23 Sections specifying duct and piping penetrations.
5. Division 26 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide through-penetration firestop systems that are 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 assembly penetrated.
1. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
2. Fire-resistance-rated floor assemblies.
3. Fire-resistance-rated roof assemblies.

B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
1. Penetrations located outside wall cavities.
2. Penetrations located outside fire-resistive shaft enclosures.

3. Penetrations located in construction containing fire-protection-rated openings.
4. Penetrating items larger than 4-inch- (100-mm-) diameter nominal pipe or 16 sq. in. (100 sq. cm) in overall cross-sectional area.

D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches (100 mm) in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

E. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

1.4 SUBMITTALS

A. Product Data: For each type of through-penetration firestop system product indicated.

B. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.
1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.

C. Qualification Data: For firms and persons specified in "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.

D. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.

E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed through-penetration firestop systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that

comply with the following requirements and those specified in "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:.
   a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
   b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
      1) UL in "Fire Resistance Directory."

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required

by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 PRODUCTS AND 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:
   1. Firestop Systems Inc.
   2. Hilti Construction Chemicals, Inc.
   3. International Protective Coatings Corp.
   4. Isolatek International.
   5. 3M Fire Protection Products.
   6. Tremco.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
   1. Permanent forming/damming/backing materials, including the following:
      a. Slag-/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

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 after cure do not re-emulsify 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. 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.

E. 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.

F. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

G. Silicone Sealants: Moisture-curing, 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 other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system 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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. 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 through-penetration firestop system 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 through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing 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, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems 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 Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.
   1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.

C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 IDENTIFICATION

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
   1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Through-penetration firestop system designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Through-penetration firestop system manufacturer's name.
   6. Installer's name.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

END OF SECTION 07 84 00

SECTION 07 92 00 - JOINT SEALANTS June 2, 2008

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 joint sealants for the following applications, including those specified by reference to this Section:
   1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
      a. Construction joints in cast-in-place concrete.
      b. Control and expansion joints in unit masonry and cast stone units.
      c. Joints between metal panels.
      d. Joints between different materials listed above.
      e. Perimeter joints between materials listed above and frames of doors and windows.
      f. Control and expansion joints in ceilings and other overhead surfaces.
      g. Other joints as indicated.
   2. Exterior joints in the following horizontal traffic surfaces:
      a. Isolation and contraction joints in cast-in-place concrete slabs.
      b. Tile control and expansion joints.
      c. Joints between different materials listed above.
      d. Other joints as indicated.
   3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Tile control and expansion joints.
      d. Vertical joints on exposed surfaces of walls and partitions.
      e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
      f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      g. Other joints as indicated.
   4. Interior joints in the following horizontal traffic surfaces:
      a. Isolation joints in cast-in-place concrete slabs.
      b. Control and expansion joints in tile flooring.
      c. Other joints as indicated.

B. Related Sections include the following:
   1. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
   2. Division 08 Section "Glazing" for glazing sealants.
   3. Division 09 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
   4. Division 09 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

D. Qualification Data: For Installer.

E. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

F. 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.

G. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

H. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
   1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
   3. Schedule sufficient time for testing and analyzing results to prevent delaying the

Work.

4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:
   a. Each type of elastomeric sealant and joint substrate indicated.
   b. Each type of nonelastomeric sealant and joint substrate indicated.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.
   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

E. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:
1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

1.6 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. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Three years from date of Substantial Completion.

B. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
   1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
   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 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 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 sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric 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.

C. Suitability for Immersion in Liquids. Where elastomeric 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 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Single-Component Neutral-Curing Silicone Sealant:
   1. Available Products:
      a. Pecora Corporation; 895.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 50.

4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
   a. Use O Joint Substrates: Aluminum coated with a high-performance coating.
6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

F. Single-Component Acid-Curing Silicone Sealant:
1. Available Products:
   a. Dow Corning Corporation; 999-A.
   b. GE Silicones; Construction
   c. Pecora Corporation; 860.
   d. Tremco; Proglaze.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
   a. Use O Joint Substrates: Aluminum coated with a high-performance coating.

G. Multicomponent Nonsag Urethane Sealant:
1. Available Products:
   a. Pecora Corporation; Dynatrol II.
   b. Tremco; Dymeric 511.
2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
   a. Use O Joint Substrates: Aluminum coated with a high-performance coating.

H. Multicomponent Pourable Urethane Sealant:
1. Available Products:
   a. Pecora Corporation; Dynatrol II-SG.
   b. Sika Corporation, Inc.; Sikaflex - 2c SL.
   c. Sonneborn, Division of ChemRex Inc.; SL 2.
2. Type and Grade: M (multicomponent) and P (pourable).
3. Class: 25.
4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

I. Single-Component Nonsag Urethane Sealant:
1. Available Products:
   a. Pecora Corporation; Dynatrol I-XL.
   b. Sika Corporation, Inc.; Sikaflex - 15LM.
   c. Tremco; DyMonic.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

2.4 SOLVENT-RELEASE JOINT SEALANTS

A. Acrylic-Based Solvent-Release Joint Sealant: Comply with ASTM C 1311 or FS TT-S-00230.
   1. Available Products:
      a. Tremco; Mono 555.

B. Butyl-Rubber-Based Solvent-Release Joint Sealant: Comply with ASTM C 1085.
   1. Available Products:
      a. Sonneborn, Division of ChemRex Inc.; Sonneborn Multi-Purpose Sealant.
      b. Tremco; Tremco Butyl Sealant.

2.5 LATEX JOINT SEALANTS

A. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.

B. Available Products:
   1. Pecora Corporation; AC-20+.
   2. Sonneborn, Division of ChemRex Inc.; Sonolac.
   3. Tremco; Tremflex 834.

2.6 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: 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.
   2. Available Products:
      a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
      b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2.7 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. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

D. 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.

2.8 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.

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, blast cleaning, 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.
   3. Remove laitance and form-release agents from concrete.
   4. Clean nonporous 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. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on 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 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. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type 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.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. 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.
   4. Seal abutting joint at all dissimilar materials.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified 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 configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

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

B. 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

A. Joint-Sealant Application: Exterior vertical construction joints in cast-in-place concrete.
   1. Joint Sealant: Multicomponent nonsag urethane sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

B. Joint-Sealant Application: Exterior horizontal nontraffic and traffic isolation and contraction joints in cast-in-place concrete slabs.
   1. Joint Sealant: Multicomponent pourable urethane sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

C. Joint-Sealant Application: Exterior vertical control and expansion joints in unit masonry.
   1. Joint Sealant: Multicomponent nonsag urethane sealant or Single-component nonsag urethane sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

D. Joint-Sealant Application: Exterior vertical joints between different materials listed above.
   1. Joint Sealant: Multicomponent nonsag urethane sealant or Single-component nonsag urethane sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

E. Joint-Sealant Application: Exterior perimeter joints between unit masonry and frames of doors and windows.
   1. Joint Sealant: Multicomponent nonsag urethane sealant or Single-component nonsag urethane sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

F. Joint-Sealant Application: Exterior control and expansion joints in ceilings and other overhead surfaces.
   1. Joint Sealant: Multicomponent nonsag urethane sealant or Single-component nonsag urethane sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

G. Joint-Sealant Application: Vertical control and expansion joints on exposed interior surfaces of exterior walls.
   1. Joint Sealant: Multicomponent nonsag urethane sealant or Single-component nonsag urethane sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

H. Joint-Sealant Application: Interior perimeter joints of exterior openings.
   1. Joint Sealant: Multicomponent nonsag urethane sealant or Single-component nonsag urethane sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

I. Joint-Sealant Application: Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
   1. Joint Sealant: Single-component nonsag urethane sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

J. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
   1. Joint Sealant: Latex sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 07 92 00

SECTION 07 95 13 - ARCHITECTURAL JOINT SYSTEMS June 2, 2008

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. Types of joints for which architectural joint systems are specified include the following:
   1. Exterior wall joints.

B. Related Sections include the following:
   1. Division 07 Section "Sheet Metal Flashing and Trim" for sheet metal roof and wall joint systems.
   2. Division 07 Section "Joint Sealants" for elastomeric sealants and preformed compressed-foam sealants without metal frames.

1.3 DEFINITIONS

A. Architectural Joint System: Any filler or cover used to span, fill, cover, or seal a joint, except expanding foam seals and poured or foamed in-place sealants.

B. Cyclic Movement: Periodic change between widest and narrowest joint widths in an automatically mechanically controlled system.

C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist passage of flame and hot gases through a movement joint.

D. Maximum Joint Width: Widest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.

E. Minimum Joint Width: Narrowest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.

F. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage of nominal value of joint width.

G. Nominal Joint Width: Width of linear gap indicated as representing the conditions existing when architectural joint systems will be installed or, if no nominal joint width is indicated, a width equal to the sum of maximum and minimum joint widths divided by two.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide factory-fabricated architectural joint systems capable of withstanding the types of loads and of accommodating the kinds of movement, and the other functions for which they are designed including those specified below, without failure. Types of failure include those listed in Appendix X3 of ASTM E 1399.
   1. Exterior Joints: Maintain continuity of weather enclosure.

2. Joints in Fire-Resistance-Rated Assemblies: Maintain fire-resistance ratings of assemblies.
3. Joints in Smoke Barriers: Maintain integrity of smoke barrier.
4. Joints in Acoustically Rated Assemblies: Inhibit passage of airborne noise.
5. Other Joints: Where indicated, provide joint systems that prevent penetration of water, moisture, and other substances deleterious to building components or content.
6. Seismic Joints: Remain in place on exposure to seismic activity (movement).
7. Joints in Surfaces with Architectural Finishes: Serve as finished architectural joint closures.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's product specifications, construction details, material and finish descriptions, and dimensions of individual components and seals.

B. Shop Drawings: For each joint system specified, provide the following:
1. Placement Drawings: Include line diagrams showing entire route of each joint system, plans, elevations, sections, details, joints, splices, locations of joints and splices, and attachments to other Work. Where joint systems change planes, provide Isometric Drawings depicting how components interconnect to achieve continuity of joint covers and fillers.

C. Samples for Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each exposed metal and elastomeric material of joint system indicated.
1. Include similar Samples of material for joints and accessories involving color selection.

D. Product Test Reports: From a qualified testing agency indicating architectural joint systems comply with requirements, based on comprehensive testing of current products.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain architectural joint systems through one source from a single manufacturer. Coordinate compatibility with adjoining joint systems specified in other Sections.

B. Fire-Test-Response Characteristics: Where indicated, provide joint systems incorporating fire barriers that are identical to those of assemblies tested for fire resistance per ASTM E 119 and ASTM E 814, including hose-stream test of vertical wall assemblies, by a testing and inspecting agency acceptable to authorities having jurisdiction.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of architectural joint systems and are based on the specific systems indicated. Other manufacturers' systems complying with requirements may be considered. Refer to Division 1 Section "Product Requirements."
1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in Part 2 "Architectural Joint Systems" Article.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those indicated in Part 2 "Architectural Joint Systems" Article.

2.2 MATERIALS

A. Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), alloy 6061-T6 for sheet and plate.
   1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Preformed Seals: Single or multicellular extruded elastomeric seals designed with or without continuous, longitudinal, internal baffles. Formed to be installed in frames or with anchored flanges, in color indicated or, if not indicated, as selected by Architect from manufacturer's standard colors.

C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint.

D. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesives, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.3 ARCHITECTURAL JOINT SYSTEMS

A. General: Provide joint systems of design, basic profile, materials, and operation indicated. Provide units with the capability to accommodate joint widths indicated and variations in adjacent surfaces.
   1. Furnish units in longest practicable lengths to minimize number of end joints. Provide hairline mitered corners where joint changes directions or abuts other materials.
   2. Include closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
   3. Frames for Strip Seals: Designed with semiclosed cavity that provides a mechanical lock for seals of type indicated.

B. Architectural Joint System: Metal frames and preformed seals for exterior joints on walls.
   1. Basis-of-Design Product: Watson Bowman Acme, Weatherseam, or a comparable product of one of the following:
      a. Balco Metalines, A Division of Balco, Inc.
      b. MM Systems Corporation.
      c. Nystrom, Inc.
   2. Maximum Joint Width: As indicated.
   3. Nominal Joint Width: As indicated.

4. Minimum Joint Width: As indicated.
5. Movement Capability: As indicated.
6. Type of Movement Capability: Expansion and contraction.
7. Cyclic-Movement-Test-Response Characteristics: No evidence of visual fatigue, inability to cycle between designated joint widths, or other types of failure as determined by testing products identical to those indicated per ASTM E 1399 including Appendix X3.
8. Preformed Seal Material: Manufacturer's standard.
   a. Seal Color: Black.
9. Exposed Frame Material: Aluminum.
10. Moisture Barrier: Provide manufacturer's standard unit.
11. Fire-Resistance Ratings: Provide manufacturer's standard fire barrier with a rating not less than that of adjacent construction.

2.4 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.

2.5 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to architectural joint system manufacturer's written instructions.

B. Coordinate and furnish anchorages, Placement Drawings, and instructions for installing joint systems to be embedded in or anchored to concrete or to have recesses formed into edges of concrete slab for later placement and grouting-in of frames.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary to secure joint systems to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for handling and installing architectural joint assemblies and materials, unless more stringent requirements are indicated.

B. Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.

C. Terminate exposed ends of exterior architectural joint assemblies with factory-fabricated termination devices to maintain waterproof system.

D. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required to install joint systems.
   1. Install joint cover assemblies in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
   2. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling.
   3. Set covers in horizontal surfaces at elevations that place exposed surfaces flush with adjoining finishes.
   4. Locate wall and ceiling covers in continuous contact with adjacent surfaces.
   5. Securely attach in place with required accessories.
   6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

E. Continuity: Maintain continuity of joint systems with a minimum number of end joints and align metal members. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials, if any, to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

F. Extruded Preformed Seals: Install seals to comply with manufacturer's written instructions and with minimum number of end joints.
   1. For straight sections, provide preformed seals in continuous lengths.
   2. Vulcanize or heat-weld field splice joints in preformed seal material to provide watertight joints using procedures recommended by manufacturer.
   3. Apply adhesive, epoxy, or lubricant adhesive approved by manufacturer to both frame interfaces before installing preformed seals.
   4. Seal transitions according to manufacturer's written instructions.

G. Joint Systems with Seals: Seal end joints within continuous runs and joints at transitions according to manufacturer's written instructions to provide a watertight installation.

H. Seismic Seals: Install interior seals in continuous lengths. Install exterior seal in standard lengths and vulcanize or heat-weld field splice joints to provide watertight joints using manufacturer's recommended procedures. Seal transitions and end joints according to manufacturer's written instructions.

3.3 CLEANING AND PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

END OF SECTION 07 95 13

DIVISION 08 - OPENINGS

Section 08 11 00	Steel Door Frames
Section 08 14 00	Flush Wood Doors
Section 08 31 00	Access Doors and Frames
Section 08 41 00	Aluminum-Framed Entrances and Storefronts
Section 08 71 00	Door Hardware
Section 08 80 00	Glazing
Section 08 83 00	Mirrors
Section 08 91 00	Louvers and Vents

SECTION 08 11 00 - STEEL DOOR FRAMES June 2, 2008

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. Steel door frames.
2. Fire-rated door and frame assemblies.

B. Reuse, wherever possible, existing metal door frames. Existing door frames shall be refinished to match new door frames specified.

C. Related Sections include the following:
1. Division 08 Section "Flush Wood Doors" for wood doors installed in steel frames.
2. Division 08 Section "Door Hardware" for door hardware and weather stripping.
3. Division 09 Section "Gypsum Board Assemblies" for spot-grouting frames installed in steel-framed gypsum board partitions.
4. Division 09 Section "Painting" for field painting factory-primed doors and frames.

1.3 DEFINITIONS

A. Steel Sheet Thicknesses: Thickness dimensions, including those referenced in ANSI A250.8, are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets.

1.4 SUBMITTALS

A. Product Data: For each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, sound and fire-resistance ratings, and finishes.

B. Shop Drawings: Show the following:
1. Details of doors including vertical and horizontal edge details.
2. Frame details for each frame type including dimensioned profiles.
3. Details and locations of reinforcement and preparations for hardware.
4. Details of each different wall opening condition.
5. Details of anchorages, accessories, joints, and connections.

C. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.

1.5 QUALITY ASSURANCE

A. Steel Door and Frame Standard: Comply with ANSI A 250.8, unless more stringent requirements are indicated.

B. Fire-Rated Door 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 252.
   1. Test Pressure: Test at atmospheric pressure.
   2. Temperature-Rise Rating: Where indicated, provide doors that have a temperature-rise rating of 450 deg F (250 deg C) maximum in 30 minutes of fire exposure.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver door frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished door frames.

B. Inspect door frames on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.

C. Store door frames at building site under cover. Place units on minimum 4-inch-high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If packaging becomes wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked units to permit air circulation.

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:
   1. Steel Door Frames:
      a. Amweld Building Products, Inc.
      b. Ceco Door Products; a United Dominion Company.
      c. Curries Company.
      d. Kewanee Corporation (The).
      e. Pioneer Industries Inc.
      f. Republic Builders Products.
      g. Steelcraft; a division of Ingersoll-Rand.

2.2 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

C. Metallic-Coated Steel Sheets: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with an A40 zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.

D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized; suitable for unexposed applications; stretcher-leveled standard of

flatness where used for face sheets.

2.3 FRAMES

A. General: Provide steel frames for doors, transoms, sidelights, borrowed lights, and other openings that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

B. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
   1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
   2. Frames for Level 3 Steel Doors: 0.067-inch- (1.7-mm-) (16 gauge) thick steel sheet.
   3. Frames for Wood Doors: 0.067-inch- (1.7-mm-) (16 gauge) thick steel sheet.
   4. Frames for Borrowed Lights: 0.067-inch- (1.7-mm-) (16 gauge) thick steel sheet.

C. Door Silencers: Except on weather-stripped frames, fabricate stops to receive three silencers on strike jambs of single-door frames and two silencers on heads of double-door frames.

D. Plaster Guards: Provide 0.016-inch-thick, steel sheet plaster guards or mortar boxes to close off interior of openings; place at back of hardware cutouts where mortar or other materials might obstruct hardware operation.

E. Supports and Anchors: Fabricated from not less than 0.042-inch-thick, electrolytic zinc-coated or metallic-coated steel sheet.
   1. Wall Anchors in Masonry Construction: 0.177-inch-diameter, steel wire complying with ASTM A 510 may be used in place of steel sheet.

F. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.

2.4 FABRICATION

A. General: Fabricate steel door frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.

B. Interior Door and Panel Faces: Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from the following material:
   1. Cold-rolled steel sheet.

C. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch at jambs and heads, except not more than 1/4 inch between pairs of doors. Not more than 3/4 inch at bottom.

D. Clearances for Fire-Rated Doors: As required by NFPA 80.

E. Single-Acting, Door-Edge Profile: Beveled edge.

F. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

G. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.

H. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

I. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
   1. For concealed overhead door closers, provide space, cutouts, reinforcement, and provisions for fastening in top rail of doors or head of frames, as applicable.

J. Frame Construction: Fabricate frames to shape shown.
   1. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints.
   2. Provide welded frames with temporary spreader bars.
   3. Provide terminated stops where indicated.

K. Reinforce door frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.

L. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

2.5 FINISHES

A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install steel door frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.

B. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
   1. Except for frames located in existing walls or partitions, place frames before construction of enclosing walls and ceilings.
   2. In masonry construction, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
   3. In existing concrete or masonry construction, provide at least three completed opening anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices.
   4. In metal-stud partitions, provide at least three wall anchors per jamb; install adjacent

to hinge location on hinge jamb and at corresponding heights on strike jamb. Attach wall anchors to studs with screws.

5. Install fire-rated frames according to NFPA 80.
6. For openings 90 inches or more in height, install an additional anchor at hinge and strike jambs.

3.2 ADJUSTING AND CLEANING

A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.

END OF SECTION 08 11 00

SECTION 08 14 00 - FLUSH WOOD DOORS June 2, 2008

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. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.

B. Related Sections include the following:
1. Division 8 Section "Glazing" for glass view panels in flush wood doors.

1.3 SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.

B. 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 ratings for fire doors.

C. Samples for Selection: Color charts consisting of actual materials in small sections for the following:
1. Faces of Factory-Finished Doors: Show the full range of colors available for stained finishes.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
1. Test Pressure: Test at atmospheric pressure.
2. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F (250 deg C) maximum in 30 minutes of fire exposure.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

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 building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 75-mm) span.
   1. Warranty shall be in effect during the following period of time from date of Substantial Completion:
      a. Solid-Core Interior Doors: Life of installation.

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:
   1. Flush Wood Doors:
      a. Algoma Hardwoods Inc.
      b. Buell Door Company.
      c. Eggers Industries; Architectural Door Division.
      d. GRAHAM Manufacturing Corp.
      e. Oshkosh Architectural Door Co.
      f. VT Industries Inc.
      g. Weyerhaeuser Company.

2.2 DOOR CONSTRUCTION, GENERAL

A. Doors for Transparent Finish:
   1. Grade: Premium, with Grade AA faces.
   2. Species and Cut: Match existing.
   3. Match between Veneer Leaves: Book match.
   4. Assembly of Veneer Leaves on Door Faces: Running match.
   5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
   6. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.

7. Stiles: Same species as faces.

2.3 SOLID-CORE DOORS

A. Particleboard Cores: Comply with the following requirements:
1. Particleboard: ANSI A208.1, Grade LD-2.
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.

B. Interior Veneer-Faced Doors:
1. Core: Particleboard.
2. Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

C. Fire-Rated Doors:
1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated 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. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.
3. Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.
4. Pairs: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals.

2.4 LIGHT FRAMES

A. Metal Frames for Light Openings in Fire Doors: Manufacturer's standard frame formed of 0.0478-inch- (1.2-mm-) thick, cold-rolled steel sheet; factory primed and approved for use in doors of fire rating indicated.

2.5 FABRICATION

A. Fabricate doors in sizes indicated for Project-site fitting.
1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.

B. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
1. Light Openings: Trim openings with moldings of material and profile indicated.

2.6 FACTORY FINISHING

A. General: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated" for factory finishing.

B. Finish doors at factory.

C. Transparent Finish:
   1. Grade: Premium.
   2. Finish: AWI System TR-6 catalyzed polyurethane.
   3. Staining: As selected by Architect from manufacturer's full range.
   4. Effect: Open-grain finish.
   5. Sheen: Semigloss.

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 8 Section "Door Hardware."

B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, 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 cut surfaces 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. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold.
      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-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 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 08 14 00

SECTION 08 31 00 - ACCESS DOORS AND FRAMES June 2, 2008

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing 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. Wall access doors and frames.
2. Fire-rated wall access doors and frames.
3. Ceiling access doors and frames.
4. Fire-rated ceiling access doors and frames.

B. Related Sections include the following:
1. Division 03 Section "Cast-in-Place Concrete" for blocking out openings for access doors and frames in concrete.
2. Division 04 Section "Unit Masonry Assemblies" for anchoring and grouting access door frames set in masonry construction.
3. Division 07 Section "Roof Accessories" for roof hatches.
4. Division 08 Section "Door Hardware" for mortise or rim cylinder locks and master keying.
5. Division 23 Section "Duct Accessories" for heating and air-conditioning duct access doors.
6. Division 22 Section "Storm Drainage Piping" for connection of floor door drainage couplings to drains.

1.3 SUBMITTALS

A. Product Data: For each type of door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.

B. Shop Drawings: Show fabrication and installation details of customized doors and frames. Include plans, elevations, sections, details, and attachments to other Work.

C. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

D. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following:
1. Method of attaching door frames to surrounding construction.
2. Ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain doors and frames 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 labeled and listed by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction:
   1. NFPA 252 or UL 10B for vertical access doors.
   2. ASTM E 119 or UBC Standard 7.1 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 equipment, and indicate on schedule specified in "Submittals" Article.

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:
   1. Access Doors:
      a. J. L. Industries, Inc.
      b. Larsen's Manufacturing Company.
      c. Milcor Limited Partnership.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), with Class C coating and phosphate treatment to prepare surface for painting; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M for uncoated base metal.

C. 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.

2.3 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

2.4 ACCESS DOORS AND FRAMES

A. Flush, Insulated, Fire-Rated Access Doors and Trimless Frames: Fabricated from steel sheet.
   1. Locations: Gypsum board wall and ceiling surfaces.
   2. Fire-Resistance Rating: One hour and as scheduled.
   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 hinge.
   7. Automatic Closer: Spring type.
   8. Latch: Self-latching bolt operated by knurled knob with interior release.
   9. Lock: Key-operated cylinder lock with interior release.

B. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
   1. Locations: Masonry, concrete and ceramic-tile wall surfaces.
   2. Door: Minimum 0.060-inch- (1.5-mm-) thick sheet metal, set flush with exposed face flange of frame.
   3. Frame: Minimum 0.060-inch- (1.5-mm-) thick sheet metal with 1-inch-(25-mm-) wide, surface-mounted trim.
   4. Hinges: Continuous piano hinge.
   5. Latch: Screwdriver-operated cam latch.
   6. Lock: Key-operated cylinder lock.

C. Flush Access Doors and Trimless Frames: Fabricated from steel sheet.
   1. Locations: Gypsum board 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.
   4. Hinges: Continuous piano hinge.
   5. Latch: Screwdriver-operated cam latch.
   6. Lock: Key-operated cylinder lock.

2.5 FABRICATION

A. General: Provide access door 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. Steel 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. For trimless frames with drywall bead for installation in gypsum board assembly, provide edge trim for gypsum board securely attached to perimeter of frames.
   3. Provide mounting holes in frames to attach frames to framing in drywall construction and to attach masonry anchors in masonry construction. 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.

2.6 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.

2.7 METALLIC-COATED STEEL FINISHES

A. Galvanizing of Steel Shapes and Plates: Hot-dip galvanize items indicated to comply with applicable standard listed below:
   1. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. For galvanized surfaces, apply, after cleaning, a conversion coating suited to the organic coating to be applied over it. For metallic-coated surfaces, clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
   1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. Factory Priming for Field-Painted Finish: Apply shop primer immediately after cleaning and pretreating.

2.8 STEEL FINISHES

A. Surface Preparation: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
   1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

B. Apply shop primer to uncoated surfaces of metal fabrications. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

PART 3 - EXECUTION

3.1 PREPARATION

A. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames and floor doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install access doors with trimless frames and floor doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 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 08 31 00

SECTION 08 41 00 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS June 2, 2008

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. Exterior and interior aluminum-framed storefronts.
   a. Glazing is retained mechanically with gaskets on four sides.
2. Exterior and interior manual-swing aluminum doors.

B. Related Sections include the following:
1. Division 07 Section "Joint Sealants" for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
2. Division 08 Section "Door Hardware" for hardware to the extent not specified in this Section.
3. Division 08 Section "Glazing" for glazing requirements to the extent not specified in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
4. Dimensional tolerances of building frame and other adjacent construction.
5. Failure includes the following:
   a. Deflection exceeding specified limits.
   b. Thermal stresses transferred 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 thermal and structural movements.
   f. Loosening or weakening of fasteners, attachments, and other components.
   g. Sealant failure.
   h. Failure of operating units to function properly.

B. Structural Loads:
1. Wind Loads: As indicated on Drawings.
2. Seismic Loads: As indicated on Drawings.

C. Deflection of Framing Members:
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 directly below to less than 1/8 inch (3.2 mm) and clearance between members and operable units directly below to less than 1/16 inch (1.5 mm).

D. 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 less than 10 seconds.

E. Story Drift: Provide aluminum-framed systems that 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 design displacement.

F. 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. Test High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
      b. Test Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C) .
      c. Test Interior Ambient-Air Temperature: 75 deg F (24 deg C).

G. 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).

H. 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).

I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.

J. Average Thermal Conductance: Provide aluminum-framed systems with fixed glazing and

framing areas having 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.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
   3. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Samples for Selection: For units with factory-applied color finishes.

D. Fabrication Sample: Of each vertical-to-horizontal intersection of systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
   1. Joinery.
   2. Anchorage.
   3. Expansion provisions.
   4. Glazing.
   5. Flashing and drainage.

E. Welding certificates.

F. Qualification Data: For Installer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.

H. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
   1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.

B. 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 modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

C. Accessible Entrances: Comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." and ICC/ANSI A117.1.

D. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

E. Mockups: Build mockups 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 Part 3 "Field Quality Control" Article.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 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. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 WARRANTY

A. Special Assembly 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 deteriorate as defined in this Section 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. Water leakage through fixed glazing and framing areas.
   e. Failure of operating components to function properly.
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 fail within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 20 years from date of Substantial Completion.

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:
   1. EFCO Corporation.
   2. Kawneer.
      a. Equal to: Kawneer VG 451T (Exterior) and VG 451 (Interior).
   3. United States Aluminum.
   4. Vistawall Architectural Products.
   5. Wausau Window and Wall Systems.

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: With manufacturer's standard 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: Framing members are composite assemblies of two separate extruded-aluminum components permanently bonded by an elastomeric material of low thermal conductance.

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. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
   2. Reinforce members as required to receive fastener threads.

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 requirements.

E. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to

match framing and of sufficient thickness to maintain a flat appearance without visible deflection.

F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 8 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

2.5 DOORS

A. Doors: Manufacturer's standard glazed doors, for manual swing operation.
   1. Door Construction: 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch-(4.8-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
   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.
   4. Equal to: Kawneer, 350 Tuffline.

B. Entrance Door Frames: Provide tubular and channel frame entrance door frame assemblies, as indicated, with welded or mechanical joints in accordance with manufacturer's standards. Reinforce as necessary to support required loads. Entrance doors and frames shall be supplied as a complete system. Frames shall be minimum 3/16" wall thickness.

2.6 DOOR HARDWARE

A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.
   1. Opening-Force Requirements:
      a. Egress Doors: Not more than 30 lbf (133 N) required to set door in motion and not more than 15 lbf (67 N) required to open door to minimum required width.
      b. Accessible Interior Doors: Not more than 5 lbf (22.2 N).

B. Scheduled Door Hardware: Provide door hardware according to the Door Hardware Schedule.
   1. Named Manufacturer's Products: Product designation and hardware manufacturer are listed in the Door Hardware Schedule to establish minimum requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware.
      a. Provide named hardware manufacturer's products.
      b. Named products are basis-of-design products. Provide named hardware

manufacturer's products or comparable products that are equivalent in function and quality and that are recommended and supplied by entrance system manufacturer.

2. References to BHMA Standards: Provide products complying with standards referenced in this Article and with requirements for description, quality, type, and function listed in the Door Hardware Schedule.

C. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles; fabricated to full height of door and frame.
   1. Equal to: Pemko, PemkoHinge, Heavy-Duty.

D. Locking Devices, General: Do not require use of key, tool, or special knowledge for operation.
   1. Opening-Force Requirements:
      a. Latches and Exit Devices: Not more than 15 lbf (67 N) required to release latch.

E. Manual Flush Bolts: BHMA A156.16, Grade 1.

F. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
   1. Standard: BHMA A156.3, Grade 1.
   2. Provide panic exit devices with request to exit feature, where indicated.
   3. Provide panic exit devices matching those in Section 08710 - Door Hardware.

G. Cylinders: As specified in Division 8 Section "Door Hardware."

H. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

I. Operating Trim: BHMA A156.6.

J. Removable Mullions:
   1. Standard: BHMA A156.3.
   2. 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.
   3. Equal to: Von Duprin 5754 with weatherstripping and 154 stabilizer set.

K. Surface-Mounted Overhead Closers: Modern type with cover, for parallel-arm-type mounting installation. Comply with ANSI A156.4, Grade 1. Comply with manufacturer=s recommendations for closer size, depending on door size, exposure to weather and anticipated frequency of use.
   1. Equal to LCN P4041-EDA.

L. Surface-Mounted Overhead Closers: ANSI/BHMA A156.4, Grade 1. Provide cover and the following:
   1. Mounting: Parallel arm.
   2. Hold Open: Automatic, at angle selected by Architect from manufacturer=s standard options.
   3. Back Check: Adjustable.
   4. Equal to: LCN P4041-EDA H, 180 degree mounting where indicated

M. Pull Handles: Aluminum pull handles of style indicated thru bolted through door.
   1. Equal to: Forms+Surfaces, DT1221.

N. Push Bars: Manufacturer's standard full-door-width single-bar push bar.
   1. Equal to: Forms+Surfaces, DT1211.

O. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

P. Weather Stripping: Manufacturer's standard replaceable components.
   1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.

Q. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

R. Thresholds: Raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (13 mm).
   1. Standard: BHMA A156.21.

S. Remote Pedestal-Mounted Switch: Manufacturer's standard pedestal-mounted, door control switch; consisting of rectangular, flat push plate; of material indicated; and actuator mounted in junction box. Provide engraved message as indicated.
   1. Material: Stainless steel.
   2. Message: International symbol of accessibility and "Push to Open."
   3. Mounting: Pedestal.

2.7 HARDWARE SCHEDULE

A. Furnish the following items in the amounts indicated on the drawings and schedules or for a complete and operable facility:
   1. Provide door hardware in accordance with the schedule in Section 08 71 00 – Door Hardware.

2.8 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."

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.

2.9 FABRICATION

A. Form 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 occurring 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 exterior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Door Frames: Reinforce as required to support loads imposed by door operation and for installing 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.

E. Doors: Reinforce doors as required for installing hardware.
1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

F. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
1. Color: Match existing.

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 work.
1. 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 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 the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, without warp or rack.

F. Install glazing as specified in Division 8 Section AGlazing.@

G. Entrances: Install to produce smooth operation and tight fit at contact points.
   1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
   2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" and to produce weathertight installation.

I. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum 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).
   3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch (3 mm).

3.3 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. 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 stages 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. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under Part 1 "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).
2. 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 Part 1 "Performance Requirements" Article, but not less than 4.18 lbf/sq. ft. (200 Pa), and shall not evidence water penetration.

C. Repair or remove work where 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.

3.4 ADJUSTING

A. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.

1. For 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 08 41 00

SECTION 08 71 00 - DOOR HARDWARE

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. Commercial door hardware for the following:

   a. Swinging doors.
   b. Fire-rated swinging doors.
   c. Other doors to the extent indicated.

2. Cylinders for doors specified in other Sections.

B. Related Sections include the following:

1. Division 08 Section "Hollow Metal Doors and Frames" for astragals provided as part of fire-rated labeled assemblies and for door silencers provided as part of hollow-metal frames.
2. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for interior vestibule storefront doors.
3. Division 08 Section "Flush Wood Doors" for astragals and integral intumescent seals provided as part of fire-rated labeled assemblies.

C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

1. Thresholds, weather stripping, and cylinders for locks specified in other Sections.

1.3 SUBMITTALS

A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Verification: For exposed door hardware of each type, in specified finish, full size. Tag with full description for coordination with the door hardware sets. Submit Samples before, or concurrent with, submission of the final door hardware sets, if requested.

1. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

C. Qualification Data: For Installer.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for locks, latches, and closers as requested.

E. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

F. Warranty: Special warranty specified in this Section.

G. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
2. Content: Include the following information:

a. Identification number, location, hand, fire rating, and material of each door and frame.
b. Type, style, function, size, quantity, and finish of each door hardware item.
c. Complete designations of every item required for each door or opening including name and manufacturer.
d. Fastenings and other pertinent information.
e. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
f. Explanation of abbreviations, symbols, and codes contained in schedule.
g. Mounting locations for door hardware.
h. Door and frame sizes and materials.
i. List of related door devices specified in other Sections for each door and frame.

3. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
2. Installer shall have warehousing facilities in Project's vicinity.
3. Scheduling Responsibility: Preparation of door hardware and keying schedules.
4. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services

for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 and UBC Standard 7-2.

1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1016 mm) or less above the sill.

E. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to Owner’s Representative by registered mail or overnight package service.

1.6 COORDINATION

A. Coordinate layout and installation of recessed hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Coordinate with aluminum entrance door supplier for door hardware installation.

D. Existing Openings: Where new hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide for proper operation.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of operators and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: One (1) years from date of Substantial Completion, except as follows:
a. Exit Devices: Five (5) years from date of Substantial Completion.
b. Manual Closers: Ten (10) years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. 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 door hardware.

B. Maintenance Service: Beginning at Substantial Completion, provide six (6) months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Products:

a. Finish: Shall be 613/US10B Oil Rubbed Bronze at Aluminum doors; 612/US10 Satin Bronze at other interior doors, unless otherwise noted.
b. Manufacture Standard:

1) Butts: Hager, McKinney, Stanley, Ives*
2) Narrow Style Locksets: Adams Rite*
3) Closers: LCN 4041*, Corbin DC8000, Sargent 281
4) Exit Devices: Sargent 8800*, Von Duprin 98, Precision Apex
5) Trim: BBW, Rockwood, Hager, Ives*
6) Weatherstrip: Pemko, Hager, National Guard*
7) Continuous Hinges: HagerRoton, Markar, Ives*

B. Substitution requests will be made in accordance with Division 01 requirements.

2.2 SCHEDULED HARDWARE

A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:

1. Manufacturer's Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one manufacturer is specified under the Article "Manufacturers" in Part 2 for each hardware type, the comparable product of one of the other manufacturers that complies with requirements.

2. ANSI/BHMA designations used elsewhere in this Section or in schedules to describe hardware items or to define quality or function are derived from the following standards. Provide products complying with these standards and requirements specified elsewhere in this Section.

    a. Butts and Hinges: ANSI A156.1.
    b. Bored and Preassembled Locks and Latches: ANSI/BHMA A156.2.
    c. Exit Devices: ANSI A156.3.
    d. Door Controls - Closers: ANSI A156.4. 180 degree swing only!
    e. Auxiliary Locks and Associated Products: ANSI/BHMA A156.5.
    f. Architectural Door Trim: ANSI A156.6.
    g. Template Hinge Dimensions: ANSI A156.7.
    h. Door Controls - Overhead Holders: ANSI A156.8.
    i. Mortise Locks and Latches: ANSI A156.13.
    j. Closer Holder Release Devices: ANSI A156.15.
    k. Auxiliary Hardware: ANSI A156.16.
    l. Self-Closing Hinges and Pivots: ANSI A156.17.
    m. Materials and Finishes: ANSI A156.18.

2.3 MATERIALS AND FABRICATION

A. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

B. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

C. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.

D. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.4 HINGES, GENERAL

A. Quantity: Provide the following, unless otherwise indicated:

1. Two Hinges: For doors with heights up to 60 inches.
2. Three Hinges: For doors with heights 61 to 90 inches.

B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

C. Hinge Weight: Unless otherwise indicated, provide the following:

1. Entrance Doors: Heavy-weight hinges.
2. Doors with Closers: Antifriction-bearing hinges.
3. Interior Doors: Standard-weight hinges.

D. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior Hinges: Stainless steel with stainless-steel pin.
2. Interior Hinges: Steel with steel pin.
3. Hinges for Fire-Rated Assemblies: Steel with steel pin.

E. Hinge Options: Where indicated in door hardware sets or on Drawings:

1. Safety Stud: Designed for stud in one leaf to engage hole in opposing leaf.
2. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for out-swinging doors.
3. Corners: Square.

F. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Wood Screws: For wood doors and frames.
3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.

2.5 CONTINUOUS HINGES

A. Hinges shall be a geared continuous hinge utilizing a single gear section for the door leaf and a separate gear section for the frame side of the door. The door leaf and jamb leaf shall fully mortised where scheduled, and full surface where scheduled. Geared hinges are to be certified to ANSI 156.25, Grade 2 and UL 10C tested and approved for 90 minutes.

2.6 LOCKS, LATCHES, AND BOLTS

A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.

B. Lock Throw: Provide 5/8-inch (16-mm) minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.

C. Flush Bolt Heads: Minimum of 1/2-inch- (13-mm-) diameter rods of brass, bronze, or stainless steel with minimum 12-inch- (300-mm-) long rod for doors up to 84 inches (2100 mm) in height. Provide longer rods as necessary for doors exceeding 84 inches (2100 mm) in height.

2.7 KEYING REQUIREMENTS

A. Furnish temporary keyed cores for the construction period, and remove these when directed. The construction cores remain property of the supplier and shall be returned to the supplier when they are removed.

B. Key Cylinders: Small format interchangeable core, utility patented, 7-pin solid brass construction.

C. Permanent Cores: Furnish “0” bitted cores to Owner for keying by Owner.

D. Permanent Keys: Furnished by Owner.

2.8 PUSH/PULL UNITS

A. Exposed Fasteners: Provide manufacturer's standard exposed fasteners for installation, thru-bolted.

2.9 CLOSERS

A. Accessibility Requirements: Where handles, pulls, latches, locks and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural Transportations Barriers Compliance Board’s “Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG).”

1. Comply with the following maximum opening-force requirements:

   a. Interior, Non-fire-rated Hinged Doors: 5 lbf applied perpendicular to door.
   b. Fire Doors: Minimum opening force allowable by Authorities Having Jurisdiction (AHJ).

B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15lbf to open door to minimum required width.

C. Cylinder: Shall be of high strength cast iron construction. All door exterior closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified independent testing laboratory. Cylinder shall have been manufactured and in the marketplace for a minimum of 10 years

D. Size of Units: Unless otherwise indicated, comply with manufacturer’s written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory sized closers, adjustable to meet field conditions and requirements for opening force.

E. Surface Closers: BHMA A156.4 Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Thru-bolts at wood doors unless doors are provided with closer blocking. Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.
4. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.

5. Opening pressure: Exterior doors 8.5 lb., interior doors 5 lb., labeled fire doors 15 lb.
6. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
7. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
8. Exterior doors do not require seasonal adjustments in temperatures from 120 degrees F to -30 degrees F, furnish data on request.
9. Non-flaming fluid will not fuel door or floor covering fires.
10. Pressure relief values are not allowed.

2.10 EXIT DEVICES/PANIC HARDWARE

A. General features: BHMA A156.3, Grade 1.

B. Accessibility Requirements: Where handles, pulls, latches, locks and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural Transportations Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.

C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15lbf to release the latch. Locks shall not require use of a key, tool of special knowledge for operation.

D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to AHJ for panic protection, based on testing according to UL 305.

1. Push-through touch pad design. No exposed touch bar fasteners, no exposed cavities when operated. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.
2. No exposed screws to show through glass doors.
3. Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.

E. Specific features:

1. Non-Fire Rated Devices: Cylinder Dogging.
2. Lever Trim: Forged brass or bronze escutcheon min .130" thickness, match lockset lever design.
3. Fire-Labeled Devices: UL label indicating "Fire Exit Hardware". Vertical rod devices less bottom rod (LBR) unless otherwise scheduled.
4. Furnish all exit devices with deadlocking latchbolts.
5. End caps shall be sloped and of heavy-duty metal alloy construction and provide horizontal adjustment to provide flush alignment with device cover plate. When device end cap is installed, no raised edges will protrude. End cap shall be cast metal or forged aluminum and have a minimum thickness of (.250"). Plastic or metal stamping will not be acceptable.
6. Provide all shim kits and filler plates to allow flush mounting of exit devices on all types of doors used in this project.
7. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key.

2.11 TRIM AND STOPS

A. Kick plates, mop plates, and armor plates, shall be .050 gauge . Kick plates to be 10” high, mop plates to be 5” high. All plates shall be two (2) inches less full width of door.

B. Push plates, pull plates, door pulls, and miscellaneous door trim shall be shown in the hardware schedule.

C. Doorstops shall be furnished for all doors to prevent damage to doors or hardware from striking adjacent walls or fixtures. Wall stops are preferred. Floor stops are used only where noted in hardware schedule. Where conditions prohibit the use wall type stops, furnish overhead stops either surface mounted or concealed as noted in hardware sets.

2.12 WEATHERSTRIPPING AND SEALS

A. General: Provide continuous weatherstripping on exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.13 THRESHOLDS

A. General: Except as otherwise indicated, provide standard metal threshold unit of type, size, and profile as shown or scheduled.

2.14 HARDWARE FINISHES

A. Match items to the manufacturer's standard color and texture finish for the latch and locksets (or push-pull units if no latch or lock sets).

B. Provide finishes that match those established by BHMA or, if none established, match the Architect's sample.

C. 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.

D. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: Comply with DHI A115 Series.

1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

B. Wood Doors: Comply with DHI A115-W Series.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated, as follows, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.7 DOOR HARDWARE SETS

A. Manufacturer Legend:

1. (ADA) Adams Rite
2. (BYO) By Others
3. (BES) Best Access Systems
4. (GLY) Glynn Johnson
5. (IVE) Ives
6. (LCN) LCN
7. (NGP) National Guard Products
8. (SAR) Sargent

HW SET: 001
EXTERIOR (ALUMINUM)

EACH TO HAVE:

2	EA	CONTINUOUS HINGE	112HD	313	IVE
2	EA	MANUAL FLUSH BOLT	FB458	613	IVE
1	EA	DUST PROOF STRIKE	DP1	613	IVE
1	EA	DEADBOLT LEVER	4550	313	ADA
1	EA	DEADLOCK	MS1850S (PROVIDE BACKSET)	313	ADA
1	EA	MORTISE CYLINDER	1E74	613	BES
2	EA	PULL/PUSHBAR	9190-0	313	IVE
2	EA	SURFACE CLOSER	4041 SHCUSH X 18 X 30 X 61 X MC	695	LCN
1	EA	THRESHOLD	896S		NGP
1	SET	MEETING STILE	BY DOOR MFG		BYO
2	EA	DOOR SWEEP	BY DOOR MFG		BYO
1	SET	SEALS	BY DOOR MFG		BYO

HW SET: 101
CORR FR DANCE STUDIO- RATED

EACH TO HAVE:

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	639	IVE

1	EA	EXIT DEVICE	12-GL- 8813 X ETL X TB	612	SAR
1	EA	MORTISE CYLINDER	1E74	612	BES
1	EA	SURFACE CLOSER	4041 EDA X MC X TB	690	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	612	IVE
1	EA	WALL STOP	WS401CCV	612	IVE
1	SET	SEALS	155V		NGP

HW SET: 102
CORR TO STORAGE (ALUMINUM)

EACH TO HAVE:

2	EA	CONTINUOUS HINGE	112HD	313	IVE
1	EA	DUST PROOF STRIKE	DP2	613	IVE
1	SET	HEAD/THRESHOLD BOLT	4015 X 4085	313	ADA
1	EA	DEADBOLT LEVER	4550	313	ADA
1	EA	DEADLOCK	MS1850S (PROVIDE BACKSET)	313	ADA
1	EA	MORTISE CYLINDER	1E74	613	BES
2	EA	PULL/PUSHBAR	9190-0	313	IVE
2	EA	SURFACE CLOSER	4041 X 18TJ X MC X ST	695	LCN
2	EA	OVERHEAD STOP	100S-ADJ	613	GLY
1	SET	SEALS	BY DOOR MFG		BYO

END OF SECTION 08 71 00

SECTION 08 80 00 - GLAZING June 2, 2008

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 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. Storefront framing.

1.3 DEFINITIONS

A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.

B. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

C. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

D. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for 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.

E. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for 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.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for

various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
   a. Specified Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour (meters per second) at 33 feet (10 m) above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.4.2, "Analytic Procedure," based on mean roof heights above grade indicated on Drawings.
   b. Specified Design Snow Loads: As indicated, but not less than snow loads applicable to Project, required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7, "Snow Loads."
   c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
      1) Load Duration: 60 seconds or less.
   d. Maximum Lateral Deflection: For the following types of glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch (25 mm), whichever is less.
      1) For monolithic-glass lites heat treated to resist wind loads.
      2) For insulating glass.
   e. Minimum Glass Thickness for Exterior Lites: Not less than 6 mm.
   f. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. 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. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
   2. For insulating-glass units, properties are based on units with lites 6 mm thick and a nominal 1/2-inch- (13-mm-) wide interspace.
   3. Center-of-Glass U-Values: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer program, expressed as Btu/ sq. ft. x h x deg F (W/sq. m x K).
   4. Center-of-Glass Solar Heat Gain Coefficient: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer program.
   5. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: For the following products, in the form of 12-inch- (300-mm-) square Samples for glass and of 12-inch- (300-mm-) long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
   1. Insulating glass for each designation indicated.
   2. For each color (except black) of exposed glazing sealant indicated.

C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

E. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

F. Product Test Reports: From a qualified testing agency indicating the following products comply with requirements, based on comprehensive testing of current products:
   1. Insulating glass.
   2. Glazing sealants.
   3. Glazing gaskets.

G. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).

B. Source Limitations for Clear Glass: Obtain clear float glass from one primary-glass manufacturer.

C. Source Limitations for Insulating Glass: Obtain insulating-glass units from one manufacturer using the same type of glass and other components for each type of unit indicated.

D. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.

E. Source Limitations for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.

F. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
   1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

G. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
   1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
   2. Test elastomeric glazing sealants for compliance with requirements specified by

reference to ASTM C 920, and where applicable, to other standard test methods.

H. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glass type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants.
   1. Use manufacturer's standard test methods to determine whether priming and other specific preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
      a. Perform tests under normal environmental conditions replicating those that will exist during installation.
   2. Submit not fewer than nine pieces of each type and finish of glass-framing members and each type, class, kind, condition, and form of glass (monolithic, laminated, and insulating units) as well as one sample of each glazing accessory (gaskets, tape sealants, setting blocks, and spacers).
   3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
   4. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
   5. Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.

I. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
   1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

J. 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. GANA Publications: GANA'S "Glazing Manual" and "Laminated Glass Design Guide."
   2. SIGMA Publications: SIGMA TM-3000, "Vertical Glazing Guidelines," and SIGMA TB-3001, "Sloped Glazing Guidelines."

K. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following inspecting and testing agency:
   1. Insulating Glass Certification Council.
   2. Associated Laboratories, Inc.
   3. National Accreditation and Management Institute.

L. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

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 liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C).

1.9 WARRANTY

A. General Warranty: Special warranties 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. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

C. Manufacturer's Special Warranty on Insulating Glass: Written warranty, made out to Owner and signed by insulating-glass manufacturer agreeing to furnish replacements for insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: 10 years from date of Substantial Completion.

D. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in schedules at the end of Part 3.

2.2 PRIMARY FLOAT GLASS

A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); class as indicated in schedules at the end of Part 3.

B. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), and

complying with other requirements specified.

C. Laminated Glass: ASTM C 1172, and complying with other requirements specified and with the following:
   1. Interlayer: Polyvinyl butyral of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
      a. For polyvinyl butyral interlayers, laminate lites in autoclave with heat plus pressure.
   2. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.

2.3 HEAT-TREATED FLOAT GLASS

A. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select); class, kind, and condition as indicated in schedules at the end of Part 3.

2.4 INSULATING GLASS

A. Insulating-Glass Units: Preassembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in the Insulating-Glass Schedule at the end of Part 3.
   1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article. Provide Kind FT (fully tempered) where safety glass is indicated.

B. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in the Insulating-Glass Schedule at the end of Part 3 are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

C. Sealing System: Dual seal, with primary and secondary sealants as follows:
   1. Polyisobutylene and hot-melt butyl.

D. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
   1. Aluminum with mill or clear-anodized finish.
   2. Desiccant: Molecular sieve or silica gel, or blend of both.
   3. Corner Construction: Manufacturer's standard corner construction.

2.5 FIRE-RATED GLAZING PRODUCTS

A. Equal to FireLite®Plus as manufactured by Nippon Electric Glass Company, Ltd., and distributed by Technical Glass Products, Kirkland, Washington and meeting the following requirements:
   1. Thickness: 5/16 inch overall.
   2. Weight: 4 lbs./sq. ft.
   3. Approximate Visible Transmission: 85 percent.
   4. Approximate Visible Reflection: 9 percent.

5. Fire-rating: 45 minutes.
6. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
7. Surface Finish: Premium (polished).

B. Labeling: Permanently label each piece of FireLite®Plus with the FireLite® logo, UL logo and fire rating in sizes up to 3,325 sq. in., and with the FireLite label only for sizes that exceed the listing (as approved by the local authority having jurisdiction).

C. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent.

2.6 ELASTOMERIC GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:
1. Compatibility: Select 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. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range for this characteristic.

B. Elastomeric Glazing Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied, chemically curing sealant in the Glazing Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.
1. Additional Movement Capability: Where additional movement capability is specified in the Glazing 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 time of installation and remain in compliance with other requirements in ASTM C 920 for uses indicated.

C. Glazing Sealant for Fire-Resistive Glazing Products: Identical to product used in test assembly to obtain fire-protection rating.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; 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; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

B. Expanded Cellular Glazing Tape: Closed-cell, PVC foam tape; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
1. Type 1, for glazing applications in which tape acts as the primary sealant.
2. Type 2, for glazing applications in which tape is used in combination with a full bead

of liquid sealant.

2.8 GLAZING GASKETS

A. 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.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
   1. Neoprene.
   2. EPDM.
   3. Silicone.
   4. Thermoplastic polyolefin rubber.
   5. Any material indicated above.

2.9 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 A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer 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.

2.10 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze 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 standard, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.

C. Grind smooth and polish exposed glass edges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, 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 system.
   3. Minimum required face or 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.

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. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

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 sealant-substrate 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 the length plus width is larger than 50 inches (1270 mm) as follows:
   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. 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.

K. 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. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these 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 just 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. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance 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. 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. 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 PROTECTION AND CLEANING

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, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended 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 build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including 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 by glass manufacturer.

3.9 MONOLITHIC FLOAT-GLASS SCHEDULE

A. Uncoated Clear Float Glass: Where glass as designated below is indicated, provide Type I (transparent glass, flat), Class 1 (clear) glass lites complying with the following:
   1. Uncoated Clear Annealed Float Glass: Annealed or Kind HS (heat strengthened), Condition A (uncoated surfaces) where heat strengthening is required to resist thermal stresses induced by differential shading of individual glass lites and to comply with performance requirements.
   2. Uncoated Clear Heat-Strengthened Float Glass: Kind HS (heat strengthened).
   3. Uncoated Clear Fully Tempered Float Glass: Kind FT (fully tempered).

3.10 LAMINATED-GLASS UNITS

A. Heat-Treated Laminated-Glass Units:
   1. Kind LHS, consisting of two lites of heat-strengthened float glass.
   2. Outer Lite: Class 1 clear float glass.
      a. Kind HS (heat strengthened).
      b. Thickness: 3.0 mm.
   3. Inner Lite: Class 1 (clear) float glass.
      a. Kind HS (heat strengthened).
      b. Thickness: 3.0 mm.
   4. Plastic Interlayer:
      a. Thickness: 0.060 inch (1.52 mm), but not less than that required to comply as a Type II safety glass material.
      b. Interlayer Color: Clear.

3.11 INSULATING-GLASS SCHEDULE

A. Insulating Glass: Where glass of this designation is indicated, provide uncoated insulating-glass units complying with the following:
   1. Overall Unit Thickness and Thickness of Each Lite: 25 and 6 mm
   2. Interspace Content: Air.
   3. Indoor Lite: Type I (transparent glass, flat), Class 1 (clear) float glass.
      a. Kind HS (heat strengthened), Condition A (uncoated surfaces).
   4. Outdoor Lite: Type I (transparent glass, flat) float glass.
      a. Class 2 (tinted).
         1) Tint Color: Match existing.
      b. Kind HS (heat strengthened), Condition A (uncoated surfaces) or Kind FT (fully tempered), Condition A (uncoated surfaces).
   5. Visible Light Transmittance: 47%
   6. Visible Light Reflectance: 9%
   7. Winter Nighttime U-Value: 0.47
   8. Summer Daytime U-Value: 0.50
   9. Solar Heat Gain Coefficient: 0.51
   10. Shading Coefficient: 0.59

3.12 INFILL COMPOSITE PANEL

A. Composite Panel: Where indicated, provide composite panels consisting of two (2) sheets of smooth faced aluminum, minimum 0.0625 inches thick, bonded to a high density tempered hardboard on each face, and with a core of minimum 1.7 lb. density polyisocyanurate insulation. Panel thickness shall be 1 inch total overall thickness and have a minimum R-Value of 6.41. Provide High-Performance Organic Finish (3-Coat Fluoropolymer) to match adjacent storefront and curtainwall framing. Panels equal to Mapes Industries, Inc.

3.13 GLAZING SEALANT SCHEDULE

A. Low-Modulus Nonacid-Curing Silicone Glazing Sealant: Where glazing sealants of this designation are indicated, provide products complying with the following:
   1. Products: Available products include the following:
      a. 790; Dow Corning.

b. UltraPruf SCS2300; GE Silicones.
c. Spectrem 1; Tremco.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Additional Movement Capability: 50 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.
5. Use Related to Exposure: NT (nontraffic).
6. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.
   a. Use O Glazing Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and wood.

END OF SECTION 08 80 00

SECTION 08 83 00 - MIRRORS June 2, 2008

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 types of silvered flat glass mirrors.
   1. Tempered glass mirrors qualifying as safety glazing.

B. Related Sections include the following:
   1. Division 10 Section "Toilet and Bath Accessories" for metal-framed mirrors.

1.3 DEFINITIONS

A. Deterioration of Mirrors: Defects developed from normal use that are attributable to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning mirrors contrary to mirror manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1.4 PERFORMANCE REQUIREMENTS

A. Provide mirrors that will not fail under normal usage. Failure includes glass breakage and deterioration attributable to defective manufacture, fabrication, and installation.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
   2. Mirror mastic.
   3. Mirror hardware.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.

C. Samples: For each type of mirror product required, in the form indicated below:
   1. Mirrors, 12 inches (300 mm) square, including edge treatment on 2 adjoining edges.
   2. Mirror clips.
   3. Mirror trim, 12 inches (300 mm) long.

D. Product Certificates: For each type of mirror and mirror mastic, signed by product manufacturer.

E. Qualification Data: For Installer.

F. Mirror Mastic Compatibility Test Reports: From mirror manufacturer indicating that mirror

mastic was tested for compatibility and adhesion with mirror backing paint and substrates on which mirrors are installed.

G. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed mirror glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in mirror installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under NGA's Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).

B. Source Limitations for Mirrors: Obtain mirrors from one source for each type of mirror indicated.

C. Source Limitations for Mirror Glazing Accessories: Obtain mirror glazing accessories from one source for each type of accessory indicated.

D. Glazing Publications: Comply with the following published recommendations:
   1. GANA's "Glazing Manual" unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.
   2. GANA Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

E. Safety Glazing Products: For tempered mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.

F. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing paint and substrates on which mirrors are installed.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors, protected from moisture including condensation.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form, made out to Owner and signed by mirror manufacturer agreeing to replace mirrors that deteriorate as defined in "Definitions" Article,

f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below:

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRROR MATERIALS

A. Tempered Clear Glass Mirrors: Comply with ASTM C 1503, Mirror Glazing Quality, for blemish requirements in annealed float glass before silver coating is applied, for coating requirements, and with other requirements not affected by tempering process; and comply with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.

1. Nominal Thickness: Not less than 6.0 mm.

2.2 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Type A Shore durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

C. Mirror Mastic: An adhesive setting compound, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

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. Gunther Mirror Mastics.
   b. Palmer Products Corporation.

2.3 MIRROR HARDWARE

A. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
3. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Bottom Trim:
      1) Laurence, C. R. Co., Inc.; CRL Standard "J" Channel.
   b. Top Trim:
      1) Laurence, C. R. Co., Inc.; CRL Deep "J" Channel.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.4 FABRICATION

A. Mirror Sizes: To suit Project conditions, and before tempering, cut mirrors to final sizes and shapes.

B. Cutouts: Fabricate cutouts before tempering for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance.
   1. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.
   2. Proceed with mirror installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating surfaces with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

B. Provide a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. For wall-mounted mirrors, install mirrors with mastic and mirror hardware.
   1. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
   2. For mirror hardware in the form of continuous J-channels at bottom, provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, 2 slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long.
   3. For mirror hardware in the form of a continuous J-channel at bottom and continuous top trim at top, fasten J-channel directly to wall and attach top trim to continuous cleat fastened directly to wall.
   4. Where indicated, install mirror hardware in the form of J-channels that are fabricated

in single lengths to fit and cover top and bottom edges of mirrors.

5. Install mastic as follows:
   a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
   b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
   c. After mastic is applied, align mirrors and press into place while maintaining a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

END OF SECTION 08 83 00

SECTION 08 91 00 - LOUVERS AND VENTS June 2, 2008

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. Section Includes:

1. Fixed, formed-metal louvers.

B. Related Sections:

1. Division 08 Section "Steel Doors and Frames" for louvers in hollow-metal doors.
2. Division 08 Section "Flush Wood Doors" for louvers in flush wood doors.
3. Division 23 Sections for louvers that are a part of mechanical equipment.
4. Division 26 Sections for electrical power connections for motor-operated adjustable louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.

C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

D. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

B. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.
3. Wiring Diagrams: For power, signal, and control wiring for motorized adjustable louvers.

C. Samples for Selection: For units with factory-applied color finishes.

D. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.3, "Structural Welding Code - Sheet Steel."

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

D. UL and NEMA Compliance: Provide motors and related components for motor-operated louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Galvanized-Steel Sheet: ASTM A 653/A 653M, [G60 (Z180)] [G90 (Z275)] zinc coating, mill phosphatized.

B. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

C. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide subsills made of same material as louvers or extended sills for recessed louvers.

F. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, FORMED-METAL LOUVERS

A. Horizontal, Drainable-Blade Louver:

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. Airolite Company, LLC (The).
   b. Construction Specialties, Inc.
      1) Equal to: Model GS-410.
   c. Greenheck Fan Corporation.
   d. Ruskin Company; Tomkins PLC.

2. Louver Depth: 4 inches (100 mm).
3. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than 0.064 inch (1.63 mm).
4. Mullion Type: Exposed.
5. Louver Performance Ratings:

   a. Free Area: Not less than 6.8 sq. ft. (0.676 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
   b. Point of Beginning Water Penetration: Not less than 862 fpm (4.38 m/s).
   c. Air Performance: Not more than 0.07-inch wg (17.4-Pa) static pressure drop at 662-fpm (3.36-m/s) free-area intake velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 ADJUSTABLE, FORMED-METAL LOUVERS

A. Louver Operation: Provide adjustable louvers with operating mechanisms to suit louver sizes.
   1. Motor operation with 2-position, spring-return application (with power on, motor opens louver; with power off, spring closes louver); 110-V, 60-Hz motor and limit switch; equipped with frame-mounted switch.

B. Single-Blade, Adjustable Louver:

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. Airolite Company, LLC (The).
   b. Greenheck Fan Corporation.
   c. Ruskin Company; Tomkins PLC.

2. Louver Depth: 4 inches (100 mm).
3. Blade Type: Drainable.
4. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than 0.064 inch (1.63 mm).
5. Accessories: Equip louvers as follows:

   a. Vinyl blade-edge gaskets for each louver blade.
   b. Stainless-steel jamb seals or vinyl blade-end gaskets.

6. Louver Performance Ratings:

   a. Free Area: Not less than 6.5 sq. ft. (0.60 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
   b. Point of Beginning Water Penetration: Not less than 862 fpm (4.38 m/s).
   c. Air Performance: Not more than 0.07-inch wg (17.4-Pa) static pressure drop at 662-fpm (3.36-m/s) free-area intake velocity.

7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.5 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

   1. Screen Location for Fixed Louvers: Interior face.
   2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

   1. Metal: Same kind and form of metal as indicated for louver to which screens are attached.
   2. Finish: Same finish as louver frames to which louver screens are attached.
   3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Galvanized-Steel Louvers:

   1. Bird Screening: Galvanized steel, 1/2-inch- (13-mm-) square mesh, 0.041-inch (1.04-mm) wire.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.7 GALVANIZED-STEEL SHEET FINISHES

A. Finish louvers after assembly.

B. Surface Preparation: 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 repair according to ASTM A 780.

C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat. Comply with coating

manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 91 00

DIVISION 09 - FINISHES

Section 09 22 16	Non-Load-Bearing Steel Framing
Section 09 29 00	Gypsum Board
Section 09 64 00	Wood Flooring
Section 09 65 19	Resilient Floor Tile
Section 09 68 00	Carpet
Section 09 91 00	Painting

SECTION 09 22 16 - NON-LOAD-BEARING STEEL FRAMING June 2, 2008

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 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 07 Section "Building Insulation" for insulation installed with Z-shaped furring members.
   2. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall joint systems installed with non-load-bearing steel framing.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

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. 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 zinc coating, 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. 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. Flat Hangers: Steel sheet, minimum 1 by 3/16 inch (25.4 by 4.76 mm) by length indicated.

E. 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: Minimum 1-1/2 inches (38 mm).

F. Furring Channels (Furring Members):
1. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.
a. Minimum Base Metal Thickness: Minimum 0.0312 inch (0.79 mm).
2. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.
a. Equal to: RSIC-1 as manufactured by PAC International, Inc.

G. 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:
a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation.
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: Minimum 0.0312 inch (0.79 mm).

B. Slip-Type Head Joints: Where indicated, provide one of the following:
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:
1) Steel Network Inc. (The); VertiClip SLD/VertiTrack VTD Series.

C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width

indicated.
1. Minimum Base-Metal Thickness: Minimum 0.0312 inch (0.79 mm).

D. 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: Minimum 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.

E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base Metal Thickness: Minimum 0.0312 inch (0.79 mm).
2. Depth: 7/8 inch (22.2 mm).

F. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.
1. Equal to: RSIC-1 as manufactured by PAC International, Inc.

G. 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: Minimum 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.

H. 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 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
   1. 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, cabinets and casework, 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.

3.3 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.

3.4 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.

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.
   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. 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 7 Section "Building 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.

END OF SECTION 09 22 16

SECTION 09 29 00 - GYPSUM BOARD June 2, 2008

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. Interior gypsum board.
2. Exterior gypsum board.

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 07 Section "Building Insulation" for insulation and vapor retarders installed in assemblies that incorporate gypsum board.
3. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall assemblies that incorporate gypsum board.
4. Division 07 Section "Joint Sealants" for acoustical sealants installed in assemblies that incorporate gypsum board.
5. Division 09 Section "Non-Load-Bearing Steel Framing" for non-structural framing and suspension systems that support gypsum board.
6. 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.

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.

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. 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:
      a. American Gypsum Co.
      b. BPB America Inc.
      c. G-P Gypsum.
      d. National Gypsum Company.
      e. PABCO Gypsum.
      f. USG Corporation.

B. Type X:
   1. Thickness: 5/8 inch (15.9 mm).
   2. Long Edges: Tapered.

C. Special Type X: Having improved fire resistance over standard Type X, and complying with requirements of fire-resistance-rated assemblies indicated on Drawings.
   1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
   2. Long Edges: Tapered.

2.3 EXTERIOR GYPSUM BOARD

A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M.
   1. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum.
   2. Core: 5/8 inch (15.9 mm), Type X.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
   2. Shapes:
      a. Cornerbead.
      b. Bullnose bead.
      c. LC-Bead: J-shaped; exposed long flange receives joint compound.
      d. L-Bead: L-shaped; exposed long flange receives joint compound.
      e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
      f. Expansion (control) joint.
      g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
   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. Fry Reglet Corp.
      b. Gordon, Inc.
      c. Pittcon Industries.
   2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
   3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Wallboard: Paper.
   2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

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, rounded or 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.
   3. Fill Coat: For second coat, use drying-type, all-purpose compound.
   4. Finish Coat: For third coat, use drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:
   1. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

2.6 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. Acoustical Sealant: As specified in Division 7 Section "Joint Sealants."

E. Thermal Insulation: As specified in Division 7 Section "Building Insulation."

F. Vapor Retarder: As specified in Division 7 Section "Building 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.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
1. Type X: Vertical surfaces, unless otherwise indicated.
2. Special Type X: Where required for specific fire-resistance-rated assembly indicated.

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 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 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.

E. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.4 APPLYING EXTERIOR GYPSUM PANELS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
1. Install with 1/4-inch (6.4-mm) open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.5 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 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. Bullnose Bead: Use where indicated.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.
5. U-Bead: Use at exposed panel edges.
6. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

E. Install corner beads at external corners. Provide metal trim to protect edge of gypsum board wherever gypsum board intersects a dissimilar material. Hold channel and >L= trim back from metal window and door frames 1/8 inch to allow for caulking.

3.6 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, rounded or 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:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 3: Panels that are substrates for wall coverings and wall panels.
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 9 Sections.

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

3.7 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.

3.8 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Architect will conduct an above-ceiling observation before installing gypsum board ceilings and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
   1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
   2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
      a. Installation of 80 percent of lighting fixtures, powered for operation.
      b. Installation, insulation, and leak and pressure testing of water piping systems.
      c. Installation of air-duct systems.
      d. Installation of air devices.
      e. Installation of mechanical system control-air tubing.
      f. Installation of ceiling support framing.

END OF SECTION 09 29 00

SECTION 09 64 00 - WOOD FLOORING June 2, 2008

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 factory-finished wood flooring.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details including location and layout of each type of wood flooring and accessory.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and finishes available for wood flooring.

D. Samples for Verification: For each type of wood flooring and accessory, with stain color and finish required, approximately 12 inches (300 mm) long and of same thickness and material indicated for the Work and showing the full range of normal color and texture variations expected.

1.4 QUALITY ASSURANCE

A. Source Limitations: For field-finished wood flooring, obtain each species, grade, and cut of wood from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

B. Hardwood Flooring: Comply with NOFMA's "Official Flooring Grading Rules" for species, grade, and cut.

1. Certification: Provide flooring that carries NOFMA grade stamp on each bundle or piece.

C. Softwood Flooring: Comply with WCLIB No. 17 grading rules for species, grade, and cut.

D. Mockups: Install mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. To set quality standards for installation, install mockup of floor area as shown on Drawings.

2. To set quality standards for sanding and application of field finishes, prepare finish mockup of floor area as shown on Drawings.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver wood flooring materials in unopened cartons or bundles.

B. Protect wood flooring from exposure to moisture. Do not deliver wood flooring until after concrete, masonry, plaster, ceramic tile, and similar wet work is complete and dry.

C. Store wood flooring materials in a dry, warm, ventilated, weathertight location.

1.6 PROJECT CONDITIONS

A. Conditioning period begins not less than seven days before wood flooring installation, is continuous through installation, and continues not less than seven days after wood flooring installation.

1. Environmental Conditioning: Maintain an ambient temperature between 65 and 75 deg F (18 and 24 deg C) and relative humidity planned for building occupants in spaces to receive wood flooring during the conditioning period.
2. Wood Flooring Conditioning: Move wood flooring into spaces where it will be installed, no later than the beginning of the conditioning period.

   a. Do not install flooring until it adjusts to relative humidity of, and is at same temperature as, space where it is to be installed.
   b. Open sealed packages to allow wood flooring to acclimatize immediately on moving flooring into spaces in which it will be installed.

B. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.

C. Install factory-finished wood flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 FACTORY-FINISHED WOOD FLOORING

A. Solid-Wood Flooring: Kiln dried to 6 to 9 percent maximum moisture content; tongue and groove and end matched; and with backs channeled (kerfed) for stress relief.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Mannington, Vertical Bamboo, 3.625, BV03CB1.

2. Species: Bamboo.
3. Cut: Vertical grain.
4. Thickness: 9/16 inch.
5. Face Width: 3-5/8 inches.
6. Lengths: Random-length strips complying with applicable grading rules.
7. Edge Style: Micro-Beveled (eased).
8. Finish: UV urethane system.

    a. Color: As selected by Architect from manufacturer's full range.

2.2 ACCESSORY MATERIALS

A. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than 6.0 mils (0.15 mm) thick.

B. Wood Underlayment: As specified in Division 06 Section "Miscellaneous Carpentry."

C. Wood Flooring Adhesive: Mastic recommended by flooring and adhesive manufacturers for application indicated.

D. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood flooring manufacturer.

E. Fasteners: As recommended by manufacturer, but not less than that recommended in NWFA's "Installation Guidelines: Wood Flooring."

F. Cork Expansion Strip: Composition cork strip.

G. Trim: In same species and grade as wood flooring, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of wood flooring.

1. Verify that substrates comply with tolerances and other requirements specified in other Sections.
2. For adhesively applied wood flooring, verify that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Substrate Moisture Testing, General: Perform tests recommended by manufacturer or, if none, comply with applicable recommendations in NWFA's "Installation Guidelines: Wood Flooring."

1. Proceed with installation only after substrates pass testing.

C. Concrete Moisture Testing: Perform anhydrous calcium chloride test per ASTM F 1869, as follows:

1. Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) and perform not less than 2 tests in each installation area with test areas evenly spaced in installation area.
2. 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.
3. Perform alkalinity and adhesion tests recommended in writing by manufacturer or, if none, according to NWFA's "Installation Guidelines: Wood Flooring." Proceed with installation only after substrates pass testing.

3.2 PREPARATION

A. Grind high spots and fill low spots on concrete substrates to produce a maximum 1/8-inch (3-mm) deviation in any direction when checked with a 10-foot (3-m) straight edge.

1. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

B. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

C. Broom or vacuum clean substrates to be covered immediately before product installation. 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. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in NWFA's "Installation Guidelines: Wood Flooring."

B. Provide expansion space at walls and other obstructions and terminations of flooring of not less than 1/2 inch (12.5 mm).

C. Vapor Retarder:
1. Wood Flooring Installed Directly on Concrete: Install a layer of polyethylene sheet according to flooring manufacturer's written instructions.

D. Wood Underlayment: Install according to requirements in Division 06 Section "Rough Carpentry."

E. Solid-Wood Flooring: Blind nail or staple flooring to substrate.

1. For flooring of face width more than 3 inches (75 mm), do the following:

a. Install countersunk screws at each end of each piece in addition to blind nailing. Cover screw heads with wood plugs glued flush with flooring.

b. Install no fewer than 2 countersunk nails at each end of each piece, spaced not more than 16 inches (406 mm) along length of each piece, in addition to blind nailing. Fill holes with matching wood filler.

F. Wood Trim: Nail baseboard to wall and nail shoe molding or other trim to baseboard; do not nail to flooring.

3.4 PROTECTION

A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.

1. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 09 64 00

SECTION 09 65 19 - RESILIENT FLOOR TILE June 2, 2008

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. Vinyl composition tile (VCT).
   2. Resilient wall base and accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required.
   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. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
   2. 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. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products listed in other Part 2 articles.

2.2 COLORS AND PATTERNS

A. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.3 VINYL COMPOSITION TILE

A. Vinyl Composition Tile (VCT): ASTM F 1066.
   1. Armstrong World Industries, Inc.;
   2. Azrock Commercial Flooring, DOMCO;
   3. Congoleum Corporation;
   4. Mannington Mills, Inc.;
   5. Tarkett Inc.;

B. Class: 2 (through-pattern tile).

C. Wearing Surface: Smooth.

D. Thickness: 0.125 inch (3.2 mm).

E. Size: 12 by 12 inches (305 by 305 mm).

F. Fire-Test-Response Characteristics:
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

2.4 RESILIENT WALL BASE

A. Wall Base: ASTM F 1861.
   1. AFCO-USA, American Floor Products Company, Inc.;
   2. Armstrong World Industries, Inc.;
   3. Burke Mercer Flooring Products;
   4. Johnsonite;
   5. Marley Flexco (USA), Inc.;
   6. Musson, R. C. Rubber Co.;
   7. Roppe Corporation;

B. Type (Material Requirement): TP (rubber, thermoplastic).

C. Group (Manufacturing Method): I (solid, homogeneous).

D. Style: Cove (base with toe) and Straight (flat or toeless).

E. Minimum Thickness: 0.125 inch (3.2 mm).

F. Height: 4 inches (102 mm).

G. Lengths: Coils in manufacturer's standard length.

H. Outside Corners: Premolded.

I. Inside Corners: Premolded.

J. Surface: Smooth.

2.5 RESILIENT MOLDING ACCESSORY

A. Description, including but not limited to: Carpet bar for tackless installations, Carpet edge for glue-down applications, Nosing for carpet, Nosing for resilient floor covering, Reducer strip for resilient floor covering, and Joiner for tile and carpet.
   1. Burke Mercer Flooring Products;
   2. Johnsonite;
   3. Marley Flexco (USA), Inc.;
   4. Roppe Corporation;

B. Material: Vinyl.

C. Profile and Dimensions: As indicated.

2.1 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.

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to

protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

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 TILE INSTALLATION

A. Lay out 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.

B. Match 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 direction alternating in adjacent tiles (basket-weave pattern).

C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

D. Extend tiles into toe spaces, door reveals, closets, and similar openings.

E. 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.

F. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

G. Adhere 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 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. Premolded Corners: Install premolded corners before installing straight pieces.

3.5 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.

3.6 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 and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
   1. Apply protective floor polish to horizontal surfaces that are free from soil, visible adhesive, and surface blemishes if recommended in writing by manufacturer.
      a. Use commercially available product acceptable to manufacturer.
      b. Coordinate selection of floor polish with Owner's maintenance service.
   2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
   3. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 09 65 19

SECTION 09 68 00 - CARPET June 2, 2008

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 floor carpet and carpet accessories as shown on the drawings and specified herein.

B. General Contractor is directed to purchase and coordinate the installation of carpet through the State-wide contract with Midwest Office Supply, the State Carpet Contractor.

C. Pre-determined prices for carpet, including installation, are available for State-owned facilities. Any recent modifications to the State-wide contract prices are to be itemized.

D. Architect will coordinate with the State Carpet Contract to develop colors, patterns, locations, special layouts, and actual yardage of carpet.

E. Related Sections include the following:
1. Division 09 Section "Resilient Tile Flooring" for resilient wall base and accessories installed with carpet.

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 recommendations for each type of substrate required.

B. Shop Drawings: Show the following:
1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
2. Carpet type, color, and dye lot.
3. Locations where dye lot changes occur.
4. Seam locations, types, and methods.
5. Type of subfloor.
6. Type of installation.
7. Pattern type, repeat size, location, direction, and starting point.
8. Pile direction.
9. Type, color, and location of insets and borders.
10. Type, color, and location of edge, transition, and other accessory strips.
11. Transition details to other flooring materials.

C. 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: 12-inch-square Sample.
2. Exposed Edge Stripping and Accessory: 12-inch-long Samples.

D. Product Schedule: Use same room and product designations indicated on Drawings and in schedules.

E. Maintenance Data: For carpet to include in maintenance manuals specified in Division 1. Include the following:
   1. Methods for maintaining carpet, 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.

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 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 over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet 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 Warranty: Written warranty, signed by carpet manufacturer agreeing to replace carpet that does not comply with requirements or that fails within specified warranty

period. Warranty does not include deterioration or failure of carpet 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: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 - PRODUCTS

2.1 CARPET

A. Approved Product:

1. Mill: Shaw Contract
   a. Style: Synthesis III SQ
   b. Style Number: 59050
   c. Refer to finish plans for colors, types and patterns.

B. Face System: 100% Solutia Ultron VIP BCF Nylon.

C. Face Construction: Random Tipshear.

D. Gauge: 1/10".

E. Stitches: 11.0

F. Production Yarn Weight: 30.0 ozs/sq.yd.

G. Pile Height Average: .154 inches for finished carpet per ASTM D 418.

H. Density Factor: 7,013 oz/cu.yd.

I. Weight Density: 210,390

J. Dye Method: Yarn Dyed.

K. Backing Structure:

1. Secondary Backing: PermaBac

L. Size: 18" x 18" Tile

M. Performance Characteristics: As follows:

1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
2. Dry Breaking Strength: Not less than 100 lbf per ASTM D 2646.
3. Resistance to Insects: Comply with AATCC-24.
4. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC-165.
5. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) per

AATCC-16.

6. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC-174.

2.2 INSTALLATION ACCESSORIES (By State Carpet Contract)

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the following:
   1. Carpet manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and that is recommended by the following:
   1. Carpet manufacturer.

C. Seaming Cement: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

E. Rubber Accessory Molding: Provide rubber accessory molding complying with the following:
   1. Color: As selected by Architect from manufacturer's full range of colors produced for rubber accessory molding complying with requirements indicated.
   2. Product Description: Including but not limited to carpet edge for glue-down applications, carpet nosing, tile and carpet joiner.
   3. Profile and Dimensions: As indicated and as required.

PART 3 - EXECUTION

3.1 EXAMINATION (By State Carpet Contract)

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet 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 the following:
      a. Carpet manufacturer.
   2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet.
   3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. 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 manufacturer's written installation instructions for preparing substrates indicated to receive carpet 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 the following:
   1. Carpet manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION (By State Carpet Contract)

A. Direct-Glue-Down Installation: Comply with CRI 104, Section 8, "Direct Glue-Down Installation."

B. Stair Installation: Comply with CRI 104, Section 12, "Carpet on Stairs."

C. Comply with carpet manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
   1. Level adjoining border edges.

D. Do not bridge building expansion joints with carpet.

E. Cut and fit carpet 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 manufacturer.

F. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. 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.

H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. (By State Carpet Contract): Perform the following operations immediately after installing carpet:

   1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
   2. Remove yarns that protrude from carpet surface.

3. Vacuum carpet using commercial machine with face-beater element.

B. (By General Contractor): Protect installed carpet to comply with CRI 104, Section 15, "Protection of Indoor Installations."

C. (By General Contractor): Protect carpet 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 manufacturer.

END OF SECTION 09 68 00

SECTION 09 91 00 - PAINTING June 2, 2008

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes painting work, interior and exterior. Work Includes, but is not limited to painting the following:
   1. Exterior steel.
   2. Exterior metal mechanical units.
   3. Interior walls and ceilings.
   4. Interior steel rails and misc. metal.
   5. Exterior exposed metal flashing.
   6. Work includes field painting of exposed bare and covered pipes and ducts (including color coding), and of hangers, exposed steel and iron work, plug mold, electric panels, and primed metal surfaces of equipment installed under mechanical and electrical work, except as otherwise indicated. Field painting of a roof mounted mechanical units is part of this section.

B. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

C. Surfaces to be Painted: Except where natural finish of material is specifically noted as a surface not to be painted, paint all exposed surfaces whether or not colors are designated in "schedules". Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these from standard or custom colors and finishes. Multiple colors may be selected by the Architect for any type of paint system.
   1. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.
   2. Walls behind scheduled coverings shall receive prime coat.
   3. If it can be seen, paint it.

D. Following categories of work are not included as part of field-applied finish work.
   1. Pre-Finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) metal toilet enclosures, prefinished partition systems, acoustic materials, architectural woodwork and casework, elevator entrance doors and frames, elevator equipment, and finished mechanical and electrical equipment, including light fixtures, switchgear and distribution cabinets.
   2. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.
   3. Finished Metal Surfaces: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting.
   4. Operating Parts: Unless otherwise indicated, moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting.
   5. Do not paint over any code-required labels, such as Underwriters' Laboratories and

Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

C. Related Sections:
1. Shop Primers: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, metal fabrications, hollow metal work and similar items.
a. Unless otherwise specified, shop priming of fabricated components such as architectural woodwork, wood casework and shop-fabricated or factory-built mechanical and electrical equipment or accessories is included under other sections of these specifications.

D. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical information including Paint label analysis and application instructions for each material proposed for use.

B. Samples: Prior to beginning work, Architect will furnish color chips for surfaces to be painted. Use representative colors when preparing samples for review. Submit samples for Architect's review of color and texture only. Provide a listing of material and application for each coat of each finish sample.
1. On 12" x 12" hardboard, provide two samples of each color and material, with texture to simulate actual conditions. Resubmit samples as requested by Architect until acceptable sheen, color, and texture is achieved.
2. On actual wood surfaces, provide two 4" x 8" samples of natural and stained wood finish. Label and identify each as to location and application.
3. On actual wall surfaces and other exterior and interior building components, duplicate painted finishes of prepared samples. Provide full-coat finish samples on at least 100 sq. ft. of surface,or as directed, until required sheen, color and texture is obtained; simulate finished lighting conditions for review of in-place work.
a. Final acceptance of colors will be from samples applied on the job.

1.3 QUALITY ASSURANCE

A. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

B. Coordination of Work: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

1.4 DELIVERY AND STORAGE

A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:
1. Name or title of material.
2. Fed. Spec. number, if applicable.
3. Manufacturer's stock number and date of manufacture.

4. Manufacturer's name.
5. Contents by volume, for major pigment and vehicle constituents.
6. Thinning instructions.
7. Application instructions.
8. Color name and number.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage of paint in a clean condition, free of foreign materials and residue.
   1. Protect from freezing where necessary. Keep storage area neat and orderly. Remove oily rags and waste daily. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

1.5 JOB CONDITIONS

A. Apply water-base paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50°F and 90°F, unless otherwise permitted by paint manufacturer's printed instructions.

B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45°F and 95°F, unless otherwise permitted by paint manufacturer's printed instructions.

C. Do not paint in snow, rain, fog or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.
   1. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

D. Determine moisture content of surfaces to be painted by performing appropriate tests using a commercially available moisture meter. Apply paint only when surfaces are within limits specified by the paint manufacturer=s printed instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Approved Manufacturers:
   1. ICI Paint Stores.
   2. PPG Industries, Pittsburgh Paints (Pittsburgh).
   3. Pratt and Lambert (P & L).
   4. The Sherwin-Williams Company (S-W).
   5. Benjamin Moore & Co.
   6. Kwal-Howells Paint.

2.2 MATERIALS

A. Material Quality: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

B. Proprietary names used to designate color or materials are not intended to imply that

products of named manufacturers are required to exclusion of equivalent products of other manufacturers.

C. Federal Specifications establish minimum acceptable quality for paint materials. Provide written certification from paint manufacturer that materials provided meet or exceed these minimums.

D. Manufacturer's products which comply with coating qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to Architect. Furnish material data and manufacturer's certificate of performance to Architect for any proposed substitutions.

E. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

F. Lead content in pigment, if any, is limited to contain not more than 0.06% lead, as lead metal based on the total non-volatile (dry-film) of paint by weight.
   1. This limitation is extended to interior surfaces and those exterior surfaces, such as stairs, decks, porches, railings, windows, and doors which are readily accessible to children under seven years of age.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been correct in a manner acceptable to Applicator.

B. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.2 PREPARATION

A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

B. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Architect in writing of any anticipated problems in using the specified coating systems with substrates primed by others.

C. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.

D. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants

from cleaning process will not fall onto wet, newly-painted surfaces.

E. Cementitious Materials: Prepare cementitious surfaces to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.
   1. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
   2. Clean concrete floor surfaces scheduled to be painted with a commercial solution or muriatic acid, or other etching cleaner. Flush floor with clean water to neutralize acid, and allow to dry before painting.

F. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.
   1. Caulk fabrication joints in hollow metal door frames which paint application cannot bridge.

G. Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch-up with same type shop primer.

H. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum based solvent.

I. Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, fry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.
   1. Prime, stain, or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, paneling.
   2. When transparent finish is required, use spar varnish for backpriming.

J. Materials Preparation:
   1. Mix and prepare painting materials in accordance with manufacturer's directions.
   2. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
   3. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3.3 APPLICATION

A. General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
   1. Paint colors, surface treatments, and finishes, are indicated in "schedules" of the contract documents.
   2. Provide finish coats which are compatible with prime paints used.
   3. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only before final installation of equipment.
5. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.
6. Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.
7. Finish doors on tops, bottoms and side edges same as faces, unless otherwise indicated.
8. Sand lightly between each succeeding enamel or varnish coat.
9. Omit first coat (exterior faces of surfaces which have been shop-primed and touch-up painted, unless otherwise indicated.

B. Scheduling Painting: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firms, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
2. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

C. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to those items exposed to mechanical equipment rooms and in occupied spaces.
1. Mechanical items to be painted include, but are not limited to, the following:
   a. Piping, pipe hangers, and supports.
   b. Roof mounted mechanical units.
   c. Ductwork, where exposed in occupied spaces.
   e. Motor, mechanical equipment, and supports.
   f. Accessory items.
2. Electrical items to be painted include, but are not limited to, the following:
   a. Conduit and fittings.

D. Prime Coats: Apply prime coat of material which is required to be painted or finished, and which has not been prime coated by others.
1. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

E. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

F. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.4 FIELD QUALITY CONTROL

A. The right is reserved by Owner to invoke the following material testing procedure at any time, and any number of times during period of field painting:
1. Owner will engage services of an independent testing laboratory to sample paint being used. Samples of materials delivered to project site will be taken, identified and sealed, and certified in presence of Contractor.

a. Testing laboratory will perform appropriate tests for any or all of following characteristics: Abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali resistance and quantitative materials analysis.

b. If test results show that material being used does not comply with specified requirements, Contractor may be directed to stop painting work, and remove non-complying paint; pay for testing; repaint surfaces coated with rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are non-compatible.

3.5 CLEAN-UP AND PROTECTION

A. Clean-Up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day.

1. Upon completion of painting work, clean window glass and other paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using car not to scratch or otherwise damage finished surfaces.

B. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

1. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
2. At completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

C. Extra Stock: Deliver stock or maintenance materials to Owner. Furnish maintenance material matching products installed, packaged with protective covering for storage and identified with appropriate labels.

1. Paint: Furnish not less than one (1) full gallon for each color and type of paint installed.

3.6 EXTERIOR PAINT SCHEDULE

A. General: Provide the following Paint systems for the various substrates, as indicated.

1. METAL (Aluminum)

a. Latex Systems

(1) Gloss Finish

1st Coat:	S-W DTM Acrylic Gloss Coating, B66 Series
2nd Coat:	S-W DTM Acrylic Gloss Coating, B66 Series (10 mils wet, 4 mils dry per coat)

2. METAL (Galvanized)

a. Latex Systems

(1) Gloss Finish

1st Coat:	S-W DTM Acrylic Primer, B66W1 Series (10 mils wet, 5 mils dry per coat)
2nd Coat:	S-W DTM Acrylic Gloss Coating, B66 Series
3rd Coat:	S-W DTM Acrylic Gloss Coating, B66 Series (10 mils wet, 4 mils dry per coat)

3. **METAL (Miscellaneous Iron, Ornamental Iron)**
   a. Alkyd Systems
      (1) Gloss Finish
         1st Coat: S-W Kem Kromik Universal Metal Primer, B50Z Series (6 mils wet, 3 mils dry)
         2nd Coat: S-W Industrial Enamel, B54Z Series
         3rd Coat: S-W Industrial Enamel, B54Z Series (5 mils wet, 2 mils dry per coat)

3.7 INTERIOR PAINT SCHEDULE

A. General: Provide the following paint systems for the various substrates, as indicated.

1. **METAL - (Galvanized)**
   a. Latex Systems
      (1) Semi-Gloss Finish
         1st Coat: S-W DTM Acrylic Primer, B66W1 Series (10 mils wet, 5 mils dry per coat)
         2nd Coat: S-W ProMar 200 Latex Semi-Gloss B31W200 Series
         3rd Coat: S-W ProMar 200 Latex Semi-Gloss B31W200 Series (4 mils wet, 1.3 mils dry per coat)

2. **METAL - (Exposed Structural Steel, Joists, Beams, Misc. & Ornamental Iron, Doors and Door Frames, Non-Galvanized Metal)**
   a. Latex Systems
      (1) Semi-Gloss Finish
         1st Coat: DTM Acrylic Primer/Finish, B66W1 (6 mils wet, 3 mils dry)
         2nd Coat: S-W ProMar 200 Latex Semi-Gloss B31W200 Series
         3rd Coat: S-W ProMar 200 Latex Semi-Gloss B31W200 Series (4 mils wet, 1.3 mils dry per coat)

3. **DRYWALL (Walls, Ceilings, Gypsum Board, Etc.)**
   a. Latex Systems
      (1) Semi-Gloss Finish
         1st Coat: S-W Preprite 200 Latex Wall Primer, B28W200 (4 mils wet, 1.2 mils dry)
         2nd Coat: S-W ProMar 200 Latex Semi-Gloss, B31W200 Series
         3rd Coat: S-W ProMar 200 Latex Semi-Gloss, B31W200 Series (4 mils wet, 1.3 mils dry per coat)

   b. Epoxy System (Water Base)
      (1) Semi-Gloss Finish
         1st Coat: S-W Preprite 200 Latex Wall Primer, B28W200 (4 mils wet, 1.2 mils dry)
         2nd Coat: S-W Water Based Catalyzed Epoxy, B70/B60V25
         3rd Coat: S-W Water Based Catalyzed Epoxy, B70/B60V25 (8 mils wet, 3 mils dry per coat)

(2) Approved Manufacturer's
(a) Porter Paints
(b) Columbia Paint and Coatings

4. DRYWALL (Behind Scheduled Wall Coverings, Tackable Wall Panels, Casework)

a. Latex Systems
(1) Semi-Gloss Finish
1st Coat: S-W Preprite 200 Latex Wall Primer, B28W200 (4 mils wet, 1.2 mils dry)

5. CONCRETE SLABS (Floors not scheduled for applied finishes)

a. Primer: EPOPRIME WB by L & M Construction Chemicals, Inc. Apply at rate of 400 sq. ft. per gallon.
b. 1st and 2nd Coat: Durathane HS/VOC, Moisture-Cured Polyurethane Sealer by L & M Construction Chemicals, Inc. Apply at rate of 300 sq.ft. per gallon.

END OF SECTION 09 91 00

DIVISION 10 - SPECIALTIES

Section 10 22 26 Operable Panel Partitions

SECTION 10 22 26 - OPERABLE PANEL PARTITIONS June 2, 2008

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. Manually operated, continuously hinged panel partitions.

B. Related Sections include the following:
   1. Division 09 Section "Gypsum Board Assemblies" for sound barrier construction above the ceiling at track.

1.3 DEFINITIONS

A. STC: Sound Transmission Class.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Provide operable panel partitions capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

B. 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 in a full-scale opening, 14 by 9 feet (4.2 by 2.7 m), 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.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

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.
   2. Indicate storage and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.

C. 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. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.

D. Setting Drawings: For embedded items and cutouts required in other work, including support-beam punching template.

E. Samples for Selection: For each type of finish, covering, or facing indicated.
   1. Include similar Samples of accessories involving color selection.
   2. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches (75 mm) square.

F. Product Certificates: For each type of operable panel partition, signed by product manufacturer.

G. Qualification Data: For Installer.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each operable panel partition.

I. Maintenance Data: For operable panel partitions to include in maintenance manuals.
   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.

J. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Fire-Test-Response Characteristics: Provide operable panel partitions with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

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 operable panel partition openings by field measurements before

fabrication and indicate measurements on Shop Drawings.

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 described below 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 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. Modernfold, Inc.; Acousti-Seal 933.
   2. Others shall submit for approval prior to bidding.

2.2 MATERIALS

A. Steel Frame: Steel sheet, not less than 0.0747-inch (1.9-mm) nominal specified thickness for uncoated steel.

B. Medium-Density Fiberboard: ANSI A208.2, made with binder containing no urea formaldehyde.

2.3 OPERABLE PANELS

A. 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.

B. Dimensions: Fabricate operable panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
   1. Panel Width: Standard widths.

C. STC: Not less than 47.

D. Panel Weight: 8 lb/sq. ft. (40 kg/sq. m) maximum.

E. Panel Thickness: Not less than 3-1/4 inches (83 mm).

F. Panel Closure:
   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.

G. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

2.4 SEALS

A. General: Provide types of acoustical seals indicated that produce operable panel partitions complying with acoustical performance requirements and the following:
   1. Seals made from materials and in profiles that minimize sound leakage.
   2. 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 astragals mounted on each edge of panel, with continuous PVC acoustical seal.

C. Horizontal Top Seals: Continuous-contact, extruded-PVC or PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on track when extended.

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: Extension and retraction of bottom seal automatically operated by movement of partition, with operating range not less than 1-1/2-inch (38-mm) between retracted seal and floor finish.

2.5 FINISH FACING

A. General: Provide finish facings 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 invisible seams complying with Shop Drawings for location, and with no gaps or overlaps. Horizontal seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
   2. Where facings with directional, repeating, or matching grain are indicated, mark facing top and attach facing in same direction.
   3. Color/Pattern: As selected by Architect from manufacturer's full range.

B. Vinyl-Coated Fabric Wall Covering: Manufacturer's standard mildew-resistant, washable, vinyl-coated fabric wall covering; complying with CFFA-W-101-B for type indicated; Class A.

C. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:

1. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper required to comply with performance requirements; and with manufacturer's standard clear anodic finish.

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 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.

D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish, unless otherwise indicated.

2.7 ACCESSORIES

A. Pass Doors: Fabricated to comply with recommendations in ANSI A117.1 and Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)." Swinging door built into and matching panel construction, acoustical qualities, 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 hardware.
      c. Concealed door closer.
      d. Door Viewer: Installed with view in direction of swing.
      e. Exit Sign: Recessed, self-illuminated.
      f. 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. Rim Lock: Key-operated lock cylinder, keyed to master key system, to secure pocket door in closed position. Include two keys per lock.

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.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with 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.

3.3 ADJUSTING

A. Adjust operable panel partitions to operate smoothly, without warping or binding. Lubricate hardware and other moving parts.

B. Adjust pass doors and 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 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.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 10 22 26

DIVISION 21 – FIRE 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 fire-suppression piping and equipment for the following building systems:

1. Remodel project: Wet-pipe, fire-suppression sprinklers, including piping, valves, specialties, and automatic sprinklers. Add/relocate fire sprinkler head locations for modified floor and ceiling plans. Contractor to field-verify existing fire sprinkler system. See architectural plans for remodeled areas.
2. In areas that all sprinklers in the compartment are new, provide Quick Response type sprinkler heads with the finish that matches the existing in adjacent areas. If not, provide standard response heads that match the existing in the compartment.
3. There are many areas that will have a new ceiling where there was none before. It is not known if the outlets to the sprinklers in these areas is 1”. Provide new connections with mechanical tees if necessary..

B. Related Sections include the following:

1. Division 10 Section "Fire-Protection Specialties" for cabinets and fire extinguishers.
2. Division 26 Section "Fire Alarm Systems" for alarm devices not in this Section.

1.3 DEFINITIONS

A. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from authorities having jurisdiction.

B. Authority having Jurisdiction: The building official, Engineer and the insurance underwriter, where applicable.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction. Obtain approval from the Engineer prior to submitting to other authorities having jurisdiction.

1. Design Sprinkler system using existing pipe sizing.
2. Maximum Protection Area per Sprinkler: As follows:

   a. Light-Hazard Occupancies: 225 sq.ft.
   b. Storage Areas: 130 sq. ft.
   c. Mechanical Equipment Rooms: 130 sq. ft.
   d. Electrical Equipment Rooms: 130 sq. ft..
   e. Shellspace/Future tenant finish: 100 sq.ft.
   f. Materials Handling/Storage Areas (eg. Plastics): 100 sq. ft.
   g. Other Areas: According to NFPA 13

B. Components and Installation: Capable of producing piping systems with 175-psig minimum working-pressure rating, unless otherwise indicated.

1.5 SYSTEM DESCRIPTIONS

A. Wet-pipe fire protection riser and fire suppression sprinklers.

1.6 SUBMITTALS

A. Product Data:

1. Pipe and fitting materials and methods of joining for sprinkler piping.
2. Pipe hangers and supports.
3. Piping seismic restraints.
4. Valves, including specialty valves, accessories, and devices.
5. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.

B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by engineer and other authorities having jurisdiction. Include hydraulic calculations, unless noted otherwise. Drawings are to be approved by the Engineer prior to submitting to other authorities having jurisdiction.

C. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

D. Maintenance Data: For each type of standpipe and sprinkler specialty to include in maintenance manuals specified in Division 1.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction. The Engineer requires evidence to support the ability of the contractor to perform work in the scope and volume as specified. A contractor who cannot show such experience, may be found not suitable to perform the work. Fire protection contractors pre-approved to submit bids for this project are:

1. Delta Fire Systems, Inc.
2. Fire Engineering Co., Inc.
3. Firetrol Protection Systems, Inc.
4. Grinnell Fire Protection Systems Co.
5. Western Automatic Sprinkler
6. Chapparal Fire

Other contractors shall submit documentation to the engineer prior to bidding. Allowance of additional contractors shall be by addendum.

B. Engineering Responsibility: Preparation of working plans using AutoCad compatible drawing program, calculations, and field test reports by a qualified professional engineer or Engineering Technician NICET Level III. Base calculations on results of the Engineer's water analysis provided by Van Boerum and Frank Associates.

C. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.

D. Standpipe and Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

F. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:

1. NFPA 13-07, "Installation of Sprinkler Systems."
2. NFPA 70-05, “National Electric Code.”
3. NFPA 72-07, “National Fire Alarm Code.”

G. International Conference of Building Code Officials codes and standards complying with the following:

1. IBC-2006, “International Building Code.”
2. IFC-2006, “International Fire Code.”

1.8 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. Sprinkler Cabinets: A supply of spare sprinklers shall be supplied and located in a cabinet where the temperature does not exceed 100EF. These sprinklers shall correspond to the types and temperature ratings fo the sprinklers installed on the project. Special sprinkler head wrenches shall be included to correspond to the types of heads provided.

The stock of spare sprinklers shall include all types and ratings installed and shall be as follows:

a. For systems with over 1000 sprinklers, not less than 24 sprinklers.
b. Locate spare head box, wrench and sprinklers near system riser serving each building.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Specialty Valves and Devices:

a. Tyco Corp.
b. Reliable Automatic Sprinkler Co., Inc.
c. Star Sprinkler Corp.
d. Viking Corp.

2. Sprinkler, Drain and Alarm Test Fittings:

a. Tyco Corp
b. Fire-End and Croker Corp.

c. Victaulic Co. of America.

3. Sprinklers:

a. Tyco Corp.
b. Reliable Automatic Sprinkler Co., Inc.
c. Viking Corp.
d. Victaulic Co of America.

4. Keyed Couplings for Steel Ductile, Iron, and Copper Tubing Piping:

a. Tyco Corp.
b. Victaulic Co. of America.
c. Gruvlok.
d. Star
e. Ward Couplox

5. Press-Seal Fittings for Steel Piping: (not allowed)

6. Mechanically Formed Tee Outlets: (not allowed)

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PIPES AND TUBES

A. Standard-Weight Steel Pipe: ASTM A 53, ASTM A 135, or ASTM A 795; Schedule 40 in NPS 6 and smaller.

B. Thinwall, Threadable Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10. NPS 2" and smaller. (Dyna-Thread 40 allowed)

2.4 PIPE AND TUBE FITTINGS

A. Cast-Iron Threaded Flanges: ASME B16.1.

B. Cast-Iron Threaded Fittings: ASME B16.4.

C. Steel, Threaded Couplings: ASTM A 865.

D. Steel Welding Fittings: ASTM A 234/A 234M, ASME B16.9, or ASME B16.11.

E. Steel Flanges and Flanged Fittings: ASME B16.5.

F. Steel, Grooved-End Fittings: UL-listed and FM-approved, ASTM A 47, malleable iron or ASTM A 536, ductile iron; with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

2.5 JOINING MATERIALS

A. Refer to Division 23 Section for pipe-flange gasket materials and welding filler metals.

B. Steel, Keyed Couplings: UL 213 and AWWA C606, for steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gaskets, and steel bolts and nuts. Include listing for dry-pipe service for couplings for dry piping.

C. Transition Couplings: AWWA C219, sleeve type, or other manufactured fitting the same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

2.7 SPRINKLERS

A. Sprinkler types, features, and options include the following:

1. Extended-coverage sprinklers.
2. Pendent sprinklers.
3. Pendent, dry-type sprinklers.
4. Quick-response sprinklers.
5. Recessed sprinklers, including escutcheon.
6. Sidewall sprinklers.
7. Sidewall, dry-type sprinklers.
8. Upright sprinklers.
9. Concealed sprinklers, where indicated.

B. Sprinkler Finishes: Chrome-plated, bronze, and painted.

C. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: white painted, one piece, flat.
2. Ceiling Mounting: white painted, two piece, with 1-inch vertical adjustment.
3. Sidewall Mounting: white painted, two piece, recessed.

D. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.8 SPECIALTY SPRINKLER FITTINGS

A. Specialty Fittings: UL listed and FM approved; made of steel, ductile iron, or other materials compatible with piping.

B. Dry-Pipe-System Fittings: UL listed for dry-pipe service.

C. Locking-Lug Fittings: (not allowed).

D. Mechanical-T Fittings: Victaulic 920 or 920N or approved equal.

E. Mechanical-Cross Fittings: (not allowed).

F. Drop-Nipple Fittings: UL 1474, with threaded inlet, threaded outlet, and seals; adjustable.

G. Sprinkler, Drain and Alarm Test Fittings: UL-listed, cast- or ductile-iron body; with threaded inlet and outlet, test valve, and orifice and sight glass.

2.9 PRESSURE GAGES

A Pressure Gages: UL 393, 3-1/2- to 4-1/2-inch- diameter dial with dial range of 0 to 250 psig.

PART 3 - EXECUTION

3.1 PREPARATION

A. Engineer's Water Analysis. See Part I requirement.

3.2 EARTHWORK

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.3 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 COORDINATION

A. All work of this contractor will be coordinated with other trades to insure minimal changes to the sprinkler system from the designs. Careful coordination of mechanical and electrical ducts, pipe and conduit shall be required.

B. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing waste, rainwater, and soil lines; supply, return, and exhaust ductwork, water piping, fire protection piping; and pneumatic control piping.

C. All piping shall be run concealed where possible. All lines will be run as high as possible so as to not interfere with future changes to ceiling heights or other mechanical equipment. This contractor will be responsible for all sleeves, core drills, and sealing of penetrations in walls, floors, and structural members to facilitate the installation of the system, however, no holes in structural members will be allowed unless approved by the structural engineer.

3.5 PIPING APPLICATIONS

A. Flanges, unions, and transition and special fittings with pressure ratings the same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

B. Standpipes and mains: Use the following:

1. NPS 6 to NPS 10: Schedule 10 steel pipe with grooved ends & Welded outlets.
2. NPS 4 and Smaller: Schedule 40 steel pipe with threaded ends, or grooved ends. No plain ends allowed.

C. Wet-Pipe Sprinklers: Use the following:

1. NPS 2 and Smaller: Schedule 40 and Dynathread 40, threadable steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.

3.6 JOINT CONSTRUCTION

A. Refer to Division 23 for basic piping joint construction.

B. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends and Schedule 30 or thinner steel pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping, preaction, FDC & roof standpipes.

C. Press-Seal-Fitting Joints: (not allowed).

D. Locking-Lug-Fitting, Twist-Locked Joints: (not allowed).

E. Dissimilar-Piping-Material Joints: Construct joints using adapters or couplings compatible with both piping materials. Use dielectric fittings if both piping materials are metal. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for dielectric fittings.

3.7 PIPING INSTALLATION

A. Refer to Division 23 for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

F. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Hangers and Supports: Comply with NFPA 13 for hanger materials. Install according to NFPA 13 for sprinkler piping and to NFPA 14 for standpipes.

1. No powder driven studs allowed.
2. Wrap-around braces are to be provided at end of branch lines.
3. MRI area- install with Non-metallic hangers.

I. Earthquake Protection: Install piping according to Factory Mutual 2-8 requirements, to protect from earthquake damage. Seismic Bracing shall be designed to withstand vertical forces and movement.

J. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated, or required by NFPA 13 for flexibility in seismic zones.

K. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

3.8 SPECIALTY SPRINKLER FITTING INSTALLATION

A. Install specialty sprinkler fittings according to manufacturer's written instructions.

3.9 SPRINKLER APPLICATIONS

A. General: Sprinkler heads shall be of the latest design closed spray type for 155EF unless specified otherwise or required by code. All sprinklers shall be UL listed as quick response. Heads shall be a minimum orifice size of 1/2". Temperature rating of heads in elevator shafts & boiler plant shall be 286EF. Extra Large Orifice (ELO) heads shall not be used. Use sprinklers according to the following applications:

1. Rooms without Ceilings: Upright and/or pendent sprinklers. Provide mechanical guards on all heads at or below 7'-0" height above the floor or where damage from room occupant use may occur.
2. Rooms with Suspended Ceilings: Recessed sprinklers, typical.
3. Rooms with Suspended Ceilings: Concealed sprinklers, where indicated. Refer to list below.
4. Wall Mounting: Sidewall sprinklers with eschutcheon.
5. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
7. Provide freezeproof type automatic sprinkler heads serving walk in freezers, unconditioned spaces, areas subject to freezing and in other areas requiring their use.
8. Heads located within the air streams of unit heaters or other heat-emitting equipment shall be selected for proper temperature rating.
9. Sprinkler Finishes: Use sprinklers with the following finishes:

    a. Upright, Pendent, and Sidewall Sprinklers: Chrome-plated in finished spaces exposed to view; rough bronze in mechanical spaces (typical) not exposed to view.
    b. Concealed Sprinklers: Rough brass, with white cover plate. See below for required areas.
    c. Recessed Sprinklers: Bright white, with bright white escutcheon.

3.10 SPRINKLER INSTALLATION

A. Every effort shall be required to insure that the heads form a symmetrical pattern in the ceiling with the ceiling grid, lights, diffusers and grilles. Offsets shall be made in piping to accommodate ductwork in the ceiling. Heads should be symmetrical and all piping run parallel or perpendicular to building lines.

1. In no case shall sprinkler heads be installed closer than approved distances from ceiling obstructions. Provide a 6" center line clearance as a minimum dimension allowed.
2. Sprinkler heads in patient rooms shall be located inside area of patient bed curtain tracks.
3. Locate sprinkler o***n*** narrow center line of suspended ceiling tile in Corridors and Lobby/Waiting areas.

B. Where layout of sprinkler heads is shown on reflected ceiling plans the locations shall be followed unless approval is obtained from the Architect or such locations shown do not meet the requirements of NFPA-13. In either case, approval of the Architect shall be obtained in writing before sprinkler head locations are changed. If the installation of additional heads are needed to conform to NFPA 13 requirements in areas where heads are shown on reflected ceiling plans, they shall be included in the contract price.

C. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

D. Future finish and tenant finish, Shell spaces shall be piped to accommodate future. Install sprinklers with 1" x ½" bushings, and space heads at a max. spacing of 100 sq. ft. per head. Occupancy shall be Ordinary-Hazard Group 1 Design.

3.11 CONNECTIONS

A. Connect water-supply piping and standpipes and sprinklers where indicated.

B. Install ball drip valves at each check valve for fire department connection & Roof top standpipes. Drain to floor drain, express drain or outside building.

C. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

3.12 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14.

3.13 FIELD QUALITY CONTROL

A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.

C. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

D. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.14 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers having paint other than factory finish.

3.15 PROTECTION

A. Protect sprinklers from damage until Substantial Completion.

3.16 COMMISSIONING

A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

B. Verify that specified tests of piping are complete and that “Material Test Certificates” are complete.

C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.

H. Fill wet-pipe sprinkler piping with water.

3.17 DEMONSTRATION & TESTS

A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

B. All tests will be conducted as required by the local authority having jurisdiction, and in no case less than those required by NFPA standards. As a minimum, piping in the sprinkler system shall be tested at a water pressure at 200 psi for a period of not less two hours, or at 50 psi in excess of the normal pressure when the normal pressure is above 150 psi. Bracing shall be in place, and air shall be removed from the system through the hydrants and drain valves before the test pressure is applied. No apparent leaks will be permitted on interior or underground piping.

C. The local jurisdiction having authority and the State Fire Marshal's office (where required) shall be notified at least three working days in advance of all tests and flushing. This includes any flushing of underground, hydrostatic testing, or flow testing that may be required.

D. This contractor shall make all the required tests to the sprinkler system as required by code. He shall be responsible to assure that the Contractor Test Certificates for the overhead and underground work are completed and delivered to the owner's insurance underwriter to assure proper insurance credit.

E. All tests requiring the witnessing by local authorities will be the responsibility of this contractor. If tests are not run or do not have the proper witness, then they will be run later and all damage caused by the system, or caused in uncovering the system for such test, will be borne by this contractor.

3.18 WARRANTY, AS-BUILT DRAWINGS & MANUALS

A. This contractor shall warranty the sprinkler system and all its components for one year from the date of acceptance by the owner. Any costs incurred to extend any warranties of materials to assure this time frame shall be borne by this contractor.

B. Provide Operation and Maintenance Manuals with copies of warranty, all contractors Test Certificates, and corrected Hard copy-as-builts included. A minimum 3 sets to be provided in red 3-ring binders.

C. Electronic copy of AutoCad as-builts drawings shall also be provided on CD, with each O&M Manual.

END OF SECTION 211001

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DIVISION 22 – PLUMBING

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING

SECTION 23 0100 - MECHANICAL REQUIREMENTS

May 30, 2008

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. The General Conditions of the Contract, with the amendments, supplements, forms and requirements in Division 1, and herewith made a part of this Division.

B. All sections of Division 23 shall comply with the Mechanical General Requirements. The standards established in this section as to quality of materials and equipment, the type and quality of workmanship, mode of operations, safety rules, code requirements, etc., shall apply to all sections of this Division as though they were repeated in each Division.

1.2 SCOPE OF WORK

A. The project described herein is the UVU Loose Center. This work shall include all labor, materials, equipment, fixtures, and devices for the entire mechanical work and a complete operating and tested installation as required for this project.

1.3 CODES & ORDINANCES

A. All work shall be executed in accordance with all underwriters, public utilities, local and state rules and regulations applicable to the trade affected. Should any change in the plans and Specifications be required to comply with these regulations, the Contractor shall notify the Architect before the time of submitting his bid. After entering into contract, the Contractor will be held to complete all work necessary to meet these requirements without extra expense to the Owner. Where work required by drawings or specifications is above the standard required, it shall be done as shown or specified.

B. Applicable codes:

Latest Edition
International Building code- 2006 Edition
International Mechanical Code- 2006 Edition
International Plumbing Code- 2006 Edition
International Fire Code- 2006 Edition

1.4 INDUSTRY STANDARDS

A. All work shall comply with the following standards.

1. Associated Air Balance council (AABC)
2. Air Conditioning and Refrigeration Institute (ARI)
3. Air Diffusion council (ADC)
4. Air Movement and Control Association (AMCA)
5. American Gas Association (AGA)
6. American National Standards Institute (ANSI)
7. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
8. American Society of Mechanical Engineers (ASME)
9. American Society of Testing Materials (ASTM)
10. American Water Works Association (AWWA)
11. Cooling Tower Institute (CTI)
12. ETL Testing Laboratories (ETL)
13. Institute of Electrical and Electronic Engineers (IEEE)
14. Hydronics Institute (HI)
15. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
16. National Fire Protection Association (NFPA)

17. National Electrical Code (NEC)
18. National Electrical Manufacturers Association (NEMA)
19. National Electrical Safety code (NESC)
20. Utah safety Standard (OSHA), Utah State Industrial Council.
21. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
22. Underwriters Laboratories (UL)
23. Tubular Exchanger Manufacturers Association, Inc. (TEMA)
24. Heat Exchanger Institute (HEI)
25. Hydraulic Institute (HI)
26. Thermal Insulation Manufacturer's Association (TIMA)
27. Scientific Apparatus Makers Association (SAMA)

B. Compliance Verification:

1. All items required by code or specified to conform to the ASME code shall be stamped with the ASME seal.
2. Form U-1, the manufacturer's data report for pressure vessels, is to be included in the Operation and Maintenance Manuals. National Board Register (NBR) numbers shall be provided where required by code.
3. Manufactured equipment which is represented by a UL classification and/or listing, shall bear the UL or equivalent ETL label.

1.5 UTILITIES & FEES

A. All fees for permits required by this work will be paid by this division. The contractor shall obtain the necessary permits to perform this work. Unless noted otherwise, all systems furnished and or installed by this Contractor, shall be complete with all utilities, components, commodities and accessories required for a fully functioning system. This Contractor shall furnish smoke generators when required for testing, furnish cleaners and water treatment additives.

1.6 SUBMITTALS AND SHOP DRAWINGS

A. Submittals: As soon as possible after the contract is awarded, but in no case more than 45 calendar days thereafter, the Contractor shall submit to the Architect six (6) copies of the descriptive literature covering products and materials to be used in the installation of mechanical systems for this project. The review of the submitted data will require a minimum of 14 days. The first day starts after the day they are received in the engineers office to which the project is being constructed from. If the Contractors schedule requires return of submitted literature in less than the allotted time, the Contractor shall accelerate his submittal delivery date. The Contractor shall resubmit all items requiring re-review within 14 days of returned submittals. Refer to each specification section for items requiring submittal review. Written approval of the Owner's Representative shall be obtained before installing any such equipment or materials for the project. The submittals shall be prepared in an orderly manner, contained in a 3-ring loose-leaf binder with index and identification tabs each item or group of items and for each specification section. All items shall be submitted at one time except automatic temperature control drawings and seismic restraint drawings which may be submitted separately within 120 days of the contract award date**. Partial submittals will not be reviewed until the complete submittal is received.**

Submitted literature shall bear the Contractor's stamp, indicating that he has checked all equipment being submitted; that each item will fit into the available space with the accesses shown on the drawings; and, further, that each item conforms to the capacity and quality standards given in the contract documents.

Submitted literature shall clearly indicate performance, quality, and utility requirements; shall show dimension and size of connection points; and shall include derating factors that were applied for each item of equipment to provide capacity at job site elevation. Temperature control submittals shall include piping and wiring diagrams, sequence of operation and equipment. Equipment must fit into the available space with allowance for operation, maintenance, etc. Factory piped and wired

equipment shall include shop drawings for all internal wiring and piping furnished with the unit.

Submitted literature shall clearly show all required field install wiring, piping, and accessory installations required by the Contractor to provide a complete operating system.

Review by the Owner's Representative is for general conformance of the submitted equipment to the project specification. In no way does such review relieve this Contractor of his obligation to furnish equipment and materials that comply in detail to the specification nor does it relieve the Contractor of his obligation to determine actual field dimensions and conditions that may affect his work. Regardless of any items overlooked by the submittal review, the requirements of the contract drawings and specifications must be followed and are not waived or superseded in any way by the review.

By description, catalog number, and manufacturer's names, standards of quality have been established by the Architect and the Engineer for certain manufactured equipment items and specialties that are to be furnished by this Division. Alternate products and equipment may be proposed for use only if specifically named in the specifications or if given written prior approval in published addenda. Design equipment is the equipment listed on the drawings or if not listed on the drawings is the equipment first named in the specifications.

If the Engineer is required to do additional design work to incorporate changes caused by submitting equipment or products, different than the design equipment specified, as defined above, the contractor shall reimburse the engineer for additional time and expenses at the engineer’s current, recognized, hourly rates.

1.7 DRAWINGS AND MEASUREMENTS

A. Construction Drawings: The contract document drawings show the general design, arrangements, and extent of the system. In certain cases, the drawings may include details that show more nearly exact locations and arrangements; however, the locations, as shown diagrammatically, are to be regarded as general.

It shall be the work of this Section to make such slight alterations as may be necessary to make adjustable parts fit to fixed parts, leaving all complete and in proper shape when done. All dimensions given on the drawings shall be verified as related to this work and with the Architect's office before work is started.

This Section shall carefully study building sections, space, clearances, etc., and then provide offsets in piping or ductwork as required to accommodate the building structure without additional cost to the Owner. In any case and at any time, a change in location required by obstacles or the installation of other trades not shown on the mechanical plans shall be made without charge.

The drawings shall not be scaled for roughing in measurements nor shall they be used as shop drawings. Where drawings are required for these purposes or where drawings must be made from field measurements, the Contractor shall take the necessary measurements and prepare the drawings. Shop drawings of the various subcontractors shall be coordinated to eliminate all interferences and to provide sufficient space for the installation of all equipment, piping, ductwork, etc.

The drawings and specifications have been prepared to supplement each other and they shall be interpreted as an integral unit with items shown on one and not the other being furnished and installed as though shown and called out on both.

B. Coordination Drawings: The contractor shall provide coordination drawings for mechanical rooms, fan rooms, equipment rooms, and congested areas to eliminate conflicts with equipment, piping, or work of other trades. The drawings shall be a minimum scale of 1/4 inch= 1 foot and of such detail as may be required by the Engineer to fully illustrate the work. These drawings shall include all piping, conduit, valves, equipment, and ductwork.

Sheet-metal shop drawings will be required for all ductwork in the entire building. These drawings will

show all ductwork in the entire building and shall be coordinated with architectural, structural and electrical portions of the project. The contractor shall specifically obtain copies of the structural shop drawings and shall coordinate the ductwork shop drawings with approved structural members. These drawings shall be submitted to the engineer for review prior to any fabrication. The contractor is responsible for all modifications necessary to accommodate duct installation within the structural, architectural and electrical restrictions. These drawings, once reviewed by the engineer, will be made available to all mechanical, electrical, and fire sprinkler subcontractors to coordinate installation of their work.

1.8 CONTRACTOR'S USE OF BUILDING EQUIPMENT

A. The Contractor may use equipment such as electric motors, fans, heat exchangers, filters, etc., with the written permission of the Owner. As each piece of equipment is used (such as electric motors and fans), maintenance procedures approved by the manufacturer are to be followed. A careful record is to be kept of the length of the time the equipment is used, maintenance procedures followed, and any difficulty encountered. The record is to be submitted to the Owner upon acceptance. All fan belts and filter media (such as bearings) shall be carefully inspected just prior to acceptance. Any excessive wear noted shall require replacement. New filter media shall be installed in air handlers at the time systems are turned over to the owner.

1.9 EXISTING CONDITIONS

A. The Contractor shall carefully examine all existing conditions that might affect the mechanical system and shall compare these conditions with all drawings and specifications for work included under this contract. He shall, at such time, ascertain and check all conditions that may affect his work. No allowance shall subsequently be made in his behalf for an extra expense incurred as a result of his failure or neglect to make such examination. This Contractor shall include in his bid proposal all necessary allowances to repair or replace any item that will remain or will be removed, and any item that will be damaged or destroyed by new construction.

B. The Contractor shall remove all abandoned piping, etc., required by new construction and cap or plug openings. No capping, etc., shall be exposed in occupied areas. All openings of items removed shall be sealed to match adjacent surfaces.

C. The Contractor shall verify the exact location of all existing services, utilities, piping, etc., and make connections to existing systems as required or as shown on the drawings. The exact location of each utility line, together with size and elevation, shall be established before any on-site lines are installed. Should elevation or size of existing main utility lines make connections to them impossible as shown on drawings, then notification of such shall immediately be given to the Owners Representative for a decision.

1.10 EQUIPMENT CAPACITIES

A. Capacities shown for equipment in the specifications and on the drawings are the minimum acceptable. No equipment shall be considered as an alternate which has capacities or performance less than that of design equipment.

B. All equipment shall give the specified capacity and performance at the job-site elevation. Manufacturers' standard ratings shall be adjusted accordingly. All capacities and performances listed on drawings or in specifications are for job-site conditions.

1.11 SEISMIC REQUIREMENTS FOR EQUIPMENT

A. All equipment shall be furnished structurally adequate to withstand seismic forces as outlined in the International Building Code and SMACNA GUIDELINES. Refer to section Mechanical Vibration Controls and Seismic Restraints. Equipment bases shall be designed for direct attachment of seismic

snubbers and/or seismic anchors.

1.12 COOPERATION WITH OTHER TRADES

A. The Contractor shall refer to other drawings and parts of this specification that cover work of other trades that is carried on in conjunction with the mechanical work such that all work can proceed without interference resulting from lack of coordination.

B. The Contractor shall properly size and locate all openings, chases, sleeves, equipment bases, and accesses. He shall provide accurate wiring diagrams to the Electrical Contractor for all equipment furnished under this Division.

C. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing, waste, and soil lines; supply, return, and exhaust ductwork; water piping; medical gases; fire protection piping; and pneumatic control piping.

D. The mechanical Contractor shall insure that the installation of all piping, ducts and equipment is in compliance with Articles 110-16 and 384-4 of the National Electrical Code relative to proper clearances in front of and over all electrical panels and equipment. No piping or ductwork will be allowed to run over electrical panel.

1.13 RESPONSIBILITY OF CONTRACTOR

A. The Contractor is responsible for the installation of a satisfactory piece of work in accordance with the true intent of the drawings and specifications. He shall provide, as a part of his work and without expense, all incidental items required even though these items are not particularly specified or indicated. The installation shall be made so that its several component parts will function together as a workable system and shall be left with all equipment properly adjusted and in working order. The Contractor shall familiarize the Owner's Representative with maintenance and lubrication instructions as prepared by the Contractor and shall explain and fully instruct him relative to operating, servicing, and maintenance of them.

1.14 PIPE AND DUCT OPENINGS AND EQUIPMENT RECESSES

A. Pipe and duct chases, openings, and equipment recesses shall be provided by others only if shown on architectural or structural drawings. All openings for the mechanical work, except where plans and specifications indicate otherwise, shall be provided as work of this Division. Include openings information with coordination drawings.

B. Whether chases, recesses, and openings are provided as work of this Division or by others, this Contractor shall supervise their construction and be responsible for the correct size and location even though detailed and dimensioned on the drawings. This Contractor shall pay for all necessary cutting, repairing, and finishing if any are left out or incorrectly made. All necessary openings thru existing walls, ceilings, floors, roofs, etc. shall be provided by this Contractor unless indicated otherwise by the drawing and/or specifications.

1.15 UNFIT OR DAMAGED WORK

A. Any part of this installation that fails, is unfit, or becomes damaged during construction, shall be replaced or otherwise made good. The cost of such remedy shall be the responsibility of this Division.

1.16 WORKMANSHIP

A. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts, and practices, and shall be acceptable in every respect to the Owner's representative. Nothing contained

herein shall relieve the Contractor from making good and perfect work in all details in construction.

1.17 SAFETY REGULATION

A. The Contractor shall comply with all local, Federal, and OSHA safety requirements in performance with this work. (See General Conditions). This Contractor shall be required to provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

1.18 ELECTRICAL SERVICES

A. All equipment control wiring and all automatic temperature control wiring including all necessary contacts, relays, and interlocks, whether low or line voltage, except power wiring, shall be furnished and installed as work of this Division unless shown to be furnished by Division 26. All such wiring shall be in conduit as required by electrical codes. Installation of any and all wiring done under Division 22 or 23 shall be in accordance with the requirements of Division 26, Electrical.

All equipment that requires an electrical connection shall be furnished so that it will operate properly and deliver full capacity on the electrical service available.

Refer to the electrical control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment.

The Mechanical Contractor must coordinate with the Electrical Contractor to insure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

1.19 WORK, MATERIALS, AND QUALITY OF EQUIPMENT

A. Unless otherwise specified, all materials shall be new and of the best quality of their respective kinds and all labor shall be done in a most thorough and workmanlike manner.

B. Products or equipment of any of the manufacturers cited herein or any of the products approved by the Addenda may be used. However, where lists of products are cited herein, the one first listed in the design equipment used in drawings and schedules to establish size, quality, function, and capacity standards. If other than design equipment is used, it shall be carefully checked for access to equipment, electrical and control requirements, valving, and piping. Should changes or additions occur in piping, valving, electrical work, etc., or if the work of other Contractors would be revised by the alternate equipment, the cost of all changes shall be borne as work of this Division.

The Execution portions of the specifications specify what products and materials may be used. Any products listed in the Product section of the specification that are not listed in the Execution portion of the specification may not be used without written approval by the Engineer.

C. The access to equipment shown on the drawings are the minimum acceptable space requirements. No equipment that reduces or restricts accessibility to this or any other equipment will be considered.

D. All major items of equipment are specified in the equipment schedules on the drawings or in these specifications and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory installation.

E. All welders shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code, latest Edition.

1.20 PROTECTION AGAINST WEATHER AND STORING OF MATERIALS

A. All equipment and materials shall be properly stored and protected against moisture, dust, and wind. Coverings or other protection shall be used on all items that may be damaged or rusted or may have performance impaired by adverse weather or moisture conditions. Damage or defect developing before acceptance of the work shall be made good at the Contractor's expense.

B. All open duct and pipe openings shall be adequately covered at all times.

1.21 INSTALLATION CHECK

A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment indicated in the equipment schedule and the seismic supplier shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the Engineer.

B. Each equipment supplier's representative shall furnish to the Owner, through the Engineer, a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated under full load conditions and that it operated satisfactorily.

C. All costs for this work shall be included in the prices quoted by equipment suppliers.

1.22 EQUIPMENT LUBRICATION

A. The Contractor shall properly lubricate all pieces of equipment before turning the building over to the Owner. A linen tag shall be attached to each piece of equipment, showing the date of lubrication and the lubricant used. No equipment shall be started until it is properly lubricated.

B. Necessary time shall be spent with the Owner's Representative to thoroughly familiarize him with all necessary lubrications and maintenance that will be required of him.

C. Detergent oil as used for automotive purposes shall not be used for this work.

1.23 CUTTING AND PATCHING

A. No cutting or drilling in structural members shall be done without written approval of the Architect. The work shall be carefully laid out in advance, and cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces necessary for the mechanical work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by professional plasterers, masons, concrete workers, etc., and all such work shall be paid for as work of this Division.

B. When concrete, grading, etc., is disturbed, it shall be restored to original condition as described in the applicable Division of this Specification.

1.24 ACCESS

A. Provide access doors in walls, ceilings and floors, for access to mechanical equipment such as valves, dampers, VAV boxes, fans, controls, etc. Refer to Division 8 for door specifications. All access doors shall be 24" x 24" unless otherwise indicated or required. Coordinate location of doors with the Architect prior to installation.

B. Valves: Valve must be installed in locations where access is readily available. If access is compromised, as judged by the Mechanical Engineer, these valves shall be relocated where directed at the Contractors expense.

C. Equipment: Equipment must be installed in locations and orientations so that access to all components requiring service or maintenance will not be compromised. If access is compromised, as judged by the Mechanical Engineer, the contractor shall modify the installation as directed by the Engineer at the Contractors expense.

1.25 CONCRETE BASES AND INSERTS

A. Bases: The concrete bases shall be provided and installed as work of Division 3, Concrete. This Division shall be responsible for the proper size and location of bases and shall furnish all required anchor bolts and sleeves with templates to be installed as work of Division 3, Concrete.

All floor-mounted mechanical equipment shall be set on 6-inch high concrete bases, unless otherwise noted or shown on drawings. Such bases shall extend 6 inches beyond equipment or mounting rails on all sides or as shown on the drawings and shall have a 1-inch beveled edge all around.

B. Inserts: Where slotted or other types of inserts required for this work are to be cast into concrete, they shall be furnished as work of this Division. Inserts shall be installed as work of Division 3, Concrete, but under the close supervision and direction of this section.

Concrete inserts and pipe support systems shall be equal to Unistrut P3200 series for all piping where more than one pipe is suspended at a common location. Spacing of the inserts shall match the size and type of pipe and of ductwork being supported. The Unistrut insert and pipe support system shall include all inserts, vertical supports, horizontal support members, clamps, hangers, rollers, bolts, nuts, and any other accessory items for a complete pipe-supporting system.

1.26 CLEANING AND PAINTING

A. Cleaning: After all tests and adjustments have been made and all systems pronounced satisfactory for permanent operation, this Contractor shall clean all exposed piping, ductwork, insulated members, fixture, and equipment installed under this Section and leave them ready for painting. He shall refinish any damaged finish and leave everything in proper working order. The Contractor shall remove all stains or grease marks on walls, floors, glass, hardware, fixtures, or elsewhere, caused by his workman or for which he is responsible. He shall remove all stickers on plumbing fixtures, do all required patching up and repair all work of others damaged by this division of the work, and leave the premises in a clean and orderly condition.

B. Painting: Painting of exposed pipe, insulated pipe, ducts, or equipment is work of Division 9, Painting.

Mechanical Contractor: All equipment which is to be furnished in factory prefinished conditions by the mechanical Contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.

C. Removal of Debris, Etc: Upon completion of this division of the work, remove all surplus material and rubbish resulting from this work, and leave the premises in a clean and orderly condition.

1.27 CONTRACT COMPLETION

A. Incomplete and Unacceptable Work: If additional site visits or design work is required by the Engineer or Architect because of the use of incomplete or unacceptable work by the Contractor, then the Contractor shall reimburse the Engineer and Architect for all additional time and expenses involved.

B. Maintenance Instructions: The Contractor shall furnish the Owner complete printed and illustrated operating and maintenance instructions covering all units of mechanical equipment, together with parts lists.

C. Instructions To Owner's Representatives: In addition to any detailed instructions called for, the mechanical Contractor must provide, without expense to the Owner, competent instructors to train the Owner's representatives who will be in charge of the apparatus and equipment, in the care, adjustment, and operation of all parts on the heating, air conditioning, ventilating, plumbing, fire protection, and automatic temperature control equipment. Instruction dates shall be scheduled at time of final inspection. A written report specifying times, dates, and name of personnel instructed shall be forwarded to the Architect. A minimum of four 8-hour instruction periods shall be provided. The instruction periods will be broken down to shorter periods when requested by the Owner. The total instruction hours shall not reduced. The ATC Contractor shall provide 4 hours of instructions. The remaining hours shall be divided between the mechanical and sheet metal Contractor.

D. Guarantee: By the acceptance of any contract award for the work herein described or shown on the drawings, the Contractor assumes the full responsibility imposed by the guarantee as set forth herein and in the General Conditions, and should protect himself through proper guarantees from equipment and special equipment Contractors and from subcontractors as their interests may appear.

The guarantee so assumed by the Contractor and as work of this Section is as follows:

That the entire mechanical system, including plumbing, heating, and air-conditioning system shall be quiet in operation.

That the circulation of water shall be complete and even.

That all pipes, conduit, and connections shall be perfectly free from foreign matter and pockets and that all other obstructions to the free passage of air, water, liquid, sewage, and vent shall be removed.

That he shall make promptly and free of charge, upon notice from the Owner, any necessary repairs due to defective workmanship or materials that may occur during a period of one year from date of Substantial Completion.

That all specialties, mechanical, and patent devices incorporated in these systems shall be adjusted in a manner that each shall develop its maximum efficiency in the operation of the system; i.e., diffusers shall deliver the designed amount of air shown on drawings, thermostats shall operate to the specified limits, etc.

All equipment and the complete mechanical, ductwork, piping and plumbing systems shall be guaranteed for a period of one year from the date of the Architect's Certificate of Substantial Completion, this includes all mechanical, ductwork, piping and plumbing equipment and products and is not limited to boiler, chillers, coils, fans, filters etc. Any equipment supplier not willing to comply with this guarantee period shall not submit a bid price for this project. The Contractor shall be responsible for a 100-percent guarantee for the system and all items of equipment for this period. If the contractor needs to provide temporary heating or cooling to the building and or needs to insure systems are installed properly and or to meet the project schedule the guaranteed of all systems and equipment shall be as indicated above, on year from the date of the Architect’s Certificate of Substantial Completion.

All filters used during construction shall be replaced just before equipment is turned over to the Owner, and all required equipment and parts shall be oiled. Any worn parts shall also be replaced.

If any systems or equipment is used for temporary heating or cooling the systems shall be protected so they remain clean. I.e. if the ductwork systems are used temporary filters and a filter holder (not duct-taped to ducts or grilles) shall be installed to insure the systems and the equipment remain clean.

1.28 CURBS

A. Unless otherwise noted in these specifications or on the documents all roof curbs for all equipment are to be provided by division 23.

1.29 TEST RUN

A. The Mechanical Contractor shall operate the mechanical system for a minimum of 30 days to prove the operation of the system.

1.31 EQUIPMENT STARTUP AND CHECKOUT:

A. Each major piece of equipment shall be started and checked out by an authorized representative of the equipment manufacturer. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided and shall be included in the commissioning report.

B. This contractor shall coordinate commissioning procedures and activities with the commissioning agent.

1.32 DEMOLITION

General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

Proceed with demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

Maintain adequate ventilation when using cutting torches.

Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

Dispose of demolished items and materials promptly.

Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

END OF SECTION 23 0100

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PART 1 - GENERAL

1.1 SUMMARY

A. This section includes requirements for temporary us of equipment and systems and any other items that are used during the construction of the project.

1.2 EQUIPMENT OR SYSTEMS NEEDED TO OPERATE BEFORE CONTRACT COMPLETION

A. If the contractor needs to provide temporary heating or cooling to the building and or needs to insure systems are installed properly and or to meet the project schedule the guaranteed of all systems and equipment shall be one year from the date of the Architect's Certificate of Substantial Completion.

All equipment and the complete mechanical, ductwork, piping and plumbing systems shall be guaranteed for a period of one year from the date of the Architect's Certificate of Substantial Completion, this includes all mechanical, ductwork, piping and plumbing equipment and products and is not limited to boiler, chillers, coils, fans, filters etc. Any contractor or equipment supplier who is not willing to comply with this guarantee period shall not submit a bid price for this project. The Contractor shall be responsible for a 100-percent guarantee for the systems and all items of equipment for this period.

All filters used during construction shall be replaced just before equipment is turned over to the Owner, and all required equipment and parts shall be oiled. Any worn parts shall also be replaced.

If any systems or equipment is used for temporary heating or cooling the systems shall be protected so they remain clean. I.e. if the ductwork systems are used temporary filters and a filter holder (not duct-taped to ducts or grilles) shall be installed to insure the systems and the equipment remain clean.

1.3 TEMPORATY EQUIPMENT OR SYSTEM SUBMITTALS

A. If it is determined by the project or contractor that equipment or systems are needed to operate to provide heating, cooling or other needed services this division shall submit a document indicating what measures will be taken to insure the safe and proper operation of the equipment, systems and personal associated with the operation, this document shall be submitted to the engineer for approval. This plan shall show connections of equipment, utility hookups (if required) staging areas etc.

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.

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

D. SMACNA: The latest standard from SSMACNA shall apply.

1.5 PROJECT CONDITIONS

A. Temporary Use of equipment or systems: Engage installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use until the facility has been accepted by the owner regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 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 and cooling units if required 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 filters with MERV of **8** at each return air opening in system and remove at end of construction. These filters are to be installed in a filter housing frame and are not to be duct taped. Clean HVAC system as required in Division 01 Section "Closeout Procedures.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate equipment where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify equipment and systems as required by progress of the Work.

1. Locate equipment to limit site disturbance as specified in Division 01 Section "Summary."

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. 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.

C. 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.

3.3 OPERATION, TERMINATION, AND REMOVAL

A. Maintenance: Maintain equipment and systems in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar equipment and systems on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

B. Termination and Removal: Remove each temporary facility or equipment when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials equipment that constitute temporary equipment are property of Contractor.
2. At Substantial Completion, repair, renovate, and clean permanent equipment and systems used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

3.4 EQUIPMENT STARTUP AND CHECKOUT:

A. Each major piece of equipment shall be started and checked out by an authorized representative of the equipment manufacturer at substantial completion. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided and shall be included in the commissioning report.

END OF SECTION 230150

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. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

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.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Eslon Thermoplastics.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Thompson Plastics, Inc.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Watts Industries, Inc.; Water Products Div.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated and rough brass.

D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

E. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.

M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. PVC Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section " Miscellaneous Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 230500

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SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

May 30, 2008

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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Basic requirements apply to mechanical equipment motors, unless otherwise indicated.

D. Motors 3/4 HP and Larger: Polyphase.

E. Motors Smaller than 3/4 HP: Single phase.

F. Frequency Rating: 60 Hz.

G. Voltage Rating: Determined by voltage of circuit to which motor is connected.

H. Service Factor: According to NEMA MG 1 – 2003, unless otherwise indicated.

I. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

J. Enclosure: Open drip-proof, unless otherwise indicated.

K. All motors shall have ASTM Grade 5 hardware that is Yellow Zinc-dichromate plated.

2.3 POLYPHASE MOTORS

A. Motors Used in Across the Line Starters or with Reduced-Inrush Controllers: Match wiring connection requirements for the indicated controller. Motor leads connections that are brought to motor terminal box shall be suitable with controller or starting method.

Description: EPACT NEMA MG 1, Low Voltage Induction Motor – Single Speed Application.

1. Design Characteristics: NEMA MG 1, Design B, unless otherwise indicated.
2. EPACT Energy-Efficient Design: As indicated by application.
3. Stator: Copper windings, unless otherwise indicated. Multispeed motors shall have separate winding for each speed.
4. Rotor: Squirrel cage, unless otherwise indicated.
5. Design Classification: NEMA Design B
6. Temperature Rise: Class F rise, unless otherwise indicated.
7. Insulation: Class F, unless otherwise indicated.
8. Minimum vibration: Each motor shall not exceed 0.5 G vibration peek/peek.
9. Bearings: Motor bearings shall be rated for an L-10 life 40,000 hours with an external load per NEMA MG 1-14 and an L-10 life of 100,000 hours in direct coupled applications for continuous duty and shall be of the regreasable type with grease relief fitting or Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading Per the motor manufactures standards.

B. Motors Used with Variable-Frequency Controllers shall meet the following: Current Ratings, characteristics, and features shall be rated for a minimum of 10:1 turndown ratio and the motor that is provided will be coordinated and approved by controller manufacturer. A Variable Frequency driven motor shall have the following characteristics:

1. Critical vibration frequencies shall be minimized so that motor will operate throughout the range of controller output based on the system requirements.
2. Temperature Rise: Class B rise.
3. Insulation: Class F.
4. Thermal Protection: Where indicated, conform to NEMA MG 1 requirements for thermally protected motors and inverter duty rated for NEMA MG-1-31 1998.
5. Bearings: Motor bearings shall be rated for an L-10 life 50,000 hours with an external load per NEMA MG 1-14 and an L-10 life of 100,000 hours in direct coupled applications for continuous duty and shall be of the regreasable type with automatic grease relief valve.
6. Motors shall be sized with respect to horsepower rating without using the service factor. All motors being operated by adjustable or variable frequency drives shall have a service factor 1.15 at equipments elevation.
7. The winding insulation system shall have an insulation rating of 1860 volt, peak with a 0.1 micro second rise time.
8. Motor stator and rotor steel shall be low-loss C-5 electrical grade silicon steel with interlaminated insulation system capable of withstanding a minimum 1000°F burnout.

9. Motors are to be of the NEMA Premium efficiency Design
10. All motor nameplates shall have raised letters stamped on stainless steel and be fastened to the motor frame with four stainless steel drive pins. Name plate shall meet applicable Nema MG1standards.

C. Severe-Duty Motors: Where indicated, motors are (TEFC) totally enclosed with 1.15 minimum service factors at altitude, and shall have greased bearings, integral condensate drains, and capped relief vents. Windings shall be insulated with non-hygroscopic material class H insulation. External finish shall be chemical-resistant paint over corrosion-resistant primer. The minimum performance and construction requirements are outline in part B of this specification.

D. Source Quality Control: Perform the following routine tests according to NEMA MG 1-12 and shall consist of:

1. No load watts input, current and speed (RPM).
2. Winding resistance test.
3. High-potential test.
4. Locked rotor watts input and current.
5. Stator insulation resistance test.
6. Visual inspection and factory approval.
7. Each motor shall have a factory certified test report forwarded with each motor and included in O&M Manual.

2.4 SINGLE-PHASE MOTORS

A. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application.

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: Do not use, unless motors are smaller than 1/20 hp.

C. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.

D. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, prelubricated sleeve bearings for other single-phase motors.

E. Motors are to have the ECM label where variable speed with variable input (0-5vDC) is indicated.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

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SECTION 230519 - METERS AND GAGES

May 30, 2008

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. Thermometers.
2. Gages.
3. Test plugs.

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, are limited to, the following:

1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Die-cast aluminum or brass, 9 inches long.

C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 THERMOWELLS

A. Manufacturers: Subject to compliance with requirements, are limited to, the following:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Marsh Bellofram.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

B. Manufacturers: Same as manufacturer of thermometer being used.

C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.3 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, are limited to, the following:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Eugene Ernst Products Co.
5. KOBOLD Instruments, Inc.
6. Marsh Bellofram.
7. Miljoco Corp.
8. Noshok, Inc.
9. Palmer - Wahl Instruments Inc.
10. REO TEMP Instrument Corporation.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass.
8. Ring: Stainless steel.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.4 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, [are limited to, the following:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Trerice, H. O. Co.
7. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

E. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, one thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.

3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
4. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.

B. Provide the following temperature ranges for thermometers:

1. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
2. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.
3. Air Ducts: Minus 40 to plus 110 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.

B. Install liquid-filled-case-type pressure gages at chilled-water inlets and outlets of chillers.

C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

A. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.

B. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

C. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).

D. Install needle-valve and syphon fitting in piping for each pressure gage for steam.

E. Install test plugs in tees in piping.

F. Install flow indicators, in accessible positions for easy viewing, in piping systems.

G. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.

H. Install permanent indicators on walls or brackets in accessible and readable positions.

I. Install connection fittings for attachment to portable indicators in accessible locations.

3.4 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

END OF SECTION 230519

N:\07\07400\07414 Losee Center Addition\03_Specifications\90%\230519 Meters and Gages.DOC

SECTION 230523 – GENERAL PIPING VALVES FOR HVAC 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 general duty valves common to several mechanical piping systems.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Special purpose valves are specified in Division 23 Sections.
2. Valve tags and charts are specified in Division 23 Section "Identification for HVAC piping and equipment."

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.

C. Maintenance data for valves to include in the operation and maintenance manual specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Comply with the requirements specified in Division 1 Section "Materials and Equipment," under "Source Limitations" Paragraph.

B. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set globe and gate valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Center Line
2. Conbraco Industries, Inc., Apollo Division
3. Cla-Val Company
4. Grinnell Corporation
5. Hammond Valve Corporation
6. Keystone Valve USA, Inc.
7. Metraflex Company
8. Milwaukee Valve Company, Inc.
9. NIBCO, Inc.
10. Stockham Valves & Fittings, Inc.
11. Val-Matic Valve & Mfg. Corporation
12. Victaulic Company of America
13. Bray

2.2 BASIC, COMMON FEATURES

A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.

1. Nonrising stem valves may be used only where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Operators: Use specified operators and handwheels, except provide the following special operator features:

1. Handwheels: For valves other than quarter turn.
2. Lever Handles: For quarter-turn valves 6 inches and smaller, except for plug valves, which shall have square heads. Furnish Owner with 1 wrench for every 10 plug valves.
3. Chain-Wheel Operators: For valves 4 inches and larger, installed 120 inches or higher above finished floor elevation.
4. Gear-Drive Operators: For quarter-turn valves 8 inches and larger.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.

G. Threads: ASME B1.20.1.

H. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24for bronze valves.

I. Solder Joint: ASME B16.18.

1. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 GATE VALVES

A. No gate valves will be used on this project.

2.4 BALL VALVES, HOT & CHILLED WATER

A. Ball Valves, 4 Inches and Smaller: MSS SP-110, 600-psi CWP, ASTM B 584 ,B 61 or B 62 bronze body (containing no more than 15% zinc), 2-piece construction; chrome-plated, full port, brass ball; blowout proof; silicon- bronze or silicon-brass stem; teflon seats and seals; threaded or soldered end connections,.
   1. Operator: Vinyl-covered steel lever handle for sizes 2-1/2" and smaller.
   2. Operator: Lever operators with lock for sizes 3" and larger.
   3. Valves shall be equipped with 2" extended handles of non-thermal conductive material. Also provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Supply with memory stops, which are fully adjustable after insulation is applied.

B. Memory Stop: For operator handles.

2.5 PLUG VALVES

A. Plug Valves: MSS SP-78, 175-psi CWP, ASTM A 126 cast-iron body and bonnet, cast-iron plug, Viton, or teflon packing, flanged or grooved end connections:

   1. Operator: Square head with 1 wrench for every 10 valves.
   2. Operator: Worm and gear with handwheel, sizes 6 inches and larger.
   3. Operator: Worm and gear with chain wheel, sizes 6 inches and larger, 120 inches or higher above floor.

2.6 GLOBE VALVES

A. Globe Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 150, 300-psi CWP; ASTM B 62 cast-bronze body and screwed bonnet, rubber, bronze, or teflon disc, silicon bronze-alloy stem, teflon-impregnated packing with bronze packing nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.

B. Globe Valves, 3 Inches and Larger: MSS SP-85, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted bonnet with bronze fittings, renewable bronze seat and disc, brass-alloy stem, outside screw and yoke, teflon-impregnated packing with cast-iron follower, flanged end connections; and with cast-iron handwheel.

2.7 BUTTERFLY VALVES

A. Butterfly Valves: MSS SP-67 200/250 CWP, ASTM A536 Ductile Iron, full lug body, 2 inch extended neck, 316 stainless steel or aluminum-bronze disc, slide through one piece 400 series stainless steel stem design with geometric connection to disc no taper pins, molded-in EPDM seat liner. Valves must be suitable for bi-directional dead end service at valves dead and rated pressure service with out the need for downstream flanges. The disk can be made of stainless steel for chilled water valves.

Operator for sizes 2-1/2” to 6”: Lever handle with latch lock.
Operator for sizes 8” to 24”: Weather-proof Handwheel gear operator.
Operator for 8” and larger, 120 “ or higher above floor: Cain-wheel operator assembly.

B. Butterfly Valves for high pressure applications:
Valves shall meet the requirements of MSS SP-68, High Pressure Butterfly Valves with Offset Design. Unless otherwise indicated, full lug type valves suitable for bi-directional end of line service at full rated pressure, without the need of a downstream flange. ANSI Class 150 or 300, Carbon Steel Body, Stainless Steel Disc, Stainless Steel or Duplex Steel Stem, PTFE Seats, PTFE or Graphite Seals. Permanently lubricated bearings of 316 Stainless Steel with Graphite. 2 ½” to 6” shall have lever lock operator, 8” and larger shall have gear operators or Pneumatic/Electric Actuators.

NIBCO Figure Number LCS6822 (Class 150)
NIBCO Figure Number LCS7822 (Class 300)

2.8 CHECK VALVES

A. Swing Check Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and bonnet cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:

B. Swing Check Valves, 3 Inches and Larger: MSS SP-71 Type 1, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted bonnet cap, horizontal-swing bronze disc, flanged or grooved end connections.

1. On sumppump discharge use swing check valve with external spring or lever and weight.

C. Wafer Check Valves: Class 125, 200-psi CWP, ASTM A 126 cast-iron body, bronze disc/plates, stainless-steel pins and springs, Buna N seals, installed between flanges.

1. On grooved piping systems use grooved by grooved check valve in lieu of flanged or wafer with grooved flange adapters.

D. Lift Check Valves: Class 125, ASTM B 62 bronze body and cap (main components), horizontal or vertical pattern, lift-type, bronze disc or Buna N rubber disc with stainless-steel holder threaded or soldered end connections.

2.9 DRAIN VALVES

A. Full port bronze ball valves with ¾” hose thread outlet and hose cap and chain.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves as indicated, according to manufacturer's written instructions.

B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the center of the pipe.

F. Install valves in a position to allow full stem movement.

G. Installation of Check Valves: Install for proper direction of flow as follows:

1. Swing Check Valves: Horizontal position with hinge pin level.
2. Wafer Check Valves: Horizontal or vertical position, between flanges.
3. Lift Check Valve: With stem upright and plumb.

Note – Install all checks a minimum of 5 pipe diameters downstream of pump discharge or elbow to avoid flow turbulence. Flow straighteners may be needed in extreme cases.

3.3 SOLDERED CONNECTIONS

A. Cut tube square and to exact lengths.

B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.

C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.

D. Open gate and globe valves to fully open position.

E. Remove the cap and disc holder of swing check valves having composition discs.

F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.

G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 THREADED CONNECTIONS

A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.

D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.5 FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

C. For dead-end service, all butterfly valves, except for the NIBCO LD2000 / 3000, require flanges both upstream and downstream for proper shutoff and retention. NIBCO LD2000 / 3000 series butterfly valves are suitable for bubbletight dead-end service with out the need for a downstream flange.

3.6 VALVE END SELECTION

A. Select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size, 2-1/2 Inches and Smaller:
2. Steel Pipe Sizes, 2-1/2 Inches and Smaller: Threaded or grooved end.
3. Steel Pipe Sizes, 3 Inches and Larger: Grooved end or flanged.

3.7 APPLICATION

A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.

3.8 ADJUSTING

A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION 230523

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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 hangers and supports for HVAC system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
3. Division 23 Section " Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
4. Division 23 Section " Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
5. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel." ASME Boiler and Pressure Vessel Code: Section IX.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
5. ASME Boiler and Pressure Vessel Code: Section IX.

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 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

H. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

J. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and 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. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

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PART 1 - GENERAL

1.1 DESCRIPTION

The work in this section consists of furnishing engineering and materials necessary for vibration isolation and seismic restraints for equipment contained herein for the project.

Other sections of DIVISION 23 form a part of this section. Refer to all sections for a complete description of the work.

All mechanical equipment .75 HP and over listed in the equipment schedule shall be mounted on vibration isolators to prevent the transmission of objectionable vibration and vibration induced sound to the building structure.

All isolation materials, flexible connectors and seismic restraints shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.

The contractor and manufacturer of the isolation and seismic equipment shall refer to the isolator and seismic restraint schedule which lists isolator types, isolator deflections and seismic restraint type. Vibration isolators shall be selected in accordance with the equipment, pipe or duct weight distribution so as to produce reasonably uniform deflections.

Unless otherwise specified, all mechanical, electrical, and plumbing equipment, pipe, and duct shall be restrained to resist seismic forces. Restraints shall maintain equipment, piping, and duct work in a captive position. Restraint devices shall be designed and selected to meet the seismic requirements as defined in the latest issue of the IBC or local jurisdiction building code.

These exceptions are based on IBC 2006. Verify local code is the same. The 2006 IBC requires that mechanical & electrical components be given an importance factor. This importance factor is used to determine which equipment may or may not be exempt from seismic design force requirements. The component importance factor is determined as follows:

$I_p = 1.5$	Life-safety component is required to function after an earthquake.
$I_p = 1.5$	Component contains hazardous or flammable material.
$I_p = 1.5$	Storage racks in occupancies open to the general public (e.g., warehouse retail stores).
$I_p = 1.0$	All other components.

In addition, for structures in Seismic Use Group III (Buildings having essential facility required for post earthquake recovery, and those containing substantial quantities of hazardous substances as designated by local building officials),

$I_p = 1.5$	For components needed for continued operation of the facility or whose failure could impair the continued operation of the facility. This project shall use an IP = 1.5.

1.2 Seismic restraint shall not be required for the following:

Rigidly floor mounted mechanical, electrical, and plumbing components in all seismic design categories, where $I_p = 1.0$ and flexible connections between the components and associated duct work, piping and conduit are provided, that are mounted at 4 feet (1219 mm) or less above a floor level and weight 400 pounds (1780 N) or less and are not critical to the continued operation of the structure. Suspended, wall mounted and flexibly mounted equipment are not included in this exclusion.

Hanging, wall mounted, and flexibly supported mechanical, plumbing and electrical components that weigh 20 pounds (89 N) or less, where I p = 1.0 and flexible connections are provided between the components and associated duct work, piping and conduit.

Piping supported by individual clevis hangers where the distance, as measured from the top of the pipe to the supporting structure, is less than 12 inches (305mm) for the entire pipe run and the pipe can accommodate the expected deflections. Trapeze or double rod hangers where the distance from the top of the trapeze or support to the structure is less than 12 inches for the entire run. Hanger rods shall not be constructed in a manner that would subject the rod to bending moments (swivel, eye bolt, or vibration isolation hanger connection to structure).

High deformability piping (steel, copper, aluminum with welded, brazed, ground, or screwed connections) designated as having an Ip = 1.5 and a nominal pipe size of 1 inch (25 mm) or less where provisions are made to protect the piping from impact or to avoid the impact of larger piping or other mechanical equipment. Note, any combination of piping supported on a trapeze where the total weight exceeds 10 lb/ ft. must be braced.

High deformability piping (steel, copper, aluminum with welded, brazed, ground, or screwed connections) and limited deformability piping (cast iron, FRP, PVC) designated with an Ip = 1.0 and a nominal pipe size of 1 inch and less in the mechanical equipment room, or 2" and less outside the mechanical equipment room.

PVC or other plastic or fiberglass vent piping.

HVAC ducts suspended from hangers that are 12 inches (305 mm) or less in length from the top of the duct to the supporting structure and the hangers are detailed to avoid significant bending of the hangers and their connections. Duct must be positively attached to hanger with minimum #10 screws within 2" from the top of the duct.

HVAC duct with an I p = 1.5 that have a cross-section area less than 4 square feet. HVAC ducts with an I P = 1.0 that have a cross sectional area of less than 6 square feet (0.557 m2).

Equipment items installed in-line with the duct system (e.g, fans, heat exchangers and humidifiers) with an operating weight less than 76 pounds (334 N). Equipment must be rigidly attached to duct at inlet and outlet.

1.3. MANUFACTURER'S RESPONSIBILITIES: Manufacturer of vibration and seismic control products shall have the following responsibilities:

Determine vibration isolation and seismic restraint sizes and locations.

Provide piping, ductwork and equipment isolation systems and seismic restraints as scheduled or specified.

Provide installation instructions and shop drawings for all materials supplied under this section of the specifications.

Provide calculations to determine restraint loads resulting from seismic forces presented in local building code or IBC, Chapter 16 latest edition. Seismic calculations shall be certified by a licensed engineer in the employ of the seismic equipment manufacturer with a minimum 5 years experience. Provide calculations for all floor or roof mounted equipment 400lbs (1780 N) or greater (20lbs (89 N)or greater for Ip=1.5), all suspended or wall mounted equipment 20lbs (89 N)or greater, and vibration isolated equipment 20lbs (89 N)or greater.

Seismic restraint load ratings must be certified and substantiated by testing or calculations under direct control of a registered professional engineer.

Calculations and restraint device submittal drawings shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors from concrete edges. Concrete anchor locations shall not be near edges, stress joints, or an existing fracture. All bolts shall be ASTM A307 or better.

1.4 QUALITY CONTROL

The isolators and seismic restraint systems listed herein are as manufactured by Amber / Booth, Mason Industries Inc. (M.I.), Kinetics Noise Control Inc. (K.N.C.), Vibration Mounting & Controls, Inc. (V.M.C.). Manufacturer must be a member of the Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

Steel components shall be cleaned and painted with industrial enamel. All nuts, bolts and washers shall be zinc-electroplated. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

All isolators, bases and seismic restraints exposed to the weather shall utilize cadmium-plated, epoxy coat or PVC coated springs and hot dipped galvanized steel components. Nuts, bolts and washers may be zinc-electroplated. Isolators for outdoor mounted equipment shall provide adequate restraint for the greater of either wind loads required by local codes or withstand a minimum of 30 lb. / sq. ft. applied to any exposed surface of the equipment.

Provide a written quality control procedure that outlines complete compliance of attachment of cabling restraints to brackets. For swaged connections, provide a gage to verify swage. For screw/clamp connection, provide torque values for attachment fasteners.

1.5 SUBMITTALS

Submit shop drawings of all isolators, seismic restraints and calculations provided (para 1.3).

The manufacturer of vibration isolation products shall submit the following data for each piece of isolated equipment: clearly identified equipment tag, quantity and size of vibration isolators and seismic restraints for each piece of rotating isolated equipment. Submittals for mountings and hangers incorporating springs shall include spring diameter and free height, rated deflections, and solid load. Submittals for bases shall clearly identify locations for all mountings as well as all locations for attachment points of the equipment to the mounting base. Submittals shall include seismic calculations signed and checked by a qualified licensed engineer in the employ of the manufacturer of the vibration isolators. Catalog cut sheets and installation instructions shall be included for each type of isolation mounting or seismic restraint used on equipment being isolated.

Submit quality assurance procedures as required under 1.4.4 at time of isolator/seismic submittals. Submittal must be stamped by a registered professional engineer who is responsible for the seismic restraint design. All vibration isolation/seismic submittals not complying with this certification will be rejected.

Provide shop drawings indicating location of all specification SC cable restraints (section 2.3.2) required for pipe and ductwork. Drawings must be stamped by manufacturer's registered professional engineer.

Mechanical, electrical and plumbing equipment manufacturers shall provide certification that their equipment is capable of resisting expected seismic loads without failure. Equipment manufacturers shall provide suitable attachment points and/or instructions for attaching seismic restraints.

Provide a certification from the seismic design engineer that the seismic restraints will comply with the applicable code requirements. Certification must be stamped by a registered profession engineer.

Provide a Certificate of Completion from the manufacturer's representative upon completion of the job.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

Specification W: a pad type mounting consisting of two layers of ribbed elastomeric pads with a ½" poro-elastic vibration absorptive material bonded between them. Pads shall be sized for approximate deflection of 0.10" to 0.18". Pads shall be Amber / Booth Type NRC.

Specification A: an elastomeric mounting having a steel baseplate with mounting holes and a threaded insert at top of the mounting for attaching equipment. All metal parts shall be completely embedded in the elastomeric material. Mountings shall be designed for approximately 1/2" deflection, and incorporate a steel seismic snubber with all directional restraint. Mountings shall be Amber/Booth Type SRVD.

Specification B: an adjustable, freestanding, open spring mounting with combination leveling and equipment fastening bolt. The spring shall be welded to the spring mounting baseplate and compression plate for stability. The isolator shall be designed for a minimum kx/ky (horizontal-to-vertical spring rate) of 1.0. An elastomeric pad having a minimum thickness of 1/4" shall be bonded to the baseplate. Nuts, adjusting bolts and washers shall be zinc-electroplated to prevent corrosion. This type isolator must be used with specification SL seismic restraint (section 2.3.1). Isolators shall be Amber/Booth Type SW.

Specification C: a unitized adjustable, stable open spring isolator with a seismic restraint housing which serves as a blocking device during equipment installation. The spring package shall include an elastomeric pad for high frequency absorption at the base of the spring. The springs shall be designed for a minimum kx/ky (horizontal-to-vertical spring rate) of 1.0. Nuts, adjusting bolts and washers shall be zinc-electroplated to prevent corrosion. The spring assembly shall be removable with equipment in place and shall fit within a welded steel enclosure consisting of a top plate and rigid lower housing. Isolated seismic restraint bolts shall connect top plate to lower housing to resist seismic and wind forces in all directions and limit motion to a maximum of 1/4" movement before engaging. Surfaces that engage under seismic motion shall be cushioned with a resilient elastomeric pad or grommet to protect equipment. Top plate shall have adequate means for fastening to the equipment, and baseplate shall have adequate means for bolting to structure. Entire assembly shall be rated to exceed the applied seismic load (para 1.3.4.). Seismic isolator shall be Amber/Booth Type CTER.

Specification D: an elastomeric hanger consisting of a rectangular steel box capable of 200% minimum overload without visible deformation, 30 degree rod misalignment and an elastomeric isolation element designed for approximately 1/2" deflection. Hangers shall be Amber/Booth Type BRD.

Specification E: a combination spring and elastomeric hanger consisting of a rectangular steel box capable of 200% minimum overload without visible deformation, 30 degree rod misalignment, coil spring, spring retainers and elastomeric element designed for approximately 1/2" deflection. The spring shall be designed for a minimum kx/ky (horizontal-to-vertical spring rate) of 1.0. Spring hangers shall be Amber/Booth Type BSRA.

Specification F: a set (two or more) of spring thrust resisting assemblies, which consist of coil springs, spring retainer, isolation washer, angle mounting brackets, and elastomeric tubing for isolating thrust resister rod from fan discharge. Thrust restraints shall be Amber / Booth Type TRK.

Specification SB: a unitized adjustable open spring isolator and a welded steel housing designed to resist seismic forces in all directions. Restraint surfaces which engage under seismic motion shall be cushioned with a resilient elastomer to protect equipment. Restraints shall allow a maximum of 1/4" movement before engaging and shall allow for the spring to be changed if required. Isolator shall be a stable spring with a minimum ky/ky of 1.0. The spring package shall include an elastomeric pad for high frequency absorption at the base of the spring. Nuts and bolts shall be zinc-electroplated to prevent corrosion. Bolting equipment to isolator with bolts smaller than main adjusting bolt will not be allowed.

Base plate shall provide means for bolting to the structure. Entire assembly shall be rated to exceed the applied seismic load (para 1.3.4.) Mountings shall be Amber/Booth Type SWSR.

2.2 BASES

Specification G: a welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. The steel members shall be adequately sized to prevent distortion and misalignment of the drive, and specifically, shall be sized to limit deflection of the beam on the drive side to 0.05" due to starting torque. Snubbers to prevent excessive motion on starting or stopping shall be furnished if required; however, the snubbers shall not be engaged under steady running conditions. Bases shall be Amber/Booth Type SFB.

Specification H: a welded WF (main member) structural steel base for increasing rigidity of equipment mounted thereon or for unitizing belt driven fans. Fan bases shall have holes drilled to match fan and located to provide required center distance between fan and supplied NEMA standard motor slide rails. The steel members shall have minimum depth of 1/12" of the longest span, but not less than 6" deep. Junior beams and junior channels shall not be used. Cross members shall be provided where necessary to support the equipment or to prevent twisting of the main members. Where height restrictions prevent the use of members having a depth of 1/12 of the longest span, beams of less depth may be used provided they have equal rigidity. Provide height-saving brackets for side mounting of the isolators. Brackets for use with Specification type B isolators having 2.5" deflection or greater shall be of the precompression type to limit exposed bolt length. Bases shall be Amber/Booth Type WSB.

Specification J: a concrete inertia base consisting of perimeter structural steel concrete pouring form (CPF), reinforcing bars welded in place, bolting templates with anchor bolts and height-saving brackets for side mounting of the isolators. Brackets for use with Specification type B isolators having 2.5" deflection or greater shall be of the pre-compression type to limit exposed bolt length. The perimeter steel members shall have a minimum depth of 1/12 of the longest span, but not less than 6" deep. The base shall be sized with a minimum overlap of 4" around the base of the equipment and, in the case of belt-driven equipment, 4" beyond the end of the drive shaft. Fan bases are to be supplied with NEMA standard motor slide rails. The bases for pumps shall be sized to support the suction elbow of end suction pumps and both the suction and discharge elbows of horizontal split-case pumps. The bases shall be T-shaped where necessary to conserve space. Inertia bases shall be Amber/Booth Type CPF.

2.3 SEISMIC RESTRAINTS:

Specification SL: a restraint assembly for floor mounted equipment consisting of welded steel interlocking assemblies welded or bolted securely to the equipment or the equipment bases and to the supporting structure. Restraint assembly surfaces which engage under seismic motion shall be lined with a minimum ¼" thick resilient elastomeric pad to protect equipment. Restraints shall be field adjustable and be positioned for 1/4" clearance as required to prevent interference during normal operation. Restraint assembly shall have minimum rating of 2 times the catalog rating at 1 G as certified by independent laboratory test. Restraint shall be Amber/Booth Type ER.

Specification SC: a restraint assembly for suspended equipment, piping or ductwork consisting of high strength galvanized steel aircraft cable. Cable must have Underwriters Laboratories listed certified break strength, and shall be color-coded for easy field verification. Secure cable to structure and to braced component through bracket or stake eye specifically designed to exceed cable restraint rated capacity. Cable must be manufactured to meet or exceed minimum materials and standard requirements per AISI Manual for structural applications of steel cables and ASTM A603. Break strengths must be per ASTM E-8 procedures. Safety factor of 1.5 may be used when prestretched cable is used with end connections designed to meet the cable break strength. Otherwise safety factor 3.76 must be used. Cables shall be sized for a force as listed in section 1.3. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation. Restraint shall be type LRC.

2.4 PIPE GUIDES AND ANCHORS FOR ISOLATED PIPING

Specification M: For Pipe Guides where specifically shown on drawings to accommodate expansion loops and compensators, the vibration isolator manufacturer shall provide pipe guides consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum, half

inch thickness of heavy duty neoprene and duck or elastomeric isolation material. Guides shall be Amber/ Booth type AG.

Specification N: For anchors where specifically shown on drawings to accommodate expansion loops and compensators, the vibration isolator manufacturer shall provide all directional acoustical pipe anchors consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum half inch thickness of heavy duty neoprene and duck or elastomeric isolation material. All-directional anchors shall be Amber/Booth type AG.

PART 3 - EXECUTION

3.1 Isolator and seismic restraints shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 0.75 hp and over per the isolation schedule and these specifications.

3.2 PIPING ISOLATION

Horizontal Pipe Isolation: all HVAC pumped water piping size 1-1/4" and larger within mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50' or 100 pipe diameters from rotating equipment. For the first 3 support locations from externally isolated equipment provide specification E hangers or specification SB or SX floor mounts with the same deflection as equipment isolators (max 2"). All other piping within the equipment rooms shall be isolated with the same specification isolators with a 3/4" minimum deflection. Steam piping size 1-1/4" and larger which is within an equipment room and connected to rotating equipment shall be isolated for three (3) support locations from the equipment. Provide specification E or SB (SX) isolators with the same deflection as the equipment but a minimum of ¾"

All plumbing pumped water 1-1/4" and larger within mechanical rooms shall be isolated the same as HVAC piping (para. 3.2.1). Isolators are not required for any plumbing pumped water, pumped condensate, and steam piping outside of mechanical rooms unless listed in the isolation schedule (para. 3.5.5.)

Pipe Riser Isolation: All variable temperature vertical pipe risers 1-1/4" and larger, riser piping requiring isolation per para. 3.2.1 or 3.2.2 or where specifically shown and detailed on riser drawings shall be fully supported by specification B mounts with precompression plates. Steel spring deflection shall be 3/4-inch minimum except in those locations where added deflection is required due to pipe expansion and contraction. Spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Pipe risers up through 16" shall be supported at intervals of every third floor of the building. Pipe risers 18" and over, every second floor. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Horizontal take-offs and at upper and lower elbows shall be supported with spring isolators as required to accommodate anticipated movement. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist if installed per design proposed. Riser supports shall be Amber/Booth Type SWP.

3.3 DUCT ISOLATION:

Isolate all duct work with a static pressure 2" W.C. and over in equipment rooms and to minimum of 50 feet from the fan or air handler. Use specification type E hangers or type SB (SX) floor mounts.

3.4 INSTALLATION

Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary support during installation or shipping.

Locate isolation hangers as near the overhead support structure as possible.

Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of 2 inch clearance below base will result when supported equipment has been installed and loaded for operation.

Roof curbs shall be installed directly to building structural steel or concrete roof deck. Installation on top of steel deck or roofing material is not acceptable.

3.5 APPLICATION OF SEISMIC RESTRAINTS

ISOLATED EQUIPMENT

All floor mounted isolated equipment shall be protected with type SB or type C unitized isolator and restraint or with separate type SL restraints (minimum of 4) in conjunction with type B isolators. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.

All suspended isolated equipment and vessels shall be protected with specification SC restraints. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation.

Rigidly Mounted Equipment

Floor mounted which are not exempt (para.1.2.) shall be protected by properly sized anchor bolts with elastomeric grommets provided by the isolation manufacturer. Suspended equipment shall be protected with type SC bracing.

PIPING

All piping shall be protected in all planes by SC restraints, designed to accommodate thermal movement as well as restrain seismic motion. (Spring-loaded control rods should be used on flexible connectors in system). Tanks and vessels connected inline to piping shall be restrained independently. Locations shall be as determined by the isolator/seismic restraint supplier and shall include, but not be limited to: (1) At a proximity to protect all drops to equipment connections. (2) At changes in direction of pipe as required to limit over stressing of pipe or movement that contacts other building material. (3) At horizontal runs of pipe, not to exceed the spacing as presented in Amber/Booth design criteria. (4) SMACNA design criteria. Seismic restraints shall not be required for piping exempted by paragraph 1.2.

Where riser pipes pass through cored holes, core diameters to be a maximum of 2" larger than pipe O.D. including insulation. Cored holes must be packed with resilient material or firestop as provided by other sections of this specification or local codes. No additional horizontal seismic bracing is required. Restrained isolators type C or SB shall support risers and provide longitudinal restraint at floors where thermal expansion is minimal and will not bind isolator restraints. For risers in pipe shafts, specification SC cable restraints shall be installed at each level in a manner that does not interfere with thermal movement.

DUCT WORK

Duct work 6 square feet and larger in cross sectional area shall be protected in all planes by SC restraints. Locations shall be determined by the isolator supplier and shall include, but not be limited to: (1) at equipment connections as required to protect the connections. (2) at all duct

runs and duct run ends (transverse bracing and longitudinal bracing not to exceed spacing specified in Amber/Booth, or SMACNA guidelines).

The isolation and/or seismic restraints listed shall be furnished and installed for the equipment listed in the table below in accordance with the previous sections of this specification:

3.6 QUALITY ASSURANCE

Representative of seismic restraint system manufacturer to walk the project and provide documentation indicating conformance to ISAT shop drawing seismic restraint layout.

EQUIPMENT ISOLATION SCHEDULE (1)(4)									
	LOCATION								
	A' CRITICAL (35'-50' SPAN)			B' UPPER STORY (20'-35' SPAN)			C' GRADE		
EQUIPMENT	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE (1) TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE (1) TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE (1) TYPE
AIR HANDLING UNITS									
FLOOR MOUNTED									
UP TO 15 HP	SWSR	1.5		SWSR	0.75		SWSR	0.75	
20 HP & OVER	SWSR	2.5	WSB	SWSR	1.5		SWSR	0.75	
SUSPENDED (4)									
UP TO 15 HP	PBSRA	1.75		BSRA	1		BSRA	1	
20 HP & OVER	PBSRA	2.5	. WSB	PBSRA	1.75		PBSRA	1	
HIGH PRESSURE FAN SECTIONS (2)									
UP TO 30 HP	SW	2.5	CPF	SWISWSR	1.5	CPF	SWISWSR	0.75	CPF
40 HP & OVER	SW	3.5	CPF	SWISWSR	2.5	CPF	SWISWSR	1.5	CPF
CENTRIFUGAL FANS									
CL. I & II UP TO *54-112"* W.D.									
UPT015HP	SWISWSR	1.5	SFB	SWISWSR	0.75	SFB	SWISWSR	0.75	SFB
20-50 HP	SW	2.5	CPF	SWISWSR	1.5	CPF	SWISWSR	0.75	SFB
60 HP & OVER	SW	3.5	CPF	SW	2.5	CPF	SWISWSR	1.5	SFB
CL. I & II 60" W.D. & OVERI ALL CL. III FANS									
UPT015HP	SW	2.5	CPF	SWISWSR	1.5	CPF	SWISWSR	0.75	CPF
20-50 H P	SW	2.5	CPF	SW	2.5	CPF	SWISWSR	1.5	CPF
60 HP & OVER	SW	3.5	CPF	SW	2.5	CPF	SWISWSR	1.5	CPF
PUMPS									
FLOOR MTD.									
UP TO 15 HP	SWISWSR	0.75	CPF	SWISWSR	0.75	CPF	SRVD	0.4	CPF
7-112 HP & OVER	SWISWSR	1.5	CPF	SWISWSR	1.5	CPF	SWISWSR	0.75	CPF
SUSPENDED INLINE	PBSRA	1.75		PBSRA	1.75		PBSRA	1	

NOTES:

1) WITH TYPE ER SEISMIC SNUBBERS IF SW ISOLATORS ARE USED. NO ADDITIONAL SNUBBER IS REQUIRED FOR SWSR ISOLATORS.
2) TYPE TRK THRUST RESISTORS REQUIRED ON ALL HIGH PRESSURE FAN SECTIONS, SUSPENDED AXIAL FLOW FANS AND ON FLOOR MOUNTED AXIAL FANS OPERATING AT 3" S.P. OR GREATER.
3) WITH STEEL BASE TYPE WSB IF REQUIRED FOR SUPPORT.
4) SEISMIC RESTRAINTS SC MUST BE USED WITH ALL SUSPENDED ISOLATED EQUIPMENT.

END OF SECTION 230548

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SECTION 23 0550 - OPERATIONS & MAINTENANCE MANUALS

PART 1- GENERAL

1.1 RELATED DOCUMENTS

A. All pertinent sections of Division 23 Mechanical General Requirements, are part of the work of this Section. Division 1 is part of this and all other sections of these specifications.

1. Testing and Balancing is specified in section 230594.
2. Training and Instructions to Owner's Representative is specified in section 230100.

1.2 SCOPE OF WORK

A. Submission of Operating and Maintenance Manuals complete with Balancing reports. (Coordinate with Division 1).

B. Coordination of work required for system commissioning.

1.3 SUBMITTALS

A. Submit product data in accordance with Division 1 and Section 230100. Submit the following:

B. Sample of O and M manual outline.

PART 2 - PRODUCTS

2.1 O & M MANUALS

A. The operating and maintenance manuals shall be as follows:

1. Binders shall be red buckram with easy-view metal for size 8-1/2 x 11-inch sheets, with capacity expandable from 2 inches to 3-1/2 inches as required for the project. Construction shall be rivet-through with library corners. No. 12 backbone and lining shall be the same material as the cover. The front cover and backbone shall be foil-stamped in white as follows: (coordinate with Section 1730)

OPERATING AND MAINTENANCE
MANUAL
FOR THE

(INSERT PROJECT NAME)

2007

VOLUME No. ( )

VAN BOERUM & FRANK ASSOCIATES, INC.
MECHANICAL ENGINEER

(INSERT ARCHITECT)

Binders shall be a manufactured by Hiller Bookbinding.

PART 3- EXECUTION

3.1 OPERATING AND MAINTENANCE MANUALS:

A. Work under this section shall be performed in concert with the contractor performing the system testing and balancing. Six (6) copies of the manuals shall be furnished to the Architect for distribution to the owner.

B. The "Start-Up and Operation" section is one of the most important in the manual. Information in this section shall be complete and accurately written and shall be verified with the actual equipment on the job, such as switches, starters, relays, automatic controls, etc. A step-by-step start-up procedure shall be described.

C. The manuals shall include water-balancing reports, system commissioning procedures, start-up tests and reports, equipment and system performance test reports, warranties, and certificates of training given to the owner's representatives.

D. An index sheet typed on AICO Gold-Line indexes shall be provided in the front of the binder. The manual shall be include the following:

SYSTEM DESCRIPTIONS

START-UP PROCEDURE AND OPERATION OF SYSTEM

MAINTENANCE AND LUBRICATION TABLE

OPERATION AND MAINTENANCE BULLETINS

AUTOMATIC TEMPERATURE CONTROL DESCRIPTION OF OPERATION, INTERLOCK AND CONTROL DIAGRAMS, AND CONTROL PANELS.

AIR AND WATER SYSTEM BALANCING REPORTS

EQUIPMENT WARRANTIES AND TRAINING CERTIFICATES

SYSTEM COMMISSIONING REPORTS

EQUIPMENT START-UP CERTIFICATES

END OF SECTION 23 0550

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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 mechanical identification materials and devices.

B. All ductwork and piping and equipment is to be per UVU standards. Use this sections if a standard does not exists.

1.3 SUBMITTALS

A. Product Data: For identification materials and devices.

B. Samples: Of color, lettering style, and graphic representation required for each identification material and device.

1.4 QUALITY ASSURANCE

A. Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 IDENTIFYING DEVICES AND LABELS

A. General: Products specified are for applications referenced in other Division 22 & 23 Sections. If more than single type is specified for listed applications, selection is Installer's option.

B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
2. Location: Accessible and visible.

C. Stencils: Standard stencils, prepared with letter sizes conforming to recommendations of ASME A13.1. Minimum letter height is 1-1/4 inches for ducts, and 3/4 inch for access door signs and similar operational instructions.

1. Stencil Paint: Exterior, oil-based, alkyd gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
2. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

D. Snap-On Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

E. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.

F. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least 3 times letter height and of length required for label.

G. Lettering: Manufacturer's standard preprinted captions as selected by Engineer.

H. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

1. Arrows: Either integrally with piping system service lettering, to accommodate both directions, or as separate unit, on each pipe marker to indicate direction of flow.

I. Plastic Duct Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cold-air supply.
2. Yellow: Hot-air supply.
3. Blue: Exhaust, outside, return, and mixed air.
4. Hazardous Material Exhausts: Use colors and designs recommended by ASME A13.1.
5. Terminology: Include direction of airflow; duct service such as supply, return, and exhaust; duct origin, duct destination, and design flow.

J. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive, vinyl tape, at least 3 mils thick.

1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
2. Color: Comply with ASME A13.1, unless otherwise indicated.

K. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick, polished brass..
2. Size: 1-1/2-inches diameter, unless otherwise required.
3. Indicate valve service and normal position on valve. Example Cold water, N.O.

L. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.

M. Valve Tag Fasteners: Brass, wire-link chain; beaded chain; or S-hooks.

N. Access Panel Markers: 1/16-inch- thick, engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve. Provide 1/8-inch center hole for attachment.

O. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Brown: Energy reclamation equipment and components.
4. Blue: Equipment and components that do not meet criteria above.
5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
6. Terminology: Match schedules as closely as possible. Include the following:

    a. Name and plan number.
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

P. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.

1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

PART 3 - EXECUTION

3.1 LABELING AND IDENTIFYING PIPING SYSTEMS

A. Install pipe markers on each system. Include arrows showing normal direction of flow.

B. Marker Type: Stenciled markers with painted, color-coded bands complying with ASME A13.1.

C. Marker Type: Plastic markers, with application systems. Install on pipe insulation segment where required for hot, noninsulated pipes.

D. Fasten markers on pipes and insulated pipes by one of following methods:

1. Snap-on application of pretensioned, semirigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Laminated or bonded application of pipe marker to pipe or insulation.
4. Taped to pipe or insulation with color-coded plastic adhesive tape, not less than 3/4 inch wide, lapped a minimum of 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
5. Taped to pipe or insulation with color-coded plastic adhesive tape, not less than 1-1/2 inches wide, lapped a minimum of 3 inches at both ends of pipe marker, and covering full circumference of pipe.

E. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations according to the following:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
3. Near penetrations through walls, floors, ceilings, or nonaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.
6. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.2 VALVE TAGS

A. Install on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. Indicate service and normal position of all tagged valve and control devices. List tagged valves in valve schedule.

B. Tag Material: Brass.

3.3 EQUIPMENT SIGNS AND MARKERS

A. Install engraved plastic-laminate signs or equipment markers on or near each major item of mechanical equipment. Include signs for the following general categories of equipment:

1. Meters, gages, thermometers, and similar units.
2. Pumps,.
3. Fans, blowers, primary balancing dampers,.

B. Optional Sign Types: Stenciled signs may be provided instead of engraved plastic, at Installer's option, where lettering larger than 1-inch high is needed for proper identification because of distance from normal location of required identification.

1. Lettering Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
2. Terms on Signs: Distinguish between multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

C. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows showing service and direction of flow.

1. Location: Locate signs near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.4 ADJUSTING AND CLEANING

A. Relocate mechanical identification materials and devices that have become visually blocked by work of this or other Divisions.

B. Clean faces of identification devices and glass frames of valve charts.

END OF SECTION 230553

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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 testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC equipment.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Measuring sound and vibration.
7. Reporting results of the activities and procedures specified in this Section.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

K. Test: A procedure to determine quantitative performance of a system or equipment.

L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

M. AABC: Associated Air Balance Council.

N. AMCA: Air Movement and Control Association.

O. NEBB: National Environmental Balancing Bureau.

P. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

A. Contract Documents Examination Report: Within 90 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.

B. Strategies and Procedures Plan: Within 120 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.

C. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

D. Sample Report Forms: Submit 2 sets of sample testing, adjusting, and balancing report forms.

E. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.5 QUALITY ASSURANCE

A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB. Balancing may only be performed by the following:

1. BTC Services, Inc.
2. Certified Test & Balance
3. Test & Balance Inc.

B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 14ays' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

a. Submittal distribution requirements.
b. Contract Documents examination report.
c. Testing, adjusting, and balancing plan.
d. Work schedule and Project site access requirements.
e. Coordination and cooperation of trades and subcontractors.
f. Coordination of documentation and communication flow.

C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing" or frame NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. General Warranty: The national project performance guarantee specified in this Article 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. National Project Performance Guarantee: Provide a guarantee on AABC or NEBB forms stating that AABC or NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified Agent has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.

   1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
   2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine project record documents described in Division 1 Section "Project Record Documents."

D. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

F. Examine system and equipment test reports.

G. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

I. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

K. Examine plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

L. Examine strainers for clean screens and proper perforations.

M. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.

N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

O. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

P. Examine equipment for installation and for properly operating safety interlocks and controls.

Q. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to design values.

R. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC or NEBB national standards and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems. Additional procedures are required for variable-air-volume, multizone, dual-duct, induction-unit supply-air systems and process exhaust-air systems. These additional procedures are specified in other articles in this Section.

B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

   a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each air-handling unit component.

   a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers under final balanced conditions.

4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

5. Adjust fan speed higher or lower than design to achieve design conditions. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.

C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.

D. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.

E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at design flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.

7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 HYDRONIC SYSTEMS' BALANCING PROCEDURES

A. Determine water flow at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than design flow.

E. Adjust balancing stations to within specified tolerances of design flow rate as follows:

1. Determine the balancing station with the highest percentage over design flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over design flow and proceeding to the station with the lowest percentage over design flow.
3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.8 VARIABLE-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

A. Balance systems with automatic 2- and 3-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.9 PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

A. Balance the primary system crossover flow first, then balance the secondary system.

3.10 MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating if high-efficiency motor.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.11 HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperatures.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperatures of entering and leaving air.
5. Wet-bulb temperatures of entering and leaving air for cooling coils designed for more than 5000 cfm.
6. Airflow.
7. Air pressure drop.

B. Reheat Coils: Measure the following data for each coil:

1. Entering water temperature.
2. Entering air temperature.
3. Leaving air temperature.
4. Air Flow

3.12 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.13 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Verify free travel and proper operation of control devices such as damper and valve operators.

F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

G. Confirm interaction of electrically operated switch transducers.

H. Confirm interaction of interlock and lockout systems.

I. Verify main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.14 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans: Plus 5 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.

3.15 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.16 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the certified field report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.

4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of testing, adjusting, and balancing Agent.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of testing, adjusting, and balancing Agent who certifies the report.
10. Summary of contents, including the following:

    a. Design versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.
14. Test conditions for fans and pump performance forms, including the following:

    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Fan drive settings, including settings and percentage of maximum pitch diameter.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.

F. Equipment Test Reports: For all equipment tested:

1. Unit Data: Include the following:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.

2. Motor Data: Include the following:

    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.

3. Test Data: Include design and actual values for the following: (all elements of the system that were tested, including air and water flows, static pressures, pump hoods, inlet and outlet static pressures, inlet, outlet pressure type of coils, raws, circuits face areas, inlet, outer wet bulb, dry bulb temperatures, duct sizes tested, inlet and outlet flows temperatures and pressures and all other pertinent data. The report to be organized per each item tested.)

   a. Total rate in cfm, gpm and lbs/hr.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat coil static-pressure differential in inches wg.
   g. Cooling coil static-pressure differential in inches wg.
   h. Heating coil static-pressure differential in inches wg.
   i. Outside airflow in cfm.
   j. Return airflow in cfm.
   k. Outside-air damper position.
   l. Return-air damper position.

G. Instrument Calibration Reports: For instrument calibration, include the following:

1. Report Data: Include the following:

   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

3.17 ADDITIONAL TESTS

A. Within 120 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

3.18 ADDITIONAL CHECKLISTS

(see next page)

System Readiness Checklist
Piping and Appurtenances

Installation:

- ☐ Piping installed with slope to drain.
- ☐ Hose end drain valves installed at all low points.
- ☐ Air vents with valves installed at all high points of the hot water systems.
- ☐ Automatic air vents piping installed for drainage to nearest drain.
- ☐ Unions installed on all equipment requiring disconnects for servicing.
- ☐ Dielectric unions installed on all dissimilar materials per specifications.
- ☐ Expansion joints and loops are installed as needed and per manufacturer's recommendations.
- ☐ Pressure and temperature gages installed at all specified points.
- ☐ Pressure and temperature gage ranges per specifications.
- ☐ P/T ports installed at locations specified.
- ☐ Relief valves installed on all pressure vessels as specified.
- ☐ Strainers installed at all specified locations including blow-off valve and cap.
- ☐ Air separators, expansion tanks and suction diffusers installed.
- ☐ Water treatment system installed per project documents.
- ☐ Glycol feeder system installed per project documents.
- ☐ Valves provided and installed per specification in regards to connection style and size.
- ☐ Valves installed for area and group isolation, maintenance isolation and service disconnects.
- ☐ Valves installed with stems oriented up.
- ☐ Control valves installed and wired to control system.
- ☐ All specified equipment, piping, valves, pump bodies, drains, unions are insulated per specification - removable insulation installed as specified.
- ☐ All valves tagged with number and function, valve index posted.
- ☐ Pipes across traffic areas provided with protection.
- ☐ Piping is shielded to prevent water leakage above electrical equipment/panels.
- ☐ Mechanical supporting devices installed at specified locations and spacing

Start-Up:

- ☐ Commissioning Authority has been notified for witness of start-up.
- ☐ Expansion tank pressures have been checked and set per engineer's guidance.
- ☐ Water pipe pressure tested and accepted. Attach reports.
- ☐ Water piping flushed and cleaned and chemically treated per specifications and accepted. Attach reports.
- ☐ Strainers cleaned per specification procedure prior to balancing.
- ☐ All air has been removed/bleed from the system prior to balancing.
- ☐ Water chemical treatment complete, treatment system operational, attach treatment report.
- ☐ Glycol feeder verified operational.
- ☐ Control valves verified operational.

System Readiness Checklist
Piping and Appurtenances (Continued)

Readiness:

- ☐ Manufacturer's installation and start-up procedures were followed. Attach completed and signed copy of all manufacturer's checklists.
- ☐ Damaged factory finishes have been replaced, repaired or touched up.
- ☐ Equipment and systems are labeled per project documents.
- ☐ Equipment not painted at factory has been painted with a finish coat of paint (no primer).
- ☐ All known issues have been corrected or reported to the CA and the systems are ready for the functional performance test phase of commissioning.

Note: This checklist is not intended to represent all the requirements of the Project Documents within this section. Completion of the items on this checklist does not release the Contractor from their contractual obligation to complete all the work as detailed within the entire specification section.

System Readiness Checklist
HVAC Pumps

Unit No: ____

Installation:

- ☐ Manufacturer's required maintenance clearance provided.
- ☐ Equipment labeled with equipment number.
- ☐ Pumps installed, leveled, grouted and plumbed.
- ☐ Pumps have been lubricated.
- ☐ Pumps have been aligned. Report attached.
- ☐ Vibration isolation devices installed, adjusted and free to float, shipping blocks removed.
- ☐ Associated piping, shutoff valves, control valves and insulation are complete.
- ☐ All balancing and check valves, gages and thermometers are installed per project documents.
- ☐ Unit disconnect within sight of unit, power available to unit and disconnect labeled.
- ☐ External controls installed.
- ☐ Internal controls and safeties installed.
- ☐ All motors meet or exceed the specified Minimum Nominal Full-Load Efficiency

Start-Up:

- ☐ Commissioning Authority has been notified for witness of start-up.
- ☐ Motor operation and rotation verified.
- ☐ Controls verified operational.

Readiness:

- ☐ Manufacturer's installation and start-up procedures were followed. Attach completed and signed copy of all manufacturer's checklists.
- ☐ Damaged factory finishes have been replaced, repaired or touched up.
- ☐ Equipment and systems are labeled per project documents.
- ☐ Equipment not painted at factory has been painted with a finish coat of paint (no primer).
- ☐ All known issues have been corrected or reported to the CA and the systems are ready for the functional performance test phase of commissioning.

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Motors

Installation:

- ☐ Motors provided and installed per project documents.

Start-Up:

- ☐ Motor name plate data recorded.
- ☐ All motors meet minimum efficiency ratings.

Readiness:

- ☐ Manufacturer's installation procedures were followed.
- ☐ All required testing completed and test reports submitted.
- ☐ Damaged factory finishes have been replaced, repaired or touched up.
- ☐ Equipment and systems are labeled per project documents.
- ☐ All known issues have been corrected or reported to the CA and the systems are ready for the functional performance test phase of commissioning.

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System Readiness Checklist

Air Handling Equipment

Installation:

- ☐ Manufacturer's required maintenance clearance provided.
- ☐ Vibration isolation devices installed, adjusted and free to float, shipping blocks removed.
- ☐ Inspection and access doors are operable.
- ☐ Condensate drain with P-trap and cleanout is installed and unobstructed.
- ☐ Associated piping, shutoff valves, control valves and insulation are complete.
- ☐ Dampers and actuators installed and verified operational.
- ☐ Ductwork is complete including access to all serviceable components.
- ☐ Plenum and casings have been cleaned.
- ☐ Pipe and conduit penetrations have been caulked.
- ☐ Units are level and secured.
- ☐ Units have been lubricated prior to start-up.
- ☐ All filter access provided so filter can be replaced without the use of tools.
- ☐ Coil fins have been cleaned and combed out after construction in equipment area is completed.
- ☐ Unit disconnect within sight of unit, power available to unit.
- ☐ All motors meet or exceed the specified Minimum Nominal Full-Load Efficiency
- ☐ Controls installed and verified operational.
- ☐ Unit heaters provided with provisions for cleaning via “water bath” method to include a water source and drain pan.
- ☐ Ceiling access doors have been provided as required for unit service access.
- ☐ Ductwork installed at unit inlets and outlets is greater than or equal to manufacturer’s required minimum values.

Start-Up:

- ☐ Motor rotation has been verified.
- ☐ Voltage and phase has been verified.
- ☐ Belts have been properly adjusted and aligned.

Air Handling Equipment (continued)

Readiness:

- ☐ Manufacturer's installation and start-up procedures were followed. Attach completed and signed copy of all manufacturer's checklists.
- ☐ Temporary filters have been removed and new installed.
- ☐ All required testing completed and test reports submitted.
- ☐ Damaged factory finishes have been replaced, repaired or touched up.
- ☐ Equipment and systems are labeled per project documents.
- ☐ All known issues have been corrected or reported to the CA and the systems are ready for the functional performance test phase of commissioning.

Note: This checklist is not intended to represent all the requirements of the Project Documents within this section. Completion of the items on this checklist does not release the Contractor from their contractual obligation to complete all the work as detailed within the entire specification section.

System Readiness Checklist

Ductwork Systems

Installation:

- ☐ Manufacturer's required maintenance clearance provided.
- ☐ Inspection and access doors are operable.
- ☐ All ductwork installed per required SMACNA standards.
- ☐ Dampers and actuators installed and verified operational.
- ☐ Ductwork is complete including access to all serviceable components.
- ☐ Plenum and casings have been cleaned per the project requirements.
- ☐ Duct access doors provided before and after filters, coils, fans, automatic dampers, and fire/smoke dampers per the project requirements.
- ☐ Balancing dampers provided at all duct take-offs to diffusers, grilles, and registers.
- ☐ Fire/smoke damper shafts marked with blade position prior to installation.
- ☐ Fire/smoke damper operation (open/close) verified. Fire/smoke dampers powered open.
- ☐ Fire/smoke damper doors labeled and motors accessible for service (replacement).
- ☐ All ductwork has been thoroughly cleaned of debris, dust, marks, tags and labels removed.
- ☐ All ductwork is sealed as specified.
- ☐ All specified equipment and ductwork is insulated.

Start-Up:

- ☐ Medium velocity ductwork pressure tested to project requirements.
- ☐ Low velocity ductwork pressure tested to project requirements.

Readiness:

- ☐ Manufacturer’s installation procedures were followed.
- ☐ All required testing completed and test reports submitted.
- ☐ Damaged factory finishes have been replaced, repaired or touched up.
- ☐ Equipment and systems are labeled per project documents.
- ☐ All known issues have been corrected or reported to the CA and the systems are ready for the functional performance test phase of commissioning.

Note: This checklist is not intended to represent all the requirements of the Project Documents within this section. Completion of the items on this checklist does not release the Contractor from their contractual obligation to complete all the work as detailed within the entire specification section.

System Readiness Checklist
Temperature Control

Installation:

- ☐ All control points have been provided per the Project Documents and are communicating with front end computer.
- ☐ System graphics are complete (showing all devices controlled, all adjustable points shown, all specified components), accurate (reflects actual field/unit installation, end-to-end verification of points done) and functional.
- ☐ Access Security levels have been set up per owner's needs.
- ☐ Network connection is complete, the central operator terminal has been updated and remote monitoring of the system has been tested.
- ☐ All specified associated equipment (such as PC, Monitor, printer, modem & laptop) has been provided, installed and is operational.
- ☐ Surge protection and battery back-up devices installed per Project Documents and tested.
- ☐ Control wiring, panels and all system components are permanently labeled, including point address designation, system reference and descriptions.
- ☐ Acceptance start-up test plan has been submitted and approved. Attach copy of test plan.
- ☐ Graphical interface plan has been submitted and approved by CA.
- ☐ All control points have been provided per the Project Documents and are communicating with front end computer.
- ☐ System graphics are complete (showing all devices controlled, all adjustable points shown, all specified components), accurate (reflects actual field/unit installation, end-to-end verification of points done) and functional.
- ☐ Room temperature and other setpoints installed per specification and owner's direction.
- ☐ Operating schedules have been set up per owner's direction
- ☐ Trend logs have been set up per Project Documents and/or as directed by the CA.
- ☐ Minimum OA %, from balancer, provided on graphics as permanent reference value.
- ☐ Alarms have been programmed per Project Documents and owner's direction.
- ☐ Stability of loop and VFD's has been verified.
- ☐ All sensors have been calibrated including temperature, pressure, flow and metering devices.

Start-Up:

- ☐ Point to point testing and sensor calibration is complete and checkout forms complete with copy submitted.
- ☐ Variable speed drive start-up per manufacturer's representative complete.

System Readiness Checklist
Temperature Control

Readiness:

- ☐ Manufacturer's installation procedures were followed.
- ☐ All required testing completed and test reports submitted.
- ☐ Damaged factory finishes have been replaced, repaired or touched up.
- ☐ Equipment and systems are labeled per project documents.
- ☐ All known issues have been corrected or reported to the CA and the systems are ready for the functional performance test phase of commissioning.

Note: This checklist is not intended to represent all the requirements of the Project Documents within this section. Completion of the items on this checklist does not release the Contractor from their contractual obligation to complete all the work as detailed within the entire specification section.

System Readiness Checklist
Testing, Adjusting, and Balancing

Installation:

- ☐ Balancing agenda provided to engineer. Provide copy to CA for review.
- ☐ Pre-balance conference complete.
- ☐ All equipment has been checked prior to balancing. Installation checklists attached.
- ☐ Fan belt tension and fan rotation verified prior to balancing.
- ☐ Air balanced prior to water balance.
- ☐ Construction filters removed, clean filters installed, damper position and operation checked prior to balancing. Air balance due with filters simulated as ½ dirty.
- ☐ Bathrooms are negative relative to other areas.
- ☐ Rooms pressures are positive while allowing for door closure in economizer mode.
- ☐ Relief damper operation has been checked to assure dampers open and close as needed.
- ☐ All systems balanced to design criteria except as approved by mechanical engineer and CA.
- ☐ Overall building pressure checked with outside air at 100% to assure adequate relief.
- ☐ All volume dampers, fire dampers, balancing and controls valves are set in a fully open position at the start of balancing.
- ☐ Hydronic system and strainers has been cleaned and treated prior to balancing.
- ☐ Expansion tanks are properly pressurized and not water logged.
- ☐ Air vents installed and operational, water system balanced with no air in system.
- ☐ Final damper and speed controller permanently marked for final balancing positions.
- ☐ List of control minimum OA damper positions in report and provided to controls contractor.
- ☐ Preliminary report has been provided on approved forms with data specified, attach copy.
- ☐ All defects/ deficiencies have been noted to CA/ engineer during testing, included in report.
- ☐ Noise and vibration has been checked and adjusted as necessary.
- ☐ All TAB procedures are complete and ready for the system balance demonstration. The TAB contractor will demonstrate proper balance by measuring and verifying 10% of the systems as selected and witnessed by the Commissioning Authority.

Start-Up: Not Applicable.

Readiness:

- ☐ All required testing completed and test reports submitted.
- ☐ All known issues have been corrected or reported to the CA and the systems are ready for the functional performance test phase of commissioning.

Note: This checklist is not intended to represent all the requirements of the Project Documents within this section. Completion of the items on this checklist does not release the Contractor from their contractual obligation to complete all the work as detailed within the entire specification section.

END OF SECTION 230594

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SECTION 230700 - DUCT INSULATION

May 30, 2008

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 semirigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

B. Related Sections include the following:

1. Division 7 Section "Firestopping" for firestopping materials and requirements for penetrations through fire and smoke barriers.
2. Division 23 Section "Pipe Insulation" for insulation for piping systems.
3. Division 23 Section "Metal Ducts" for duct liner.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Removable insulation sections at access panels.
2. Application of field-applied jackets.
3. Applications at linkages for control devices.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.

D. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate clearance requirements with duct Installer for insulation application.

1.7 SCHEDULING

A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mineral-Fiber Insulation:

a. CertainTeed Manson.
b. Knauf FiberGlass GmbH.
c. Owens-Corning Fiberglas Corp.
d. Schuller International, Inc.

2.2 INSULATION MATERIALS

A. Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, without facing and with all-service jacket manufactured from aluminum foil.

B. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from aluminum foil.

2.3 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..

1. Tape Width: 4 inches.

B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:

1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
2. Galvanized Steel: 0.005 inch thick.
3. Aluminum: 0.007 inch thick.

4. Brass: 0.010 inch thick.
5. Nickel-Copper Alloy: 0.005 inch thick.

C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.

1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.

E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb for direct pull perpendicular to the adhered surface.

2.4 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Jacket Color: Color-code to match connected piping jackets based on materials contained within the piping system.

C. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Metal thickness and corrugation dimensions are scheduled at the end of this Section.

1. Finish: Smooth or Stucco-embossed finish.
2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.

2.5 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply multiple layers of insulation with longitudinal and end seams staggered.

E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

F. Keep insulation materials dry during application and finishing.

G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

H. Apply insulation with the least number of joints practical.

I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.

K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

L. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.

M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.

1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.

O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Seal insulation to roof flashing with vapor-retarder mastic.

P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

Q. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.

R. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.

1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
    c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.

4. Impale insulation over anchors and attach speed washers.
5. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
8. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
9. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

B. Board Applications for Ducts and Plenums: Secure board insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Space anchor pins as follows:

    a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
    c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.

4. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
6. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 DUCT SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.

C. Insulate the following plenums and duct systems:

1. Indoor supply-, return-, mixed-, and outside-air ductwork and plenums.

D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
5. Flexible connectors.
6. Vibration-control devices.
7. Testing agency labels and stamps.
8. Nameplates and data plates.
9. Access panels and doors in air-distribution systems.

3.6 INDOOR DUCT APPLICATION SCHEDULE

A. Service: Round, flat, oval and rectangular medium pressure round, supply-air and outside air and mixed air ducts, concealed (Including inside fan rooms). This includes low pressure round ducts a well.

1. Material: Mineral-fiber blanket
2. Thickness: 1-1/2 inches.
3. Number of Layers: One.
4. Jacket: Reinforced Foil.
5. Vapor Retarder Required: Yes.

B. Service: Round, flat, oval and rectangular, medium pressure and low pressure round and, supply-air, outside air, mixed air (exposed).

1. Material: Mineral-fiber blanket.
2. Thickness: 1-1/2 inches.
3. Number of Layers: One.
4. Jacket: Aluminum
5. Vapor Retarder Required: Yes.

3.7 PLENUM APPLICATION SCHEDULE

A. Service: Rectangular, Outside Air Plenums.

1. Material: High density, mineral-fiber board
2. Thickness: 2 inches
3. Number of Layers: One
4. Field-Applied Jacket: Corrugated Aluminum
5. Vapor Retarder Required: Yes

B. Service: Round and rectangular, concealed.

1.Material: Calcium Silicate
2.Thickness: 2 inches.
3.Number of Layers: One.
4.Field-Applied Jacket: Aluminum
5.Vapor Retarder Required: No.

3.8 MISCELLANEOUS ITEMS

1. All mechanical rooms and fan rooms shall have 1" hard fiber board insulation under a corrugated aluminum cover. This is for all insulated ductwork below 8'-0".

END OF SECTION 230700

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SECTION 230720 - PIPE INSULATION

May 30, 2008

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 preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

B. Related Sections include the following:

1. Division 7 Section "Firestopping" for firestopping materials and requirements for penetrations through fire and smoke barriers.
2. Division 23 Section "Duct Insulation" for insulation for ducts and plenums.
3. Division 23 Section "Hangers and Supports" for pipe insulation shields and protection saddles.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
2. Attachment and covering of heat trace inside insulation.
3. Insulation application at pipe expansion joints for each type of insulation.
4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Removable insulation at piping specialties and equipment connections.
6. Application of field-applied jackets.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.

D. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and

sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for insulation application.

1.7 SCHEDULING

A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

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. Mineral-Fiber Insulation:

   a. CertainTeed Manson.
   b. Knauf FiberGlass GmbH.
   c. Owens-Corning Fiberglas Corp.
   d. Schuller International, Inc.

2. Flexible Elastomeric Thermal Insulation:

   a. Armstrong World Industries, Inc.
   b. Rubatex Corp.

3. Calcium Silicate Insulation:

   a. Owens-Corning Fiberglas Corp.
   b. Pabco.
   c. Schuller International, Inc.

2.2 INSULATION MATERIALS

A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
2. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

    a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
    b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

4. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

B. Calcium Silicate Insulation: Preformed pipe sections of noncombustible, inorganic, hydrous calcium silicate with a nonasbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.3 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.

1. Finish and Thickness: Smooth finish, 0.010 inch thick.
2. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
3. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
4. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.4 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

H. Keep insulation materials dry during application and finishing.

I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

   1. Apply insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
   3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

O. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

    a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal metal jacket to roof flashing with vapor-retarder mastic.

Q. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

R. Interior Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Firestopping."

S. Floor Penetrations: Apply insulation continuously through floor assembly.

1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus

twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers.
4. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

5. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
6. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:

1. Apply metered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:

1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.
3. Apply insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.6 FIELD-APPLIED JACKET APPLICATION

A. Apply PVC jacket where indicated, with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive. Color for each piping system shall be selected by the Architect.

B. Apply metal jacket where indicated, with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.8 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Vibration-control devices.
3. Below-grade piping, unless otherwise indicated.
4. Chrome-plated pipes and fittings, unless potential for personnel injury.
5. Non-Chilled water air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.9 INSULATION APPLICATION SCHEDULE, GENERAL

A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.10 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Chilled-water supply and return.

1. Operating Temperature: 35 to 75 deg F.
2. Insulation Material: Mineral Fiber with reinforced all service jacket.
3. Insulation Thickness: See table A.
4. Field-Applied Jacket: PVC, (Mechanical Rooms and where exposed.)
5. Vapor Retarder Required: Yes.
6. Finish: None.

B. Service: Heating hot-water supply and return.

1. Operating Temperature: 100 to 200 deg F.
2. Insulation Material: Mineral Fiber with reinforced all service jacket
3. Insulation Thickness: See table A.
4. Field-Applied Jacket: PVC (Mechanical Rooms and where exposed)
5. Vapor Retarder Required: No.
6. Finish: None.

Table A

Insulation Thickness:

Insulation thicknesses in Table A are based on insulation having thermal resistivity in the range of 4.0 to 4.6 hr. ^{o}F square foot/Btu per inch of thickness on a flat surface at a mean temperature of 75°F.

TABLE 'A' - MINIMUM PIPE INSULATION
INSULATION THICKNESS IN INCHES FOR PIPE SIZES

PIPING SYSTEMS TYPES	TEMPERATURE RANGE ^{o}F	RUN OUTS UP TO 2"	1" AND LESS	1 ½" TO 2"	2 ½" TO 4"	5" TO 10"	12" AND LARGER
HEATING SYSTEMS							
Low pressure/temp.	201-250	1½"	1½"	2"	2"	2"	2"
Low temperature	120-200	1"	1"	1"	2"	2"	2"
COOLING SYSTEMS							
Chilled water	40-55	1"	1"	1½"	1½"	1½"	1½"

*1 Runouts not exceeding 12 feet in length to individual terminal units.
*2 For piping exposed to outdoor air, increase thickness by 1/2 inch.

For the purposes of the following Table A the following fluid temperatures and pressures are to be used unless specified otherwise:

Heating hot water is 200 ^{o}F

END OF SECTION 230720

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SECTION 230900 – AUTOMATIC TEMPERATURE CONTROLS

May 30, 2008

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 Building Management System (BMS) control equipment for HVAC systems and components, including open protocol control components for terminal heating and cooling units.

B. Related Sections include the following found in Division 1, 13, 15 and 16 Sections of the Specifications:
   1. Fire Alarm Systems.
   2. Basic Mechanical Requirements.
   3. Refrigeration Equipment.
   4. Air Handling Equipment.
   5. Test and Balance.
   6. Basic Electrical Requirements.
   7. Cables, Low Voltage. (600 Volts and below)
   8. Wiring Devices.
   9. Motor Control Centers.
   10. Basic Electrical Materials.

1.3 DEFINITIONS

A. Standard
   1. ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers
   2. AHU: Air Handling Unit
   3. BACnet: Building Automation Controls Network
   4. BMS: Building Management System
   5. DDC: Direct Digital Control
   6. EIA: Electronic Industries Alliance
   7. GUI: Graphical User Interface
   8. HVAC: Heating, Ventilation, and Air Conditioning
   9. IEEE: Institute Electrical Electronic Engineers
   10. MER: Mechanical Equipment Room
   11. PID: Proportional, Integral, Derivative

B. Communications and Protocols
   1. ARP: Address Resolution Protocol
   2. CORBA: Common Object Request Broker Architecture
   3. CSMA/CD: Carrier Sense Multiple Access/Collision Detect
   4. DDE: Dynamic Data Exchange
   5. FTT: Free Topology Tranceivers
   6. HRDB: Hierarchical Real-Time Database
   7. HTTP: Hyper Text Transfer Protocol
   8. IIOP: Internet Inter-ORB Protocol
   9. LAN: Local Area Network
   10. MS/TP: Master Slave Token Passing
   11. ODBC: Open DataBase Connectivity
   12. ORB: Obect Request Broker

13. SNVT: Standard Network Variable Types
14. SQL: Structured Query Language
15. UDP: User Datagram Protocol
16. XML: exTensible Markup Language

C. Controllers
1. AAC: Advanced Application Controller
2. ASC: Application Specific Controller
3. ASC: Application Specific Controller
4. CAC: Custom Application Controller
5. MSDC: Mechanical System Digital Controller
6. UDC: Unitary Digital Controller
7. UEC: Unitary Equipment Controller
8. UNC: Universal Network Controller

D. Tools and Software
1. VAVDC: Variable Air Volume Digital Controller
2. CCDT: Configuration, Commissioning and Diagnostic Tool
3. HHOT: Hand Held Operators Tool
4. LPES: LON Portable Engineering Station
5. PES: Portable Engineering Station
6. POT: Portable Operator's Terminal

1.4 SYSTEM DESCRIPTION Ethernet (IEEE 802.3), peer-to-peer CSMA/CD

A. Furnish all labor, materials, equipment, and service necessary for a complete and operating temperature control system, utilizing a high speed peer to peer network of interoperable Direct Digital Controls (DDC), Graphical User Interface (GUI) with color graphic displays available for a minimum of at least p 64 possible client computers, and electronic interfaces and actuation devices, as shown on the drawings and as described herein.

B. The Local Area Network (LAN) shall be either a 10 or 100 Mpbs Ethernet network supporting BACnet, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Universal Network Controllers (UNCs), user workstations and a local host computer system.

C. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.

D. The system will consist of an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol, as the common communication protocol between all controllers and integral ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. Both the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol are required to assure that the project is fully supported by the leading HVAC open protocol to reduce future building maintenance, upgrade, and expansion costs.

E. Where utilized by a LonMark/LonWorks based Control System, LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth.
1. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guide-lines for such encapsulation and shall be based on industry standard protocols.
2. The products used in constructing the BMS shall be LonMark™ compliant.
3. In those instances in which Lon-Mark™ devices are not available, the BMS contractor shall provide LonWorks™ devices with application source code, device resource files, and external interface definitions.

F. The software tools required to network manage both the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans that are required to meet the functional intent, shall be provided without additional cost to the Owner. Minimum BACnet compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet/Ethernet IP or MS/TP.

G. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) valves and dampers and electronic actuation of terminal equipment valves and actuators as specified herein. The BMS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel.
   1. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs.
   2. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage.
      a. This data shall reside on a supplier-installed server for all database access.
      b. Systems requiring proprietary database and user interface programs shall not be acceptable.
      c. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network.
      d. Systems employing a "flat" single tiered architecture shall not be acceptable.

H. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the authorized office representing the controls manufacturer. The authorized office shall have a minimum of 10 years of installation experience with the manufacturer and shall provide documentation in the bid and submittal package verifying longevity of the installing company's relationship with the manufacturer when requested. Supervision, calibration and checkout of the system shall be by the employees of the authorized office and shall not be subcontracted. The control contractor shall have an in place support facility within 50 miles of the site with factory certified technicians and engineers, spare parts inventory and all necessary test and diagnostic equipment for the installed system, and the control contractor shall have emergency service available.

I. For all LonMark/LonWorks based Control Systems: Provide a Portable Operator's Terminal (POT) color display personnel computer, software, and interfaces to provide uploading/downloading of Custom Application Controller and Application Specific Controllers databases, monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs, monitoring and overrides of all controller physical input/output points, and editing of controller resident time schedules. POT connectivity shall be via digital wall sensor connected to controller or an available communication port located at the wall sensor facilitating the same features.

1.5 INSTALLATION OF PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION.

A. Sections from Division 15 – Hydronic Piping:
   1. Control Valves.
   2. Flow Switches.
   3. Temperature Sensor Wells and Sockets.

B. Sections from Division 15 – Ductwork Accessories:
   1. Automatic Dampers.
   2. Terminal Unit Controls.

1.6 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION.

1. Sections from Division 15 –

1.7 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION.

1. Sections from Division 15 –
2. Sections from Division 15 –

B. Sections from Division 13- Fire Alarm System.
   1. Smoke Detectors (duct).

C. Section 16150 –Equipment and Motor Wiring.

D. Power Monitoring System Control Units and Intelligent Devices.

1.8 SUBMITTALS.

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
   1. Each control device labeled with setting or adjustable range of control.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
   2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
   3. Details of control panel faces, including controls, instruments, and labeling.
   4. Written description of sequence of operation.
   5. Schedule of dampers including size, leakage, and flow characteristics.
   6. Schedule of valves including close-off and flow characteristics.
   7. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
   8. Listing of connected data points, including connected control unit and input device.
   9. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
   10. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

C. External Interface Files: XIF files or object diagrams for each DDC system component (Custom Application Controller and Application Specific Controller) proposed.

D. Software and Firmware Operational Documentation: Include the following:
   1. Engineering, Installation, Operation and Maintenance manuals.
   2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.
   5. Licenses, guarantee, and warranty documents for all equipment and systems.

E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

F. Maintenance Data: For systems to include in maintenance manuals specified in Division 1. Include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

G. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

H. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

1.9 QUALITY ASSURANCE.

A. **Important:** Bids by wholesalers, distributors, mechanical contractors, ABCS, ACS, and non-franchised contractors shall not be acceptable. The intent of this is to ensure expertise, accountability, single point responsibility and the avoidance of conflict of interests with other divisions and contractors.

B. The system manufacturer shall, as a minimum, manufacture and supply the Custom Application Controller, Application Specific Controller, Unitary Equipment Controller, Advanced Application Controller, Graphical User Interface, damper actuators, and valve actuator assemblies., except where stated otherwise in this specification.

C. All work described in this section shall be installed, wired, circuit tested by qualified and certified electricians that are licensed journeymen or enrolled in a qualified electrician apprentice program and properly supervised according to state and local ordinances. Also work described in this section shall be calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer’s local field office.

D. The Building Management System contractor shall have a full service facility within 50 miles of the project that is staffed with engineers trained in Integrating Interoperable Systems and technicians fully capable of providing LonMark/LonWorks and/or BACnet instructions and routine emergency maintenance service on all system components.

E. 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.

F. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems.".

G. Comply with National Electric Code, UL-916 Energy Management Systems, LonMark™, ULC, FCC Part 15, subpart J, Class B Computing Devices.

H. Comply with EIA Standard 709.1 LonTalk™ protocol for DDC system control components.

1.10 DELIVERY, STORAGE AND HANDLING.

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.11 COORDINATION.

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor-Control Centers," "Panelboards," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.

C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.

D. Coordinate location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete".

E. Coordinate with the Owner's IT department on locations for UNC's, Ethernet communication cabling and TCP/IP addresses.

1.12 WARRANTY AND MAINTENANCE.

A. All components, system software, and parts furnished and installed by the BMS contractor shall be guaranteed against defects in materials and workmanship for 1 year of substantial completion. Labor to repair, reprogram, or replace these components shall be furnished by the BMS contractor at no charge during normal working hours during the warranty period. Materials furnished but not installed by the BMS contractor shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the owner's request for warranty service within 24 standard working hours.

1.13 OWNERSHIP OF PROPRIETARY MATERIAL.

A. The owner shall sign a copy of the manufacturer’s standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to owner as defined by the manufacturer’s license agreement, but shall protect manufacturer’s rights to disclosure of trade secrets contained within such software. All project developed software and documentation shall become the property of the owner. These include, but are not limited to project graphic images, record drawings, project database, project specific application programming code, and all other associated documentation.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS AND INSTALLING CONTRACTORS

1. TAC I/A-Series System (LonMark Solution) as provided and installed by Utah Yamas Controls Inc.
2. No other contractor or products considered.

2.2 DDC EQUIPMENT

A. Workstation Server Hardware Station: IBM-compatible microcomputer with minimum configuration as follows:
   1. Processor: 2-Intel Pentium IV, 1.5 GHz., or faster.
   2. Random-Access Memory: 2GB ECC SDRAM, minimum.

3. Graphics: Super video graphic adapter (SVGA), minimum 1024 x 768 pixels, 2.0-MB EDO video memory.
4. Monitor: 17 inches (17.4 viewable, minimum), noninterlaced, color, with maximum 0.28-mm dot pitch.
5. Keyboard: QWERTY, 105 keys in ergonomic shape.
6. Floppy-Disk Drives: 1.44 MB.
7. Hard-Disk Drive: 73GB 10K RPM Ultra 160 SCSI Hard Drive, minimum.
8. Embedded Intel PRO/100+ Server Adapter for TCP/IP Communication
9. DVD-ROM Drive: 24X, IDE CD-ROM with software decoding.
10. Mouse: Optical 3- button.
11. Tape Backup: 110/220GB, Controller Included, Internal, minimum.
12. Operating System: Microsoft Windows NT/2000.
13. Provide a Printer Dot-matrix type:
    a. Print Head: 24 pin, 360 x 360 dpi resolution
    b. Carriage: Wide, 132 characters per line of paper
    c. Paper Handling: Fan-fold paper, with 2 cartons containing minimum of 2500 sheets each and two (2) printer ribbons or cartridges.
    d. Print Speed: Minimum of 120 characters per second.

B. UPS (uninterruptible power supply) shall be installed at the server Size for 50% spare capacity with sufficient capacity to allow emergency power for a minimum of 10 minutes backup.

C. GUI Server Application Software shall employ a Niagara Framework™ software architecture solution (solution may be a OEM, licensed or re-branded product implementing the Niagara Framework™) as the foundation for hosting and generating the GUI as well as all trending, achieving and database functions. Include the following:

Input/output capability from operator station for monitoring and controlling all of the points listed in the input/output point list. The operator shall be able to monitor and access all points by means of clear concise English names without having to understand or reference hardware point locations or controller programs.

1. Operating System: The GUI shall run on Microsoft Windows NT Workstation 4.0, Service Pack 4, Windows XP, or later.
2. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
3. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
    a. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
    b. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
    c. Graphics shall support layering and each graphic object shall be configurable for assignment to one a layer. A minimum of six layers shall be supported.
    d. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
        1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
        2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

4. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
5. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.
6. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
    a. Create, delete or modify control strategies.
    b. Add/delete objects to the system.
    c. Tune control loops through the adjustment of control loop parameters.
    d. Enable or disable control strategies.
    e. Generate hard copy records or control strategies on a printer.
    f. Select points to be alarm-able and define the alarm state.
    g. Select points to be trended over a period of time and initiate the recording of values automatically.
7. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
8. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
9. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
10. Alarm Console
    a. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
    b. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

D. Web Browser Clients
1. The system shall be capable of supporting 64 clients using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, are only acceptable if 64 licensed copies of the client machine software are provided, installed, and tested.
2. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall only be acceptable if 64 workstations or workstation hardware upgrades are provided.
3. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
4. The Web browser client shall support at a minimum, the following functions:

a. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

b. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.

c. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

d. Storage of the graphical screens shall be in the Building Control Units (BC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.

e. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.

f. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

1) Modify common application objects, such as schedules, calendars, and set points in a graphical manner.

a) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

b) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

2) Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

3) View logs and charts

4) View and acknowledge alarms

g. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

h. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

i. The Web access shall be a true thin client Web-Based system, <u>NOT</u> a web-enabled Thick client access. Thick client solutions are not acceptable.

E. Universal Network Controllers (UNC) shall employ a Niagara Framework™ software and hardware architecture solution (solution may be an OEM, licensed or re-branded product implementing the Niagara Framework™) as the foundation for managing and facilitating all services, global and communication functions.

1. The Universal Network Controllers (UNC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the UNC. It shall be capable of executing application control programs to provide:

a. Calendar functions

b. Scheduling

c. Trending

d. Alarm monitoring and routing

e. Time synchronization by means of an Atomic Clock Internet site including automatic synchronization

f. Integration of LonWorks controller data and BACnet controller data

g. Network Management functions for all LonWorks based devices

2. The Universal Network Controller Type 2 must provide the following hardware features as a minimum:
    a. One Ethernet Port – 10/100 Mbps
    b. Two RS-232 ports
    c. Four RS-RS485 ports electrically isolated
    d. One LonWorks Interface Port – 78KB FTT-10A with Weidmuller connector
    e. Power supply 24 VAC or 24 VDC
    f. Battery Backup
    g. Real-time clock
    h. Processor @ 200 MHz or greater
    i. 64 Mb flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
    j. 128 Mb Ram or greater
3. The UNC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the UNC shall be an ODBC compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
4. The UNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 64 simultaneous users.
5. Event Alarm Notification and Actions
    a. The UNC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
    b. The UNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
    c. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
        1) To alarm
        2) Return to normal
        3) To fault
    d. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
    e. Provide timed (schedule) routing of alarms by class, object, group, or node.
    f. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
    g. Control equipment and network failures shall be treated as alarms and annunciated.
    h. Alarms shall be annunciated in any of the following manners as defined by the user:
        1) Screen message text
        2) Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
            a) Day of week
            b) Time of day
            c) Recipient
        3) Pagers via paging services that initiate a page on receipt of email message
        4) Graphic with flashing alarm object(s)
        5) Printed message, routed directly to a dedicated alarm printer
    i. The following shall be recorded by the UNC for each alarm (at a minimum):
        1) Time and date
        2) Location (building, floor, zone, office number, etc.)
        3) Equipment (air handler #, accessway, etc.)

4) Acknowledge time, date, and user who issued acknowledgement.

5) Number of occurrences since last acknowledgement.

j. Alarm actions may be initiated by user defined programmable objects created for that purpose.

k. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

l. A log of all alarms shall be maintained by the UNC and/or a server (if configured in the system) and shall be available for review by the user.

m. Provide a “query” feature to allow review of specific alarms by user defined parameters.

n. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

o. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

6. Data Collection and Storage

a. The UNC shall have the ability to collect data for any property of any object and store this data for future use.

b. The data collection shall be performed by log objects, resident in the UNC that shall have, at a minimum, the following configurable properties:

1) Designating the log as interval or deviation.

2) For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.

3) For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

4) For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.

5) Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

7. All log data shall be stored in a relational database in the UNC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.

8. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

9. All log data shall be available to the user in the following data formats:

a. HTML

b. XML

c. Plain Text

d. Comma or tab separated values

10. Systems that do not provide log data in HTML and XML formats at a minimum shall provide as an alternative Microsoft SQL Serverâ, Oracle 8i or Expressâ, Hyperion Solutions™ SQL Server.

11. The UNC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other UNC on the network. Provide the ability to configure the following archiving properties, at a minimum:

a. Archive on time of day

b. Archive on user-defined number of data stores in the log (buffer size)

c. Archive when log has reached it’s user-defined capacity of data stores

d. Provide ability to clear logs once archived

12. AUDIT LOG

a. Provide and maintain an Audit Log that tracks all activities performed on the UNC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached it’s user-defined buffer size. Provide the ability to archive the log locally (to the UNC), to another UNC on the network, or to a server. For each log entry, provide the following data:

1) Time and date

2) User ID

3) Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

13. DATABASE BACKUP AND STORAGE
    a. The UNC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
    b. Copies of the current database and, at the most recently saved database shall be stored in the UNC. The age of the most recently saved database is dependent on the user-defined database save interval.
    c. The UNC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

F. Control Units General:

Control units, other than for the Workstation Server Software and Hardware as well as for any Universal Network Controllers, shall be based entirely upon the LonMark/LonWorks standards. Provide an adequate number of control units to achieve monitoring and control of all data points specified and necessary to satisfy the sequence of operation for all mechanical systems shown on the plans. Provide a minimum of one separate controller for each AHU or other HVAC system. Multiple DDC controllers may control one system provided that all points associated with individual control loops are assigned to the same DDC controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement. Each of the following panel types shall meet the following requirements.

1. Controllers shall be suitable for the anticipated ambient conditions.
    a. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40°F to 140°F and 5 to 95% RH, non condensing.
    b. Controllers used in conditioned ambient space shall be mounted in dustproof enclosures, and shall be rated for operation at 32°F to 122°F and 5 to 95% RH, non condensing.
2. Serviceability: Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Memory: The Control Units shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
4. Diagnostics: The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode and generate an alarm notification.
5. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 ft.
6. Automatic staggered restart of field equipment after restoration of power and short cycle protection.

G. Custom Application Control Units:

Modular, comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control applications. CAC's shall be provided for Roof Top Units, Boiler Plant, Chiller Plant and other applications as shown on drawings and shall have published Lon-Works™ application source code, device resource files and external interface definitions.

1. Units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control including mathematical equations, Boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats,

enthalpy calculation, counters, interlocks, ramps, drivers, schedules, calendars, OSS, compare, limit, curve fit, and alarms.

2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Peer to peer primary network level communications supporting at least 200 LonMark™ Standard Network Variables (SNVTs) per CAC utilizing at least 100 different SNVT types as documented by the LonMark™ Interoperability Association to assure present and future compatibility with third party LonMark™ devices. The 200 LonMark™ SNVTs, minimum, must be configurable in any combination – all inputs or all outputs or any combination of input/outputs in any combination of the 100 different, minimum, SNVT types. The XIF SNVT order shall be definable, rather than random, to provide logical and effective LonMark™ network management. With the submittal package, contractor shall provide CAC performance data that specifies the exact maximum number of SNVTs available in any combination and a list of all available SNVT types including the LonMark™ Interoperability Association SNVT number.
   b. Automatic communications loss detection to maintain normal control functionality regardless of available network communications.
   c. Discrete/digital, analog, and pulse input/outputs.
   d. Monitoring, controlling, or addressing data points.
   e. Local energy management control strategies
   f. Incorporate internal customizable safeties and limits to prevent third party LonMark ™ tools from providing improper and unrealistic inputs to CAC's.
3. Local operator interface port provides for download from and connection to portable workstation.
4. Communication: The Custom Application Controller shall communicate via the Primary Controller Network between BMS Controllers and other LonWorks ™ devices. CAC's shall communicate with the Building Controller and ASC's at a baud rate of not less than 78.8 baud using LonWorks ™ communications protocol (EIA 709.1).

H. CAC Room Sensor
1. The CAC Sensor shall provide room temperature value to the CAC.
2. The CAC Sensor shall connect directly to the CAC and shall not utilize any of the I/O points of the controller.
3. The CAC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive.
4. The CAC Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering.
5. TheCAC Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering.
6. The CAC Sensor shall allow for the customization of the color on the esthetic covering as a standard offering.
7. The CAC Sensor shall be supplied in the following manner:
   a. LCD display for showing (typically) the current temperature.
   b. Tenant override to allow timed override of unoccupied to occupied mode of operation.
   c. LED indication of override state.
   d. Up/Down keys to allow adjustment of the current setpoint
   e. User interface with the CAC Sensor shall be provided as a configurable function, and shall offer password protection for access to network variable editing.
   f. ASHRAE 95 compliance (LCD display and sub-base functionality)
   g. The room sensor shall provide access to additional diagnostic data from a sensor-user keypad request. This Diagnostic mode is displayed on the LCD screens and includes separate displays for the controllers:
      1) Subnet and Node Address
      2) Errors
      3) Alarms
      4) Temperature Offset

I. Portable Operator's Terminal

1. The Portable Operator's Terminal (POT) color display personal computer when required shall include software, and interfaces to provide; uploading/downloading of Custom Application Controller and Application Specific Controllers databases, monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs, monitoring and overrides of all controller physical input/output points, and editing of controller resident time schedules. POT connectivity shall be via digital wall sensor connected to controller.
2. Connection of a POT to the Custom Application Controller or Application Specific Controller shall not interfere with normal network operation in any way, prevent alarms from being transmitted or centrally initiated commands from being executed.
3. If the POT cannot be used for both the CAC's and ASC's, provide, in addition to the POT, the separate color display personnal computer(s), software, and interfaces required to provide full POT functionality for both the CAC's and ASC's.
4. Functionality of the POT connected to any CAC or ASC shall include:
   a. Uploads and downloads of CAC and ASC Controller databases.
   b. Uploads and downloads of CAC and ASC LonMark™ SNVT nci values.
   c. Editing of LonMark™ SNVT nci values for minor equipment operational parameters (including minimum on/off and delay times, changeover values, minimum position setpoints, etc.). All such mechanical equipment editable nci values shall contain internal CAC and ASC Controller safety range limits to prevent accidental entry of out of range or invalid values.
   d. Monitoring of all LonMark™ Standard Network Variables Types (SNVTs) including display of all bound SNVTs and test overrides of nvi SNVTs.
   e. Monitoring and overrides of all controller physical input/output points including timed overrides that automatically revert back to their normal value.
   f. Display of digital sensor values including diagnostics and calibration.
   g. Editing of controller time/date.
   h. Editing and overrides of resident Controller time schedules.
   i. LonMark™ information including program ID, Neuron ID, domain, subnet, and node.

J. Configuration, Commissioning and Diagnostic Tool (CCDT)

1. The Configuration, Commissioning and Diagnostic Tool (CCDT) color display personal computer when required shall include software, and interfaces to provide: uploading/downloading of Advanced Application Controller (ACC), Unitary Equipment Controller (UEC) and VAV Box DDC Controller (VAVDDC), monitoring of all inputs and outputs.

K. Advanced Application Controller (AAC):

Modular, comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control applications. AAC's shall be provided for large AHU's, Boiler Plant, Chiller Plant and other applications as shown on drawings.

1. Units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control including mathematical equations, Boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, enthalpy calculation, counters, interlocks, ramps, drivers, schedules, calendars, OSS, compare, limit, curve fit, and alarms.

L. Application Specific Control Units:

Single board construction comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control and unitary applications. ASCs shall be provided for Unit Ventilators, Fan Coils, Heat Pumps, Rooftop Units, and other applications as shown on the drawings. To assure complete interoperability, all ASCs firmware shall support all mandatory and all optional LonMark™ Standard Network Variables (SNVTs) for their LonMark™ profile as

documented by the LonMark™ Interoperability Association. Bidder shall provide proof of ASC compliance for all the mandatory and all optional LonMark™ SNVTs. ASCs shall be based on the Echelon Neuron 3150 microprocessor working with the ASCs stand alone control program.

1. Units monitor or control each input/output point; process information; and download from the operator station.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Peer to peer primary network level communications with automatic communications loss detection to maintain normal control functionality regardless of available network communications.
   b. Discrete/digital, analog, and pulse input/output.
   c. Monitoring, controlling, or addressing data points.
   d. Appropriate LonMark™ profiles for specific unitary applications.
   e. Support for all mandatory and optional LonMark™ Standard Network Variable Types (SNVTs) for their LonMark™ profile as documented by the LonMark™ Interoperability Association
   f. Internal customizable safeties and limits to prevent third party LonMark™ tools from providing improper and unrealistic inputs to ASC's.
3. Local operator interface port located on ASC and ASC sensor provides for download from or upload to portable workstation. All Lon bus devices shall be accessible from either port.
4. Communication: ASC's shall communicate with the Building Controller and CAC's at a baud rate of not less than 78.8K baud using LonTalk™ communications protocol (EIA 709.1).
5. ASC units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control including mathematical equations, boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, counters, interlocks, compare, limit, and alarms.
6. All ASC Controller setpoints shall be digital display setpoints with dual setpoint limits (integral hard limits which the user cannot exceed above and below and independent soft limits which are hidden from the user). All digital setpoints shall be network retentive after power outages and after replacement of sensor.

M. ASC Room Sensor
1. The ASC Sensor shall provide room temperature value to the ASC.
2. The ASC Sensor shall connect directly to the ASC and shall not utilize any of the I/O points of the controller.
3. The ASC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive.
4. The ASC Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering.
5. The ASC Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering.
6. The ASC Sensor shall allow for the customization of the color on the esthetic covering as a standard offering.
7. The ASC Sensor shall be supplied in the following manner:
   a. LCD display for showing (typically) the current temperature.
   b. Tenant override to allow timed override of unoccupied to occupied mode of operation.
   c. LED indication of override state.
   d. Up/Down keys to allow adjustment of the current setpoint
   e. User interface with the ASC Sensor shall be provided as a configurable function, and shall offer password protection for access to network variable editing.
   f. ASHRAE 95 compliance (LCD display and sub-base functionality)
   g. The room sensor shall provide access to additional diagnostic data from a sensor-user keypad request. This Diagnostic mode is displayed on the LCD screens and includes separate displays for the controllers:

1) Subnet and Node Address

2) Errors

3) Alarms

4) Temperature Offset

N. Unitary Equipment Controller Units:

Single board construction comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control and unitary applications. ASCs shall be provided for Unit Ventilators, Fan Coils, Heat Pumps, Rooftop Units, and other applications as shown on the drawings.

1. The Unitary Equipment Controller shall have the following point count as a minimum.
   a. 6 Universal Inputs
      1) 0-20mA
      2) 0-5 VDC
      3) Balco Sensors
      4) Platinum Sensor
      5) 10K thermistor
   b. 4 Analog Outputs
      1) 0-20 mA
      2) 0-5/10 VDC
      3) Individually short circuit protected
   c. 8 Digital Outputs
      1) Triacs
      2) LED indication
2. Units monitor or control each input/output point; process information; and download from the operator station.
3. The controller shall have removable terminals for:
   a. 24 VAC Power inputs
   b. MS/TP Communication terminals
4. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Peer to peer primary network level communications with automatic communications loss detection to maintain normal control functionality regardless of available network communications.
   b. Discrete/digital, analog, and pulse input/output.
   c. Monitoring, controlling, or addressing data points.
5. Local operator interface port located on UEC and UEC sensor provides for download from or upload to portable workstation. All bus devices shall be accessible from either port.
6. Communication: UEC's shall communicate with the UNC and ACC at a baud rate selectable of 9.6-76.8 Kbaud utilizing MS/TP.
7. UEC units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control including mathematical equations, Boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, counters, interlocks, compare, limit, and alarms.
8. All UEC Controller setpoints shall be digital display setpoints with dual setpoint limits (integral hard limits which the user cannot exceed above and below and independent soft limits which are hidden from the user). All digital setpoints shall be network retentive after power outages and after replacement of sensor.

O. UEC Room Sensor
   1. The UEC Sensor shall provide room temperature value to the controller.

2. Each UEC shall support a minimum of two sensors.
3. The UEC Sensor shall connect directly to the controller and shall not utilize any of the I/O points of the controller.
4. The UEC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive.
5. The UEC Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering.
6. The UEC Sensor shall allow for the customization of the color on the esthetic covering as a standard offering.
7. The UEC Sensor shall be supplied in the following manner:
   a. LCD display for showing (typically) the current temperature.
   b. Tenant override to allow timed override of unoccupied to occupied mode of operation.
   c. LED indication of override state.
   d. Up/Down keys to allow adjustment of the current setpoint
   e. User interface with the UEC Sensor shall be provided as a configurable function, and shall offer password protection for access to network variable editing.
   f. ASHRAE 95 compliance (LCD display and sub-base functionality)
   g. The room sensor shall provide access to additional diagnostic data from a sensor-user keypad request. This Diagnostic mode is displayed on the LCD screens and includes separate displays for the controllers:
      1) Subnet and Node Address
      2) Errors
      3) Alarms
      4) Temperature Offset

P. ASC – Fan Coil Unit, Unit Ventilator, Heat Pump, or Packaged Rooftop Controller Functionality.

Controls shall be microprocessor based as shown in the drawings or indicated in the sequence of operations. The ASC shall be a single integrated package consisting of a microprocessor, power supply, field terminations, and application software. The units shall be started and stopped from the BMS. A low limit protection thermostat in the mixed air section of the unit shall close down the outdoor air damper, open coil valves, and alarm the BMS when a temperature below 38°F (adjustable) is sensed. All input/output signals shall be directly hardwired to the ASC controller. In all cases, the controller shall automatically resume proper operation following the return of power to, or control by the ASC.

1. All ASCs must have an operating temperature range -40°F to 140°F and 5 to 95% RH, non condensing because they are located in the proximity of extreme temperatures (hot water/steam pipes or the outdoor air.)
2. All ASCs shall have capability for both ASHRAE Cycle II and ASHRAE Cycle III fully tested and validated. Bidder shall provide application documentation for ASC ASHRAE cycle II and III compliance including sequence of operation, controller program, and available SNVT's. The control program shall also be fully customizable in the field to accommodate any local or project specific requirements that may be required.
3. All duct averaging sensors for ASCs must be true continuous averaging units that sense the mean temperature over the complete length of the sensor end to end. Sensors that provide four or nine sensing points, which may be accurate due to air temperature stratifications, are not acceptable.
4. All ASCs shall be easily replaceable for ease of future maintenance and to minimize downtime.
5. The outputs of the ASC shall be of the relay Form C and universal analog form. All digital outputs shall be relay type Form C. ASC devices utilizing non-relay outputs shall provide an interface relay for all points. All analog outputs shall be programmable for their start points and span to accommodate the control devices.

Q. LANs:

Capacity for a minimum of 64 client workstations connected to multi-user, multitasking environment with concurrent capability to access DDC network or control units.

1. Enterprise Network LAN
   a. Media: Ethernet (IEEE 802.3), peer-to-peer CSMA/CD, operating at 10 or 100 Mbps, cable 10 Base-T, UTP-8 wire, category 5
2. Primary Controller Network LAN
   a. Media: LonTalk™ (EIA 709.1), peer to peer, FTT-10 operating at 78.8K.
3. Secondary Network LAN (If Required)
   a. Media: LonTalk™ (EIA 709.1), peer to peer, FTT-10 operating at 78.8K
4. Remote Connection
   a. ISDN, ADSL, T1 or dial-up connection, monthly charges paid by building owner

R. Software:
1. Controller and System HVAC Applications
   a. Update to latest version of software at Project completion. Include and implement the following capabilities from the control units if documented by the specified sequence of operations:
      1) Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, occupied/unoccupied setback/setup, DDC with PID, and trend logging.
      2) HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy/economizer switchover.
      3) Chiller Control Programs: Chilled water plant optimization with condenser water reset, chilled-water reset, chiller and pump equipment selection and sequencing.
      4) Boiler Control Programs: Boiler plant optimization with hot water supply reset, boiler and pump equipment selection and sequencing.
      5) Programming Application Features: Include trend point, alarm reporting, alarm lockout, weekly scheduling, staggered start, sequencing, anti-short cycling and calculated point.
2. Controller and Network Setup Software
      1) Network managements tools for LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-1995, BACnet protocol shall be provided including a network learn function, LonMark bindings, service pins, winks, and diagnostics.

2.3 CONTROL PANELS

A. Local Control Panels: Unitized NEMA 1 cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.
1. Fabricate panels 0.06-inch thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gauges.

4. Provide ON/OFF power switch with over-current protection for control power sources to each local panel.

2.4 SENSORS

A. Electronic Temperature Sensors: Vibration and corrosion resistant for wall, immersion, or duct mounting as required.
   1. Resistance Temperature Detectors: Platinum, thermistor, or balco
      a. Accuracy: Plus or minus 0.2 percent at calibration point; thermistors shall have a maximum 5 year drift of no more than .225°F maximum error of no more than .36°F
      b. Wire: Twisted, shielded-pair cable
      c. Insertion Elements in Ducts: Single point, 6 inches long; use where not affected by temperature stratification or where ducts are smaller than 4 sq. ft.
      d. Averaging Elements in Ducts: 60 inches, long, flexible for use where prone to temperature stratification or where ducts are larger than 4 sq. ft.; 264 inches long, flexible for use where prone to temperature stratification or where ducts are larger than 16 sq. ft; length as required.
      e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
      f. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
      g. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
   2. Humidity Sensors: Bulk polymer sensor element.
      a. Accuracy: 2 percent at 10-90% RH with linear output.
      b. Room Sensors: Range of 0 to 100 percent relative humidity
      c. Duct and Outside-Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
   3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
      a. Accuracy: +/- 1 percent of full scale with repeatability of 0.5 percent.
      b. Output: 4 to 20 mA, 0-5 vDC, 0-10 vDC.
      c. Building Static-Pressure Range: -.1 to .1, -0.25 to 0.25, -.5 to .5, -1.0 to 1.0 IN WC., jumper selectable.
      d. Duct Static-Pressure Range: 0 to 1, 0 to 2.5, 0 to 5, 0 to 10 IN WC., jumper adjustable.
   4. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; proportional output 4 to 20 mA.

B. Equipment operation sensors as follows:
   1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 IN WC.
   2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig.
   3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

C. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

D. Water-Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vapor proof type.

E. Carbon-Dioxide Sensor and Transmitter: Single detectors, using solid-state infrared sensors, suitable over a temperature range of 23°F to 130°F, calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.

F. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment, for flush mounting.

2.5 THERMOSTATS

A. Combination Thermostat and Fan Switches: Line-voltage thermostat with two-, three-, or four-position, push-button or lever-operated fan switch.
   1. Label switches "FAN ON-OFF," "FAN HIGH-LOW-OFF," "FAN HIGH-MED-LOW-OFF." Provide unit for mounting on two-gang switch box.

B. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.

C. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.
   1. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break ungrounded conductors.
   2. Dead Band: Maximum 2°F.

D. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature, with copper capillary and bulb, unless otherwise indicated.
   1. Bulbs in water lines with separate wells of same material as bulb.
   2. Bulbs in air ducts with flanges and shields.
   3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit, adequately supported.
   4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
   5. On-Off Thermostat: With precision snap switches, with electrical ratings required by application.
   6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

E. Room Thermostat Cover Construction:
   1. Set-Point Adjustment: Concealed or exposed
   2. Set-Point Indication: Concealed or exposed
   3. Thermometer: Optional
   4. Color: Neutral
   5. Orientation: Vertical or horizontal

F. Room thermostat accessories include the following:
   1. Insulating Bases: For thermostats located on exterior walls.
   2. Thermostat Guards: As specified in tamper prone areas
   3. Adjusting Key: As required for calibration and cover screws.
   4. Set-Point Adjustment: 1/2-inch diameter, adjustment knob.

G. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
   1. Bulb Length: Minimum 20 feet
   2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

2.6 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action under all environmental conditions (temperature, low power voltage fluctuations, tight seal damper design, maximum air and water flow forces).

1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
3. Spring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running and breakaway torque of 150 in. x lbf.
4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Damper and Valve Actuators: Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque. The actuator shall have rating of not less than twice the thrust needed for actual operation of the damper or valve
1. Coupling: V-bolt and V-shaped, toothed cradle.
2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
3. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
4. Actuators shall have the ability to be tandem mounted.
5. All spring-return actuators shall have a manual override. Complete manual override shall take no more than 10 turns.
6. Power Requirements (Two-Position Spring Return): 24V ac or dc, Maximum 10VA.
7. Power Requirements (Modulating): Maximum 15 VA at 24V ac.
8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
9. Temperature Rating: -22°F to 140ºF.
10. Run Time: 200 seconds open, 40 seconds closed.
11. All actuators shall have a 5-year warranty.
12. Valves:
    a. Size for torque required for valve close-off at maximum pump differential pressure (regardless of water loop system pressures).
    b. Valve and Actuators shall come from the factory fully assembled.
    c. Spring Return Manual Override shall come with a 10 Degree Valve Preload to assure tight close off.
13. Dampers:
    a. Size for running torque calculated as follows:
        1) Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. of damper.
        2) Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.
        3) Parallel-Blade Damper without Edge Seals: 4 inch-pounds/sq. ft. damper.
        4) Opposed-Blade Damper without Edge Seals: 3 inch-pounds/sq. ft. of damper.
        5) Dampers with 2 to 3 Inches wg. of Pressure Drop or Face Velocities of 1000 to 2500 FPM Multiply the minimum full-stroke cycles above by 1.5.
        6) Dampers with 3 to 4 Inches wg. of Pressure Drop or Face Velocities of 2500 to 3000 FPM Multiply the minimum full-stroke cycles above by 2.0.
    b. Spring Return Manual Override actuators shall have a factory set 5 Degree Damper Preload.

2.7 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

B. Globe Valves NPS 2” and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure. Valves shall have allowable media temperature of 20°F to 281°F to assure that the valve packing will have a long life (valves with narrower allowable media temperatures have no reserve packing capability for long term watertight seal.)

C. Globe Valves NPS 2-1/2” and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc. 2-way valves shall have a rangeability if at least 100:1.

D. Hydronic system globe valves shall have the following characteristics :
   1. Rating: Class 125 for service at 125 psig. and 250°F operating conditions.
   2. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
      a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
      b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
   3. Sizing: 3 psig. maximum pressure drop at design flow rate.
   4. Temperature Requirements: Valve and actuator assembly shall be able to operate in ambient temperatures of -22°F to 140°F.
   5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.
   6. Product Life: Valve and actuator assembly shall be rated for a minimum of 200,000 cycles and tested for close off prior to delivery.

E. Control Ball Valves NPS 3” and smaller (NPS 2” for 3-way valves): Forged brass body (CuZn39Pb2), chrome plated brass ball and blowout proof stem and EPDM o-rings with minimum 600 psig. rating. Valve shall contain glass filled ball insert capable of providing equal percentage flow. Valves shall have allowable media temperature of -20°F to 250°F.
   1. Rating: No less than 360 psig. at 250°F operating conditions.
   2. Rangeability: 2-way valves shall have a rangeability of at least 75:1
   3. Medium: Valves shall be used with hot water or cold water with up to 50% glycol.
   4. Temperature Requirements: Valve and actuator assembly shall be able to operate in ambient temperatures of -22°F to 140°F.
   5. Sizing:
      a. Minimum 100 psig. close off on 2 way valves and 70 psig. on three way valves
      b. Maximum differential shall be 35 psig. to ensure quiet operation.
   6. Flow Characteristics: 2 way valves shall have equal percentage characteristics. 3 way valves shall have an equal percentage characteristic through the control port and a linear characteristic through the bypass port.
   7. Product Life: Valve and actuator assembly shall be rated for a minimum of 200,000 cycles and tested for close off prior to delivery.

F. Butterfly Valves: 200 psig. maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
   1. Body Style: Wafer, Lug, or Groove
   2. Disc Type: Nickel-plated ductile iron, Aluminum bronze, Elastomer-coated ductile iron, Epoxy-coated ductile iron.
   3. Sizing: 1 psig. maximum pressure drop at design flow rate.

G. Terminal Unit Control Valves: 360 psig. forged yellow brass body, nickel plated brass ball, with optimizer insert for modulating applications, blow-out resistant stem, two or three-port as indicated, and threaded ends for chilled or hot water, up to 50% glycol solutions. Actuators shall be as noted above with 5 year warranty. Spring return is required for all Unit Ventilator heating valves and other terminal equipment that has an outside air source. All non-spring return valves must have manual override ability built in to the actuator.

1. Rating: ANSI class IV, maximum static pressure of 250 psig ., minimum fluid temperature of 20ºF. and maximum of 250ºF operating conditions.
2. Sizing: 4 psig. maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way and three-valves shall have equal percentage characteristics.

2.8 DAMPERS

A. Dampers: AMCA-rated, parallel, opposed blade designs; 0.1084 inch minimum, galvanized-steel frames with holes for duct mounting; damper blades shall not be less than 0.0635 inch galvanized steel with maximum blade width of .8 inches.
   1. Blades shall be secured to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
   2. Operating Temperature Range: -40°F to 200°F
   3. For standard applications, include optional closed-cell neoprene edging.
   4. For low-leakage applications, use parallel- or opposed-blade design with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4 inches wg. when the damper is being held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.9 CONTROL CABLE

A. Electronic and Fiber-Optic Cable for Control Wiring: As specified in Division 16 Section "Control/Signal Transmission Media."

B. LON communication cable shall be category 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that duct, pipe, and equipment mounted devices and wiring are installed before proceeding with installation.

3.2 INSTALLATION

A. Install equipment level and plumb.

B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and as appropriate to sequence of operation.

C. Connect and configure equipment and software to achieve sequence of operation specified.

D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 60 inches above the floor.
   1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

E. Install guards or tamper proof enclosures on thermostats in the following locations:
   1. Entrances.

2. Public areas.
3. Where indicated.

F. Install automatic dampers according to Division 15 Section "Duct Accessories.

G. Install damper actuators on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

H. Install labels and nameplates to identify control components according to Division 15 Section "Basic Mechanical Materials and Methods."

I. Install labels and nameplates to identify control components according to Division 15 Section "Mechanical Identification."

J. Install hydronic instrument wells, valves, and other accessories according to Division 15 Section "Hydronic Piping."

K. Install refrigerant instrument wells, valves, and other accessories according to Division 15 Section "Refrigerant Piping."

L. Install duct volume-control dampers according to Division 15 Sections specifying air ducts.

M. Install electronic and fiber-optic cables according to Division 16 Section "Control/Signal Transmission Media."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."

B. Install building wire and cable according to Division 16 Section "Conductors and Cables."

C. Install signal and communication cable according to Division 16 Section "Control/Signal Transmission Media."
1. Cable may be installed in plenums where reasonable access is available as allowed by the National Electrical Code and local area codes.
2. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
3. Install exposed cable in raceway.
4. Install concealed and inaccessible cable in raceway.
5. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
6. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
7. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
1. Install piping adjacent to machine to allow service and maintenance.

B. Ground equipment.
   1. 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.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections.

B. Replace damaged or malfunctioning controls and equipment.
   1. Start, test, and adjust control systems.
   2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
   3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

C. Verify DDC as follows:
   1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
   2. Verify operation of operator workstation.
   3. Verify local control units including self-diagnostics.

3.6 ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide two Project site visits, as scheduled by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions for one visit addressing summer specific sequences and operations and one visit addressing winter specific sequences and operations. Each site visit will consist of no more than 8 hours not to exceed a total of 16 hours.

3.7 TRAINING

A. Provided as indicated above, provide a minimum of 24 hours of on-site or classroom training throughout the contract period for personnel designated by the Owner. Each session shall be a minimum of four hours in length and must be coordinated with the building Owner. Train the designated staff of Owners Representative and Owner to enable them to:
   1. Proficiently operate the system
   2. Understand control system architecture and configuration
   3. Understand DDC system components
   4. Understand system operation, including DDC system control and optimizing routines (algorithms)
   5. Operate the workstation and peripherals
   6. Log on and off the system
   7. Access graphics, point reports, and logs
   8. Adjust and change system set points, time schedules, and holiday schedules
   9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
   10. Understand system drawings, and Operation and Maintenance manual
   11. Understand the job layout and location of control components
   12. Access data from DDC controllers
   13. Operate portable operators terminals

END OF SECTION

SECTION 232113 - HYDRONIC PIPING

May 30, 2008

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, special-duty valves, and hydronic specialties for hot-water heating, chilled-water cooling, makeup water for these systems; and condensate drain piping.

1.3 SUBMITTALS

A. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.

B. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Welding Certificates: Copies of certificates for welding procedures and personnel.

D. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

E. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.5 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

D. Coordinate pipe fitting pressure classes with products specified in related Sections.

E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Through-Penetration Firestop Systems" for fire and smoke wall and floor assemblies.

1.6 EXTRA MATERIALS

A. Water Treatment Chemicals: Furnish sufficient chemicals for initial system startup and for preventive maintenance for one year 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. Grooved Mechanical-Joint Fittings and Couplings:

   a. Grinnell Corporation.
   b. Victaulic Company of America.

2. Calibrated Balancing Valves:

   a. Armstrong Pumps, Inc.
   b. Flow Design, Inc.
   c. Gerand Engineering Company.
   d. Griswold Controls.
   e. ITT Bell & Gossett; ITT Fluid Technology Corp.
   f. Taco, Inc.

3. Pressure-Reducing Valves:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. ITT Bell & Gossett; ITT Fluid Technology Corp.
   d. Spence Engineering Company, Inc.
   e. Watts Industries, Inc.; Watts Regulators.

4. Safety Valves:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Conbraco Industries, Inc.
   d. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
   e. Kunkle Valve Division.
   f. Spence Engineering Company, Inc.

5. Automatic Flow-Control Valves:

    a. Flow Design, Inc.
    b. Griswold Controls.

6. Air Vents (automatic):

    a. Armstrong Machine Works.
    b. Bell & Gossett ITT; Fluid Handling Div.
    c. Hoffman Specialty ITT; Fluid Handling Div.
    d. Spirax Sarco.
    e. Honeywell-Baukman.

7. Pump Suction Diffusers:

    a. Armtrol, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett ITT; Fluid Handling Div.
    d. Taco, Inc.
    e. Victaulic Company of America

8. Diverting Fittings:

    a. Armtrol, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett ITT; Fluid Handling Div.
    d. Taco, Inc.

9. Y-Pattern Strainers:

    a. Armstrong Machine Works.
    b. Hoffman Specialty ITT; Fluid Handling Div
    c. Metraflex Co.
    d. Spirax Sarco
    e. Trane Co.
    f. Victaulic Co. of America
    g. Watts Regulator Co.

10. Flexible Connectors:

    a. Amber-Booth
    b. Mason Industries
    c. Metraflex Co.

2.2 PIPING MATERIALS

A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L

2.4 STEEL PIPE AND FITTINGS

A. Steel Pipe, NPS 2) and Smaller: ASTM A 53, Type S (seamless) or F, Grade B, Schedule 40, black steel, plain ends.

B. Steel Pipe, NPS 2-1/2 through NPS 12): ASTM A 53, Type E (electric-resistance welded), Grade B, Schedule 40, black steel, plain ends.

C. Steel Pipe, NPS 14 through NPS 18): ASTM A 53, Type E (electric-resistance welded) or Type S (seamless), Grade B, Schedule 30, black steel, plain ends.

D. Steel Pipe, NPS 20: ASTM A 53, Type E (electric-resistance welded) or Type S (seamless), Grade B, Schedule 30, black steel, plain ends.

   1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedule 40, black steel; seamless for NPS 2) and smaller and electric-resistance welded for NPS 2-1/2) and larger.

E. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.

F. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.

G. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.

H. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.

I. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

J. Flanges and fittings below are available in several classes, materials, facings, and end connections. Coordinate with Project requirements.

K. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

   1. Material Group: 1.1.
   2. End Connections: Butt welding.
   3. Facings: Raised face.

L. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47), Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.

M. Grooved Mechanical-Joint Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

N. Combinations of grooved mechanical-joint couplings and short nipples may also be used. Refer to Victaulic Company of America's technical information.

O. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig) minimum working pressure and 250 deg F) maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of 3/4-inch) misalignment.

P. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F) and pressures up to 150 psig).

Q. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

R. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

2.5 VALVES

A. Globe, check, ball, and butterfly valves are specified in Division 23 Section "Valves."

B. Refer to Part 3 "Valve Applications" Article for applications of each valve.

C. Calibrated Balancing Valves, NPS 2) and Smaller: Bronze body, ball type, 125-psig) working pressure, 250 deg F) maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

D. Calibrated Balancing Valves, NPS 2-1/2) and Larger: Cast-iron or steel body, ball type, 125-psig) working pressure, 250 deg F) maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

E. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.

F. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.

G. Automatic Flow-Control Valves: Gray-iron body, factory set to maintain constant flow with plus or minus 5 percent over system pressure fluctuations, and equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case. Each valve shall have an identification tag attached by chain, and be factory marked with the zone identification, valve number, and flow rate. Valve shall be line size and one of the following designs:

1. Gray-iron or brass body, designed for 175 psig) at 200 deg F) with stainless-steel piston and spring.
2. Brass or ferrous-metal body, designed for 300 psig) at 250 deg F) with corrosion-resistant, tamperproof, self-cleaning, piston-spring assembly easily removable for inspection or replacement.
3. Combination assemblies, including bronze ball valve and brass alloy control valve, with stainless-steel piston and spring, fitted with pressure and temperature test valves, and designed for 300 psig) at 250 deg F).

2.6 HYDRONIC SPECIALTIES

A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig) working pressure; 225 deg F) operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8) discharge connection and NPS 1/2) inlet connection.

B. Fitting in paragraph below is used where a single pipe acts as both supply and return, such as a branch supply line at a convector or finned-tube radiation. These fittings are available in NPS 3/4 to NPS 2 (DN 20 to DN 50).

C. Diverting Fittings: 125-psig) working pressure; 250 deg F) maximum operating temperature; cast-iron body with threaded ends, or wrought copper with soldered ends. Indicate flow direction on fitting.

D. Y-Pattern Strainers: 125-psig) working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2) and larger, threaded connections for NPS 2) and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.

E. Combinations of grooved mechanical-joint couplings and short nipples may also be used. Refer to Victaulic Company of America's technical information.

F. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig) minimum working pressure and 250 deg F) maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch) misalignment.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hydronic heating & cooling piping, NPS 2) and Smaller: Aboveground, use Type L) drawn-temper copper tubing with soldered joints or Schedule 40 steel pipe with threaded joints. Belowground or within slabs, use Type K) annealed-temper copper tubing with soldered joints. Use the fewest possible joints belowground and within floor slabs. Provide dielectric unions at junctions of copper & steel piping.

B. Hydronic heating & cooling, NPS 2-1/2 to 8”: Schedule 40 steel pipe with welded and flanged joints or grooved mechanical-joint couplings.

C. Condensate Drain Lines: Type L drawn-temper copper tubing with soldered joints.

3.2 VALVE APPLICATIONS

A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:

1. Shutoff Duty: Gate, ball, and butterfly valves.
2. Throttling Duty: Globe, ball, and butterfly valves.

B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

C. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.

3.3 PIPING INSTALLATIONS

A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping installation requirements.

B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

C. Install drains, consisting of a tee fitting, NPS 3/4) ball valve, and short NPS 3/4) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

D. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

E. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

F. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.

G. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4) nipple and ball valve in blowdown connection of strainers NPS 2) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2).

H. Anchor piping for proper direction of expansion and contraction.

I. Install unions in pipes 2-inch NPS and smaller, adjacent to each valve, at final connections of each piece of equipment, at each coil on all sides of automatic valves where valves do not have union connections, elsewhere as indicated and wherever necessary to prevent undue difficulty in making repairs or replacement. Unions are not required at flanged connections.

J. Install flanges on valves, apparatus, and equipment having 2-1/2-inch NPS and larger connections.

K. Install flexible connectors at inlet and discharge connections to pumps (except in-line pumps) and other vibration-producing equipment.

L Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

L. No piping shall be run above any electrical panels, electrical equipment, or access clearances for electrical panels or equipment. No piping shall be run through any electrical rooms.

M. Provide valving for complete drainage of system.

N. All piping systems shall be installed so that they can be easily drained by means of drainage of low points of all piping without disconnecting pipe. If not specifically indicated on the drawings, the frequency of draining shall determine whether drain caps, plugs, cocks, or valves are to be used.

All installed pipe lines shall be straight, free from dents, scars, and burrs, with ends reamed smooth, and shall remain straight against strains tending to cause distortion during system operation. The Contractor shall make proper allowance for pipe line expansion and contraction so that no unsightly distortion, noise, damage, or improper operation results therefrom.

Piping shall run only parallel or at right angles to the walls or axes of the building and shall be neatly organized. The Contractor shall study the architectural, structural, mechanical, electrical, and other drawings to eliminate conflict of piping with other structure lighting or other services. Unless specified otherwise, no piping shall be exposed in a finished room, except in shop or storage areas. All changes in direction shall be made with fittings.

No piping shall be run above any electrical panels, electrical equipment or access clearances for electrical for electrical panels or equipment. No piping shall be allowed to run through any electrical rooms.

All piping shall be clean and free from acids and loose dirt when installed and shall be kept clean during the completion of the installation.

Plugs of rags, wools, cottons, waste, or similar materials may not be used in plugging. All piping shall be so arranged to not interfere with removal of other equipment or devices; and to not block access to manholes, access openings, etc. Piping shall be arranged to facilitate equipment maintenance. Flanges or unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment. Piping shall be placed and installed so that there will be no interference with the installation of the air-conditioning equipment, ducts, etc. All piping shall be so installed to insure noiseless circulation. All valves and specialties shall be so placed to permit easy operation and access, and all valves shall be regulated and packed, and the glands shall be adjusted at the completion of the work and before final acceptance. All piping shall be erected to insure proper draining. Cooling and heating piping mains may be run level, with traps avoided where possible. No bushings, short nipples, or street-type fittings shall be used.

Drain valves shall be installed at all low points in all piping systems to allow for complete drainage of piping systems.

When insulated pipes are supported by a roller hanger they shall be protected from damage by suitable pipe covering protection saddles. Saddles shall support pipe on roller and shall be packed with insulation.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following minimum rod sizes and maximum spacing:

Pipe Size	Rod Diameter	Maximum Spacing
1 1/4 in. and smaller	½ in.	6 ft
1-1/2 in. and 2 in.	½ in.	9 ft.
2-1/2 in. and 2 in.	5/8 in.	10 ft.
4 in. and 6 in.	3/4 in.	10 ft.

8 in. and 10 in.	7/8 in.	10 ft.
12 in. and 14 in	1 in.	10 ft.
16 in. through 24 in.	(2)-1in	10 ft.

In addition to the spacing listed, an additional hanger shall be provided 1 foot 0 inches from each pipe drop, rise or turn.

D. Support vertical runs at each floor.

Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC and CPVC piping.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Automatic air vents may cause damage to ceilings and other finished surfaces. Air vents aid in system filling. Air removal after initial startup is accomplished by air separator or boiler dip-tube. Manual air vents may be a better solution.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be same as for equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If multiple, parallel control valves are installed, only one bypass is required.

D. Install ports for pressure and temperature gages at coil inlet connections.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

3.9 ADJUSTING

A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

B. Perform these adjustments before operating the system:

1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Check operation of automatic bypass valves.
7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
8. Lubricate motors and bearings.

3.10 CLEANING

A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

3.11 COMMISSIONING

A. Fill system and perform initial chemical treatment.

B. Check expansion tanks to determine that they are not air bound and that system is completely full of water.

C. Perform these steps before operating the system:

1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or bleed air completely (manual type).

5. Set temperature controls so all coils are calling for full flow.
6. Check operation of automatic bypass valves.
7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
8. Lubricate motors and bearings.

END OF SECTION 232113

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SECTION 232123 - HYDRONIC PUMPS

May 30, 2008

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 categories of hydronic pumps for hydronic systems:

1. End-suction pumps.

B. Related Sections include the following:

1. Division 23 Section "Motors" for general motor requirements.
2. Division 23 Section "Vibration Isolation and Seismic Restraints" for inertia pads, isolation pads, spring supports, and spring hangers.

1.3 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities; shipping, installed, and operating weights; furnished specialties; final impeller dimensions; and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include Setting Drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For pumps to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction requirements.

B. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of pumps and are based on the specific types and models indicated. Other manufacturers' pumps with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

C. Regulatory Requirements: Fabricate and test steam condensate pumps to comply with HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation," and HI 1.6, "Centrifugal Pump Tests."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

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. Mechanical Seals: One mechanical seal for each pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. In-Line Pumps:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett ITT; Div. of ITT Fluid Technology Corp.
d. Grundfos Pumps Corp.
e. Paco Pumps
f. Taco; Fabricated Products Div.

2. End-Suction Pumps:

a. Aurora
b. Armstrong Pumps, Inc.
c. Bell & Gossett ITT; Div. of ITT Fluid Technology Corp.
d. PACO Pumps.
e. Peerless Pump Co.
f. Taco; Fabricated Products Div.
g. Weinman

2.2 GENERAL PUMP REQUIREMENTS

A. Pump Units: Factory assembled and tested.

B. Motors: Include built-in, thermal-overload protection and grease-lubricated ball bearings. Select each motor to be nonoverloading over full range of pump performance curve.

C. Motors Indicated to Be Energy Efficient: Minimum efficiency as indicated according to IEEE 112, Test Method B. Include motors with higher efficiency than "average standard industry motors" according to IEEE 112, Test Method B, if efficiency is not indicated.

2.3 CLOSE-COUPLED, END-SUCTION PUMPS

A. Description: Centrifugal, close-coupled, end-suction, single-stage, bronze-fitted, back-pull-out, radially split case design; rated for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

1. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, and threaded gage tappings at inlet and outlet connections.

    a. Connection Option: Unions at connections for casings that are not available with threaded companion flanges.

2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
3. Shaft and Sleeve: Steel shaft extension with bronze sleeve and neoprene slinger.
4. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
5. Motor: Directly mounted to pump casing and with supporting legs as integral part of motor enclosure.

2.4 FLEXIBLE-COUPLED, END-SUCTION PUMPS

A. Description: Base-mounted, centrifugal, flexible-coupled, end-suction, single-stage, bronze-fitted, back-pull-out, radially split case design; rated for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

1. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, threaded gage tappings at inlet and outlet connections, and integral feet or other means on volute to support weight of casing and attached piping. Casing shall allow removal and replacement of impeller without disconnecting piping.
2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
3. Shaft and Sleeve: Steel shaft with bronze sleeve.
4. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
5. Coupling: Flexible-spacer type, capable of absorbing torsional vibration and shaft misalignment; with flange and sleeve section that can be disassembled and removed without removing pump or motor.
6. Coupling Guard: Steel, removable, and attached to mounting frame.
7. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate for mounting pump casing, coupling guard, and motor. Field-drill motor-mounting holes for field-installed motors.
8. Motor: Secured to mounting frame, with adjustable alignment.

2.5 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle or straight pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory- or field-fabricated support.

B. Triple-Duty Valve: Not allowed

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation.

1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
2. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Install pumps according to manufacturer's written instructions.

1. Install pumps according to HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

B. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.

C. Support pumps and piping separately so piping is not supported by pumps.

D. Suspend in-line pumps using continuous-thread hanger rod and vibration-isolation hangers. Install seismic bracing as required by authorities having jurisdiction.

E. Set base-mounted pumps on concrete foundation. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.

1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.3 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting them on foundations, after grout has been set and foundation bolts have been tightened, and after piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are the same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check valve and throttling valve on discharge side of in-line circulators.

F. Install nonslam check valve and globe valve on discharge side of vertical in-line pumps.

G. Install suction diffuser and shutoff valve on suction side of vertical in-line pumps.

H. Install suction diffuser and shutoff valve on suction side of base-mounted pumps.

I. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

J. Install temperature and pressure-gage connector plugs in suction and discharge piping around each pump.

K. Install check valve and gate or ball valve on each condensate pump unit discharge.

L. Install electrical connections for power, controls, and devices.

M. Electrical power and control wiring and connections are specified in Division 26 Sections.

N. Ground equipment.

1. 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.

3.5 COMMISSIONING

A. Verify that pumps are installed and connected according to the Contract Documents.

B. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents.

C. Perform the following preventive maintenance operations and checks before starting:

1. Lubricate bearings.
2. Remove grease-lubricated bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.

3. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.
4. Verify that pumps are free to rotate by hand and that pumps for handling hot liquids are free to rotate with pumps hot and cold. Do not operate pumps if they are bound or drag, until cause of trouble is determined and corrected.
5. Check suction piping connections for tightness to avoid drawing air into pumps.
6. Clean strainers.
7. Verify that pump controls are correct for required application.

D. Starting procedure for pumps with shutoff power not exceeding safe motor power is as follows:

1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.
2. Open cooling water-supply valves in cooling water supply to bearings, where applicable.
3. Open cooling water-supply valves if stuffing boxes are water cooled.
4. Open sealing liquid-supply valves if pumps are so fitted.
5. Open warm-up valves of pumps handling hot liquids if pumps are not normally kept at operating temperature.
6. Open circulating line valves if pumps should not be operated against dead shutoff.
7. Start motors.
8. Open discharge valves slowly.
9. Observe leakage from stuffing boxes and adjust sealing liquid valve for proper flow to ensure lubrication of packing. Let packing "run in" before reducing leakage through stuffing boxes; then tighten glands.
10. Check general mechanical operation of pumps and motors.
11. Close circulating line valves once there is sufficient flow through pumps to prevent overheating.

E. When pumps are to be started against closed check valves with discharge shutoff valves open, steps are the same, except open discharge valves before starting motors.

F. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for detailed requirements for testing, adjusting, and balancing hydronic systems.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
3. Review data in maintenance manuals. Refer to Division 1 Section Contract Closeout.
4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 232123

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SECTION 232500 - CHEMICAL WATER TREATMENT

May 30, 2008

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division I Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes water-treatment systems for the following:

1. Hot-water heating systems.
2. Chilled-water systems.

1.3 SYSTEM DESCRIPTION

A. Closed System: One bypass feeder on each system, with isolating and drain valves installed around balancing valve downstream of circulating pumps, unless otherwise indicated.

1. Introduce closed system treatment through bypass feeder when required or indicated by test.

2. Performance: Water treatment sized and equipped to treat raw water available at Project site to sustain the following water characteristics:

1)	Hardness:	less than 200ppm as $CaCO_3$
2)	Sodium Nitrite:	800 —1000 ppm as $NaNO_2$
3)	Conductivity (µmhos):	3000 to 4000 µmhos/cm
4)	Silica:	60 ppm or less.
5)	pH:	9.5 or above.

Water characteristics will change with location and type of treatment - usually the treatment parameters will be left to the water treatment supplier based on the type of treatment specified.

6) Cleaning: Cleaning shall be performed by the contractor under the supervision of the chemical supplier at the time of start up. The system shall be filled with water and checked for leakage and debris. Add the proper dosage of liquid alkaline cleaner and circulate for 24 hours at required temperature. Drain and flush piping, clean the strainers. Flush until system pH is no more than eight.

7) Control: The contractor shall provide a Sodium Nitrite drop test kit for checking the concentration of sodium nitrite in the system.

8) Service: The contractor shall provide initial and continuing field service to fulfill the requirements and objectives of the General Water Treatment Specifications.

1.4 QUALITY ASSURANCE

A. Supplier Qualifications: A recognized chemical water treatment supplier with warehousing facilities in the Project's vicinity and that is or employs an experienced consultant, available at reasonable times during the course of the Work to consult with Contractor, Architect, and Owner about water treatment.

B. Chemical Standards: Meet state and local pollution-control regulations.

C. Comply with NFPA 70 for components and installation.

D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed” and “Labeled”: As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

1.5 MAINTENANCE

A. Service Period: Provide chemicals and service program for period of one year from startup date of equipment, including the following:

1. Initial water analysis and recommendations.
2. Startup assistance.
3. Training of operating personnel.
4. Periodic field service and consultation.
5. Customer report charts and log sheets.
6. Laboratory technical assistance.

1.6 EXTRA MATERIALS

A. Furnish the following extra materials, matching products installed, packaged with protective covering for storage and with identification labels clearly describing contents.

B. Chemicals: Furnish quantity equal to 50 percent of amount initially installed (or treatment for one year.)

1.7 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of product specified. Include manufacturer's technical product data, rated capacities of selected equipment clearly indicated, water-pressure drops, weights (shipping, installed, and operating), furnished specialties, accessories, and installation and startup instructions.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chemical Water Treatment Products:

1) West
2) Power

2.2 CHEMICAL WATER TREATMENT SYSTEM

A. Bypass (Pot) Feeders: Cast iron or steel, for introducing chemicals into system; with funnel, shutoff valve on top, air release valve on top, drain valve on bottom, and re-circulating shutoff valves on sides.

1. Capacity: 5 gal.
2. Working Pressure: 125 psi.
3. Working Pressure: 175 psi.

B. Positive Displacement Diaphragm Pump: Adjustable flow rate; thermoplastic construction; continuous-duty, fully enclosed electric motor and drive; and built-in relief valve.

C. Positive Displacement Piston Pump: Metal and thermoplastic construction; continuous-duty, fully enclosed electric motor and drive; and built-in relief valve.

D. Cold-Water Meter: Positive displacement type with sealed, tamperproof magnetic drive; impulse contact register; single-pole, double-throw, dry-contact switch.

2.3 CHEMICALS

A. Furnish chemicals recommended by water treatment system manufacturer for treating water to seals, and accessories.

B. System Cleaner: Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.

C. Biocide: Chlorine release agents or microbiocides.

D. Closed System (Water) Chemicals: Sequestering agent to reduce deposits and adjust pH, corrosion inhibitors, and conductivity enhancers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install treatment equipment level and plumb, according to manufacturer's written instructions, rough-in drawings, the original design, and referenced standards.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. The Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping adjacent to equipment to allow servicing and maintenance.
2. Hot Water Piping: Conform to applicable requirements of Division 23 Section "Hydronic Piping."

B. Electrical: Conform to applicable requirements of Division 26 Sections for connecting electrical equipment.

1. Install electrical devices furnished with boiler but not specified to be factory mounted

3.3 FIELD QUALITY CONTROL

1. Testing Agency: A qualified independent testing agency employed and paid by Owner will perform field quality-control testing.

2. Testing Agency: Provide the services of a qualified independent testing agency to perform field quality-control testing.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris; repair damaged finishes, including chips, scratches, and abrasions.

B. Ensure that system is operational, filled, started, and vented prior to cleaning. Place terminal control valves in OPEN position during cleaning. Use water meter to record capacity in each system.

C. Add cleaning chemicals as recommended by manufacturer.

1. Hot-Water Heating System: Apply heat while circulating, slowly raising system to design temperature; maintain for a minimum of 12 hours. Remove heat and allow to cool; drain and refill with clean water. Circulate for 6 hours at design temperature, then drain. Refill with clean water and repeat until system cleaner is removed.

2. Chilled-Water System: Circulate for 48 hours, then drain. Refill with clean water, circulate for 24 hours, then drain. Refill with clean water and repeat until system cleaner is removed.

3.5 COMMISSIONING

A. Startup Services: Provide the services of a factory-authorized service representative to provide startup service and to demonstrate and train Owner's maintenance personnel as specified below.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Startup Procedures: During boiler system startup, operate boiler water treatment system (after charging with specified chemicals) to maintain required steady-state characteristics of feedwater.

3.6 DEMONSTRATION

A. Provide services of supplier's technical representative for half a day to instruct Owner's personnel in operation, maintenance, and testing procedures of boiler water treatment system.

B. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

C. Review data in the operation and maintenance manuals. Refer to Division I Section "Contract Closeout."

D. Schedule training with Owner, through the Architect, with at least 7 days' advance notice.

END OF SECTION 232500

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PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. General procedures and requirements for ductwork.
   2. Repair leaks in ductwork, as identified by smoke test, at no additional cost to Owner.
   3. Soundproofing procedures for duct penetrations of walls, ceilings, and floors in mechanical equipment rooms.

B. Related Sections:
   1. Section 07 9219: Quality of acoustic sealant.
   2. Section 23 0500: Common HVAC Requirements.
   3. Section 23 0594: Air test and balance and smoke testing of ductwork.

1.2 SUBMITTALS

A. Samples: Sealer and gauze proposed for sealing ductwork.

B. Quality Assurance / Control:
   1. Manufacturer's installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.
   2. Specification data on sealer and gauze proposed for sealing ductwork.

1.3 QUALITY ASSURANCE

A. Requirements: Construction details not specifically called out in Contract Documents shall conform to applicable requirements of SMACNA HVAC Duct Construction Standards.

PART 2 - PRODUCTS

A. Finishes, Where Applicable: Colors as selected by Architect.

B. Duct Hangers:
   1. One inch by 18 ga galvanized steel straps or steel rods as shown on Drawings, and spaced not more than 96 inches apart. Do not use wire hangers.
   2. Attaching screws at trusses shall be 2 inch No. 10 round head wood screws. Nails not allowed.
   3. Attach threaded rod to steel joist with Grinnell Steel washer plate Fig. 60 - ph-1. Double nut connection.

C. Penetration Soundproofing Materials:
   1. Insulation for Packing: Fiberglass.
   2. Calking: Polysulphide.
   3. Escutcheon Frame: 22 ga galvanized iron 2 inches wide.

PART 3 - EXECUTION

3.1 INSTALLATION

A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.

B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.

C. Hangers And Supports:
   1. Install pair of hangers close to each transverse joint and elsewhere as required by spacing indicated in table on Drawings.
   2. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
   3. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.
   4. Where hangers are secured to forms before concrete slabs are poured, cut off flush all nails, strap ends, and other projections after forms are removed.
   5. Secure vertical ducts passing through floors by extending bracing angles to rest firmly on floors without loose blocking or shimming. Support vertical ducts, which do not pass through floors, by using bands bolted to walls, columns, etc. Size, spacing, and method of attachment to vertical ducts shall be same as specified for hanger bands on horizontal ducts.

D. Penetration Soundproofing
   1. Pack space between ducts and structure full of fiberglass insulation of sufficient thickness to be wedged tight, allowing space for application of calking.
   2. Provide calking at least 2 inches thick between duct and structure on both ends of opening through structure.
   3. Provide metal escutcheon on Equipment Room side. Secure escutcheon to wall.

3.2 CLEANING

A. Clean interior of duct systems before final completion.

END OF SECTION

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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 rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air-conditioning systems.

1.3 DEFINITIONS

A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula Btu x in./h x sq. ft. x deg F or W/m x K at the temperature differences specified. Values are expressed as Btu or W.

1. Example: Apparent Thermal Conductivity (k-Value): 0.26 or 0.037.

1.4 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 SUBMITTALS

A. Product Data: For duct liner and sealing materials.

B. Coordinate Shop Drawings: Provide scaled (1/4" = 1'-0") drawing for all ductwork showing details of the following 1.

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating pressure classifications and sizes on plans.
3. Fittings.
4. Reinforcement and spacing.
5. Seam and joint construction.
6. Penetrations through fire-rated and other partitions.
7. Terminal unit, coil, and humidifier installations.
8. Hangers and supports, including methods for building attachment, vibration isolation, seismic restraints, and duct attachment.
9. Ceiling suspension assembly members.
10. Other systems installed in same space as ducts.
11. Ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
12. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

B. Welding Certificates: Copies of certificates indicating welding procedures and personnel comply with requirements in "Quality Assurance" Article.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

D. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.6 QUALITY ASSURANCE

A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports; AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members; and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.

C. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.

D. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Chapter 3, "Duct System," for range hood ducts, unless otherwise indicated.

E. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.

C. All ductwork lined or bare shall be protected from corrosion and contamination caused by moisture and dirt. All ductwork and openings tobe protected with reinforced plastic sheating until assembled in place. All open ends of ductwork to be covered.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.

C. Stainless Steel: ASTM A 480/A 480M, Type 304, sheet form with No. 4 finish for surfaces of ducts exposed to view; and Type 304, sheet form with No. 1 finish for concealed ducts.

D. Aluminum Sheets: ASTM B 209, Alloy 3003, Temper H14, sheet form with standard, one-side bright finish for ducts exposed to view and with mill finish for concealed ducts.

E. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 DUCT LINER

A General: Comply with NFPA 90A or NFPA 90B and NAIMA's "Fibrous Glass Duct Liner Standard."

B Materials: ASTM C 1071 with coated surface exposed to airstream to prevent erosion of glass fibers.

1. Thickness: 1 inch, unless otherwise indicated.
2. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
3. Fire-Hazard Classification: Maximum flame-spread rating of 25 and smoke-developed rating of 50, when tested according to ASTM C 411.
4. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and ASTM C 916.
5. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.

    a. Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
    b. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
    c. Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
    d. Fastners are not to compress liner.

6. All edges shall be coated.

2.3 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

1 Joint and Seam Tape: 2 inches wide; glass-fiber fabric reinforced.
2. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with tape to form a hard, durable, airtight seal.
3. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
4. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.4 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, cast in place inserts, or structural-steel fasteners appropriate for building materials.

B. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rod or galvanized rods with threads painted after installation.
2. Straps and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
3. Supports for Aluminum Ducts: Aluminum support materials, unless materials are electrolytically separated from ductwork.

2.5 RECTANGULAR DUCT FABRICATION

A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

B. Static-Pressure Classification: Unless otherwise indicated, construct ducts to the following:

1. Supply ducts from low pressure supply fans: 2-inch wg
2. Return and exhaust duct: 2-inch wg, negative

C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.

2.6 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness are prohibited.

B. Apply adhesive to liner facing in direction of airflow not receiving metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

E. Do not apply liners in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

G. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profile or are integrally formed from duct wall. Fabricate edge facings at the following locations:

1. Fan discharge.
2. Intervals of lined duct preceding unlined duct.
3. Upstream edges of transverse joints in ducts with air velocity greater than 2000 fpm.

I. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire-damper sleeve.

J. All rectangular low-pressure supply air, return air, and mixed air ducts shall be lined with 1 inch of fiberglass insulation. Duct dimensions shall be increased 2 inches on each side from those shown on drawings to accommodate insulation.

K. Exhaust ductwork is to be lined with duct liner 25 feet up steam from each exhaust fan (for noise reduction). Ductwork is to be increased in size for the duct liner

2.7 ROUND AND FLAT-OVAL DUCT FABRICATION

A. General: Diameter as applied to flat-oval ducts in this Article is the diameter of the size of round duct that has a circumference equal to perimeter of a given size of flat-oval duct.

B. Round Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Flat-Oval Ducts: Fabricate supply ducts with standard spiral lock seams or with butt-welded longitudinal seams according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

2.8 ROUND AND FLAT-OVAL SUPPLY AND EXHAUST FITTING FABRICATION

A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal seam straight duct.

B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.

C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate bend radius of die-formed, gored, and pleated elbows one and one-half times elbow diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:

   a. Ducts 3 to 26 Inches in Diameter: 0.028 inch.
   b. Ducts 27 to 36 Inches in Diameter: 0.034 inch.
   c. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
   d. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
   e. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:

    a. Ducts 3 to 14 Inches in Diameter: 0.028 inch.
    b. Ducts 15 to 26 Inches in Diameter: 0.034 inch.
    c. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
    d. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
    e. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal seam flat-oval duct.
5. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material-handling classes A and B; and only where space restrictions do not permit using 1.5 bend radius elbows. Fabricate with single-thickness turning vanes.
6. Round Elbows, 8 Inches and Smaller: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.
7. Round Elbows, 9 through 14 Inches: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees, unless space restrictions require a mitered elbow. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.
8. Round Elbows, Larger Than 14 Inches, and All Flat-Oval Elbows: Fabricate gored elbows, unless space restrictions require a mitered elbow.
9. Die-Formed Elbows for Sizes through 8 Inches and All Pressures: 0.040 inch thick with two-piece welded construction.
10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
11. Flat-Oval Elbow Metal Thickness: Same as longitudinal seam flat-oval duct specified above.
12. Pleated Elbows for Sizes through 14 Inches and Pressures through 10-Inch wg: 0.022 inch.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

A. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.

B. Construct and install each duct system for the specific duct pressure classification indicated.

C. Install round and flat-oval ducts in lengths not less than 12 feet, unless interrupted by fittings.

D. Install ducts with fewest possible joints.

E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.

F. Install couplings tight to duct wall surface with a minimum of projections into duct.

G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.

K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

L. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire and smoke damper, sleeve, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Firestopping."

3.2 SEAM AND JOINT SEALING

A. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Where ducts pass through interior partitions and exterior walls,

C. Pressure Classification Less Than 2-Inch wg: Transverse joints.

D. Seal externally insulated ducts before insulation installation.

E. Seal all seams and joints of shower room exhaust duct work water tight with silicone. Slope duct down to exhaust grille.

3.3 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

C. Support vertical ducts at a maximum interval of 8 feet and at each floor.

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

E. Install concrete inserts before placing concrete.

F. Install vertical and horizontal supports for ductwork located on the roof and other structures. The support is to be per SMACNA’s supporting standards. Supports are to be for lateral and longitudinal.

3.4 CONNECTIONS

A. Connect equipment with flexible connectors according to Division 23 Section " Air Duct Accessories."

B. For branch, outlet and inlet, and terminal unit connections, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

3.5 FIELD QUALITY CONTROL

A. Disassemble, reassemble, and seal segments of systems as required to accommodate leakage testing and as required for compliance with test requirements.

B. Conduct tests, in presence of Architect, at static pressures equal to maximum design pressure of system or section being tested. If pressure classifications are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

C. Determine leakage from entire system or section of system by relating leakage to surface area of test section.

D. Maximum Allowable Leakage: Comply with requirements for Leakage Classification 3 for round and flat-oval ducts, Leakage Classification 12 for rectangular ducts in pressure classifications less than and equal to 2-inch wg (both positive and negative pressures), and Leakage Classification 6 for pressure classifications from 2- to 10-inch wg.

E. Remake leaking joints and retest until leakage is less than maximum allowable.

F. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."

3.6 ADJUSTING

A. Adjust volume-control dampers in ducts, outlets, and inlets to achieve design airflow.

B. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for detailed procedures.

3.7 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect the system. Vacuum ducts before final acceptance to remove dust and debris.

3.8 DUCT LINER APPLICATION

A. Insulation thickness: 1 inch Duct.

B. Line all transfer air, supply air, return air, mixed air, relief air.

E. PLENUM INSULATION

1. All supply, return, and mixed air plenums shall be lined with 1" thick duct liner. When the floor of the fan room is used as the bottom of the plenum, the floor shall not be lined.

END OF SECTION 233113

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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. Factory-fabricated, field-assembled, single- and double-wall casings for HVAC equipment.

1.3 PERFORMANCE REQUIREMENTS

A. Static-Pressure Classes:

1. Upstream from Fan(s): 2-inch wg.
2. Downstream from Fan(s): 4-inch wg.

B. Structural Performance:

1. Casings shall be fabricated to withstand 133 percent of the indicated static pressure without structural failure. Wall and roof deflection at the indicated static pressure shall not exceed 1/8 inch per foot of width.

   a. Fabricate outdoor casings to withstand wind load of 15 lbf/sq. ft. and snow load of 30 lbf/sq. ft..

C. Seismic Performance: HVAC casings shall withstand the effects of earthquake motions determined according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

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."

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Factory-fabricated casings.
2. Liners and adhesives.
3. Sealants and gaskets.
4. Seismic-restraint devices.

B. Shop Drawings: For HVAC casings. Include plans, elevations, sections, components, and attachments to other work.

1. Detail HVAC casing assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Sheet metal thickness(es).
3. Reinforcement and spacing.
4. Seam and joint construction.
5. Access doors including frames, hinges, and latches.
6. Filter, coil, humidifier, and other apparatus being installed in and mounted on casing.
7. Locations for access to internal components.
8. Hangers and supports including methods for building attachment, vibration isolation, seismic restraints, and casing attachment.
9. Interior lighting, including switches.

C. Welding certificates.

D. Product Certificates: For acoustically critical casings, from manufacturer.

1. Show sound-absorption coefficients in each octave band lower than those scheduled when tested according to ASTM C 423.
2. Show airborne sound transmission losses lower than those scheduled when tested according to ASTM E 90.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for casing joint and seam welding.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

B. Coordinate sizes and locations of steel supports. Supports are specified in Division 05 Section "Metal Fabrications."

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 GENERAL CASING FABRICATION REQUIREMENTS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 6, "Equipment and Casings," for acceptable materials, material thicknesses, and casing construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

1. Fabricate casings with more than 3-inch wg negative static pressure according to SMACNA's "Rectangular Industrial Duct Construction Standards."
2. Casings with more than 2-inch wg positive static pressure may be fabricated according to SMACNA's "Rectangular Industrial Duct Construction Standards."

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Exterior Surface Galvanized Coating Designation: G90.
2. Interior Surface Galvanized Coating Designation:

   a. Sections Not Exposed to Moisture: G90.
   b. Sections Housing and Downstream from Cooling Coil and Humidifiers: G90.

C. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the interior sheet metal surfaces of casing in contact with the airstream. Apply untreated clear coating to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H minimum when tested according to ASTM D 3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 according to UL 723; certified by an NRTL.
5. Applied Coating Color: Standard.

D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

E. Sealing Requirement: SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class A. Seal all seams, joints, connections, and abutments to building.

F. Penetrations: Seal all penetrations airtight. Cover with escutcheons and gaskets, or fill with suitable compound so there is no exposed insulation. Provide shaft seals where fan shafts penetrate casing.

G. Access Doors: Fabricate access doors according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 6-11, "Casing Access Doors - 2-inch wg," and Figure 6.12, "Casing Access Doors - 3-10-inch wg"; and according to pressure class of the plenum or casing section in which access doors are to be installed.

1. Size: 20 by 54 inches.
2. Vision Panel: Double-glazed, wire-reinforced safety glass with an airspace between panes and sealed with interior and exterior rubber seals.
3. Hinges: Piano or butt hinges and latches, number and size according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
4. Latches: Minimum of two wedge-lever-type latches, operable from inside and outside.
5. Neoprene gaskets around entire perimeters of door frames.
6. Doors shall open against air pressure.

H. Condensate Drain Pans: Formed sections of Type 304, stainless-steel sheet complying with requirements in ASHRAE 62.1. Pans shall extend a minimum of 12 inches past coil.

1. Double-wall construction shall have space between walls filled with foam insulation and sealed moisture tight.
2. Intermediate drain pan or drain trough shall collect condensate from top coil for units with stacked coils or stacked eliminators.
3. Insulation: Polystyrene or polyurethane.

4. Slopes shall be in a minimum of two planes to collect condensate from cooling coils (including coil piping connections and return bends), eliminators, and humidifiers when units are operating at maximum catalogued face velocity across cooling coil.
5. Each drain pan connection shall have a trap. Drain traps with depth and height differential between inlet and outlet equal or greater to the design static pressure plus 2-inch wg. Include slab height in trap calculation.

2.2 SHOP-FABRICATED CASINGS

A. Double-Wall Casing Inner Panel: Perforated, galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for sheet metal thickness based on indicated static-pressure class unless otherwise indicated.

B. Double-Wall Casing Inner Panel: Solid sheet steel. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for sheet metal thickness based on indicated static-pressure class unless otherwise indicated.

C. Interstitial Insulation: Polyurethane foam complying with NFPA 90A or NFPA 90B.

D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Coat insulation with antimicrobial coating.
3. Cover insulation with polyester film complying with UL 181, Class 1.

E. Interstitial Insulation: Flexible-elastomeric duct liner complying with ASTM C 534, Type II for sheet materials and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

F. Fabricate casings with standing seams and angle-iron reinforcements unless otherwise indicated.

G. Fabricate close-off sheets from casing to dampers, filter frames, and coils and between stacked coils. Use galvanized sheet steel of same thickness as casing and with a galvanized coating designation of G90.

H. Bolt close-off sheets to frame flanges and housings. Support coils on stands fabricated from galvanized-steel angles or channels.

I. Reinforce casings with galvanized-steel angles.

2.3 MANUFACTURED CASINGS

A. Description: Double-wall, insulated, pressurized equipment casing.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acoustical Surfaces, Inc.
2. AeroSonics, Inc.; a division of TUTCO, Inc.
3. Buffalo Air Handling.
4. CertainTeed Corp.; Insulation Group.

5. CLEANPAK International.
6. D&D Sound Control.
7. IACL.
8. Industrial Noise Control, Inc.
9. McGill AirSilence LLC.
10. SEMCO Incorporated.
11. Vibro-Acoustics.

C. Double-Wall Panel Fabrication: Solid, galvanized sheet steel exterior wall and solid perforated, galvanized sheet steel interior wall; with space between wall filled with insulation.

1. Wall Thickness: 2 inches 4 inches.
2. Fabricate with a minimum number of joints.
3. Weld exterior and interior walls to perimeter; to interior, longitudinal, galvanized-steel channels; and to box-end internal closures. Paint welds.
4. Sheet metal thickness shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for static-pressure class indicated for casing.
5. Sheet Metal Thicknesses:

   a. Exterior Wall Thickness: 0.040 inch minimum.
   b. Interior Wall Thickness: 0.034 inch minimum.

6. Double-Wall Casing Inner Panel: Perforated, galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.
7. Double-Wall Casing Inner Panel: Solid sheet steel.
8. Fill each panel assembly with insulating material that is noncombustible, inert, mildew resistant and vermin proof and that complies with NFPA 90A.
9. Fabricate panels with continuous tongue-and-groove or self-locking joints effective inside and outside each panel.

D. Trim Items: Fabricate from a minimum of 0.052-inch galvanized sheet steel, furnished in standard lengths for field cutting.

2.4 CASING LINER

A. Fibrous-Glass Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. CertainTeed Corp.; Insulation Group.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.

2. Antimicrobial Erosion-Resistant Coating: Apply to surface of the liner that will form the interior surface of casing to act as a moisture repellent and an erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

B. Natural-Fiber Casing Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor, and complying with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Bonded Logic, Inc.

b. Reflectix Inc.

2. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested according to ASTM C 518.
3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

C. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized steel, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

D. Shop or Factory Application of Casing Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of casing liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of casing liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of casings or cut and fit to ensure butted-edge overlapping.
5. Apply adhesive coating on longitudinal seams in casings with air velocity of 2500 fpm.
6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from casing wall. Fabricate edge facings at the following locations:

   a. Fan discharges.
   b. Intervals of lined casing preceding unlined duct.
   c. Upstream edges of transverse joints in casings where air velocities are higher than 2500 fpm or where indicated.

8. Secure insulation between perforated sheet metal inner wall of same thickness as specified for outer wall. Use mechanical fasteners that maintain inner wall at uniform distance from outer wall without compressing insulation.

2.5 SEALANT MATERIALS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.

5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel or stainless steel.

C. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. VOC: Maximum 395 g/L.
9. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
10. Service: Indoor or outdoor.
11. Substrate: Compatible with galvanized sheet steel or stainless steel.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single component, acid curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine concrete bases roof curbs and steel supports for compliance with requirements for conditions affecting installation and performance of HVAC casings.

B. Examine casing insulation materials and liners before installation. Reject casings that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install casings according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Equipment Mounting: Install HVAC casings on concrete base. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported casings, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use 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.

C. Install seismic restraints on casings. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Apply sealant to joints, connections, and mountings.

E. Field-cut openings for pipe and conduit penetrations; insulate and seal according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Support casings on floor or foundation system. Secure and seal to base.

G. Support components rigidly with ties, braces, brackets, seismic restraints, and anchors of types that will maintain housing shape and prevent buckling.

H. Align casings accurately at connections, with 1/8-inch misalignment tolerance and with smooth interior surfaces.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual."
2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
3. Determine leakage from entire system or section of system by relating leakage to surface area of test section. Comply with requirements for leakage classification of ducts connected to casings.

B. HVAC casings will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 233119

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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. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Smoke dampers
5. Fire dampers
6. Turning vanes.
7. Duct-mounted access doors and panels.
8. Flexible ducts.
9. Flexible connectors.
10. Duct accessory hardware.
11. High efficiency take-offs.
12. Concealed damper regulators.

B. Related Sections include the following:

1. Division 8 Section "Access Doors" for wall- and ceiling-mounted access doors and panels.
2. Division 23 Section "Diffusers, Registers, and Grilles."
3. Division 26 Section "Fire Alarm Systems" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Duct-mounted access doors and panels.
5. Flexible ducts.
6. Concealed damper regulators.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:

1. Special fittings and manual- and automatic-volume-damper installations.
2. Fire- and smoke-damper installations, including sleeves and duct-mounted access doors and panels.

C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA standards:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.

C. Aluminum Sheets: ASTM B 209, Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish for ducts exposed to view and mill finish for concealed ducts.

D. Extruded Aluminum: ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT DAMPERS

A. Description: Suitable for horizontal or vertical installations.

B. Frame: 0.063-inch- thick extruded aluminum, with mounting flange.

C. Blades: 0.050-inch- thick aluminum sheet.

D. Blade Seals: Neoprene.

E. Blade Axles: Nonferrous.

F. Tie Bars and Brackets: Aluminum.

G. Return: Spring with adjustable tension adjustable counter balance.

2.3 MANUAL-VOLUME DAMPERS

A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

   1. Pressure Classifications of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

B. Volume Dampers: Dampers smaller than 4 square feet of face area. Multiple- or single-blade, opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

   1. Galvanized Steel Frames: Hat-shaped, 16 gauge, Galvanized steel channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
   2. Galvanized Steel Blades: Single skin 16 gauge galvanized steel.
   3. Blade Axles: Nonferrous.
   4. Bearings: Molder synthetic sleeve type.

C. Jackshaft: 1-inch- diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

   1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.

D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

E. Each volume damper concealed above an inaccessible ceiling, etc., shall be provided with a shaft extended through the ceiling, to which shall be attached a chrome-plated or painted Ventlock No. 666 concealed damper regulator. No. 680 Ventlock miter gears shall be used where necessary.

2.4 COMBINATION FIRE-SMOKE DAMPERS

A. General: Labeled to UL 555S and meeting the code requirements. Combination fire and smoke dampers shall be labeled for one-and-one-half-hour rating to UL 555 for rating assemblies less than 3 hours and three hours for rating assemblies 3 hours or more.

B. Leakage Rate: Class 1 with less than 8 cfm square foot leakage at 4" w.g. static pressure.

C. Pressure Rating: Fully operational will velocities to 4000 FPM and pressures in excess of 4" w.g.

D. Fire Stat: Remotely resetable damper position with switches for remote indication. High Temperature limit returns damper to protection mode when temperature reaches operational limit of damper/actuator assembly.

E. Frame and Blades: 0.064-inch- thick, galvanized, sheet steel, blades are to be Airfoil.

F. Mounting Sleeve: Factory-installed, 0.052-inch- thick, unless otherwise indicated, galvanized, sheet steel; length to suit wall or floor application.

G. Damper Motors: Locate outside air stream unless otherwise indicated. Provide for two-position action.

1. Electric of voltage to match fire alarm system (120V). UL listed as part of damper assembly.
2. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.

H. Provide smoke dampers with two contactor indicators, one for the open position & one for the closed position.

I. Temperature ratings are to be 250 deg F. Minimum.

J. Operational Ratings 2000 fpm at 4 in. wg.

K. Provide a factory mounted single point smoke detector with the Damper. UL Listed S1383. This is not required if a Fire Alarm is provided by division 26.

L. Provide a testable/resettable switch with each damper.

2.5 SMOKE DAMPERS

A. Ratings:

1. Smoke Rating: Leakage Class II Smoke Damper in accordance with UL555S. A Class ll smoke damper leaks no more than 20 cubic feet per minute (.57 m3/min) at 4 in. wg. (1 kPa) differential pressure.
2. Elevated Temperature Rating: 250°F.
3. Air Flow Rating: 2000 fpm.
4. Pressure Rating: 4 in. wg.

B. Construction:

1. Frame: 5 inches x minimum 16 gage (127 x minimum 1.6 mm) roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gage (2.3 mm) U-channel type frame.
2. Blades:

   a. Style: True airfoil-shaped, single piece, double skin.
   b. Action: Opposed.
   c. Orientation: Horizontal.
   d. Material: Minimum 14 gage (2.0 mm) equivalent thickness, galvanized steel.
   e. Width: Maximum 6 inches (152 mm).

3. Bearings: Self-lubricating stainless steel sleeve, turning in extruded hole in frame.
4. Seals:

   a. Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450°F (232°C). Mechanically attached to blade edge (glue-on or grip type seals are not acceptable).
   b. Jamb: Stainless steel, flexible metal compression type.

5. Linkage: Concealed in frame.
6. Axles: Minimum ½ inch (13) diameter plated steel, hex-shaped, mechanically attached to blade.
7. Mounting: Vertical and/or Horizontal.
8. Actuator: Type:Electric 120 V, 60 Hz, two-position, fail close. Mounting:External..
9. Finish: Mill galvanized.
10. Indicator or Auxiliary Switch Packages: SP 100 Switch Package – Two position indicator switches linked directly to damper blade to remotely indicate damper blade position.

11. DSD – Duct Smoke Detector: Factory Mounted. Type: Photoelectronic.
12. Factory Sleeve: Minimum 20 gage (1.0 mm) thickness. Minimum 12 inches (432 mm) long.

2.6 FIRE DAMPERS

A. Curtain type fire dampers.

1. Ratings Fire Resistance: 1½ hours in accordance with UL 555.
2. Dynamic Closure Rating: Dampers shall be classified for dynamic closure to 2000 fpm and 4 inches w.g. (1 kPa) static pressure.

B. Construction:

1. Integral Sleeve Frame: Minimum 20 gauge roll formed galvanized steel.
2. Blades:

   a. Style: Curtain type, out of airstream.
   b. Action: Spring or gravity closure upon fusible link release.
   c. Orientation: Horizontal.
   d. Material: Minimum 24 gage (0.6 mm) roll formed galvanized steel.

3. Closure Springs: Type 301 stainless steel, constant force type, if required.
4. Temperature Release Device: 212 degrees F (100 degrees C) fusible link.
5. Mounting: Vertical and/or Horizontal. Duct Transition Connection, Damper Style: Blades out of air stream, high free area.
6. Finish: Mill galvanized.
7. Indicator Switches: Microswitch.
8. Mounting Angles: FAST, 1-1/2 x 1-1/2 inches (38 x 38 mm). Provide steel mullions for dampers in oversized masonry walls. Provide duct breakaway connection in all duct/damper connections.

2.7 TURNING VANES

A. Fabricate single blade vanes to comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible."

B. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.8 DUCT-MOUNTED ACCESS DOORS AND PANELS

A. General: Fabricate doors and panels airtight and suitable for duct pressure class.

B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.

C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

E. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.9 FLEXIBLE CONNECTORS

A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts.

C. Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.

   1. Minimum Weight: 26 oz./sq. yd..
   2. Tensile Strength: 530 lbf/inch in the warp, and 440 lbf/inch in the filling.

2.10 FLEXIBLE DUCTS

A. General: Comply with UL 181, Class 1.

B. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch- thick, glass-fiber insulation around a continuous inner liner.

   1. Reinforcement: Steel-wire helix encapsulated in inner liner.
   2. Outer Jacket: Glass-reinforced, silver Mylar with a continuous hanging tab, integral fibrous-glass tape, and nylon hanging cord.
   3. Inner Liner: Polyethylene film.

C. Pressure Rating: 6-inch wg positive, 1/2-inch wg negative.

D. Flexible duct connections from the main trunk ducts to diffuser boots shall be furnished and installed as shown on the drawings. Flexible ducts shall have compression fittings on both ends. Flexible ducts shall connect to trunk duct with high efficiency takeoffs. A balance damper with locking quadrant will be provided downstream of take-off from trunk duct.

E. Ducts shall conform to the requirements for Class I connectors when tested in accordance with "Standard for Factory Made Air Ducts Materials and Air Duct Connectors" (UL 181). Ducts shall also pass the 15 minute U.L. flame penetration test as specified in the UL 181 Standard.

F. Flexible ducts shall not extend more than 5’-0”.

2.11 ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness.

B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.

D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.

B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.

C. Provide test holes at fan inlet and outlet and elsewhere as indicated.

D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.

   1. Install fusible links in fire dampers.

E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.

   1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
   2. Install access panels on side of duct where adequate clearance is available.

F. Label access doors according to Division 26 Section "Identification for Piping and Equipment."

G. Where flexible duct is indicated, use insulated flexible duct for supply air return and exhaust air.

H. Use the remote damper operator when they are called out on the drawings or when the damper cannot be easily accessed.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 233300

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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 ceiling- and wall-mounted diffusers, registers, and grilles.

B Related Sections include the following:

1. Division 10 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
3. Division 23 Section "Testing, Adjusting, and Balancing" for balancing diffusers, registers, and grilles.

1.3 DEFINITIONS

A Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

B Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

C Register: A combination grille and damper assembly over an air opening.

1.4 SUBMITTALS

A Product Data: For each model indicated, include the following:

1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.

B Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

C Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for diffusers, registers, and grilles with factory-applied color finishes. Colors to be off-white, unless otherwise selected by Architect during submittal stage.

D Samples for Verification: Of diffusers, registers, and grilles, in manufacturer's standard sizes, showing the full range of colors. Prepare Samples from the same material to be used for the Work.

1.5 QUALITY ASSURANCE

A Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated.

B NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Factors
2. Krueger
3. Metal Aire
4. Nailor
5. Price
6. Titus

2.2 REGISTERS, GRILLES, & DIFFUSERS

A. General: The frames for all registers, grilles, and diffusers shall match type of ceiling where they are to be installed. Special frames shall be provided for narrow T-bar ceilings. Refer to reflected ceiling plan and other specification divisions for ceiling type.

1. Ceiling supply air diffusers in rooms with ceilings shall be Titus Omni Architectural Square Panel with baked enameled finish, directional blow clips, and earthquake tabs. Border type shall match ceiling system.

2. Ceiling supply air diffusers in rooms without ceilings and the radio supply fluoroscopy rooms shall be louvered faced Titus TDC, with opposed blade damper, baked enamel finish for four way blow pattern unless otherwise indicated.

3. Linear ceiling diffusers shall be Titus FlowBar with slot width scheduled. Border style shall be as selected by Architect to match ceiling system. Diffusers to have insulated plenum and frame type to match ceiling construction. Linear diffusers and returns shall have a continuous look. Active supply and return areas shall have insulated plenums. In areas where the ceiling curves the diffuser shall also curve. The supplier shall verify with the Architect and Engineer the exact arch of the linear diffusers before ordering. All interior components of the linear and the plenums shall be painted flat black. Exterior shall be white baked enamel finish.

4. Floor supply and return registers and grilles shall be Titus CT-541 Linear Bar with Heavy Duty core support and Heavy Duty floor mounting frame Type 5 and Type A fasteners.

5. Sidewall return-air grilles from floor to 6 feet 0 inches above the floor shall be sight-proof, heavy-duty gymnasium type equal to Titus 33RL or 33RS with horizontal 40-degree deflection blades, baked enamel finish; grilles above 6 feet 0 inches from the floor shall

be Titus 350RL, or 350RS with horizontal 40-degree deflection blades, baked enamel finish.

6. Ceiling return-air grilles in lay-in ceiling shall be Titus PAR-3, with removable perforated faceplate for lay-in T-bar application, baked enamel finish.

7. Ceiling return-air grilles in other than lay-in ceiling shall be Titus 8F with perforated faceplate, baked enamel finish.

8. Exhaust-air registers in lay-in T-bar ceiling shall be Titus PAR-3 with removable perforated faceplate and opposed-blade damper, baked enamel finish.

9. Exhaust-air registers in other than lay-in ceilings shall be Titus 355FL or 355FS with 40-degree deflection horizontal extruded aluminum blades with opposed-blade damper, baked enamel finish. Exhaust registers from 6 feet 0 inches above floor shall be sight-proof, heavy-duty gymnasium type equal to Titus 33RL or 33RS with horizontal 40-degree deflection blades, baked enamel finish with opposed blade damper.

10. Transfer grilles in ceilings shall be the same as specified for return-air grilles for that type of ceiling. Transfer grilles in walls shall be the same type as specified for return-air grilles in walls.

11. Door grilles shall be Titus T700L, nonvision with telescoping frame, baked enamel finish.

12. Return-air registers shall be the same as specified for exhaust registers.

13. Sidewall supply registers shall be aluminum Titus 272FS with opposed blade damper, baked enamel finish.

14. Sidewall supply drum louvers shall be Titus Model DL with opposed blade damper.

2.3 VAV DIFFUSERS

A. Diffuser shall provide variable air volume control and regulate supply air volume to maintain room temperature settings. The VAV actuator mechanism shall be fully electronic direct drive with immediate response to control signals from the controller board. Thermal expansion devices are not acceptable. Steel construction with plaque type faceplate for 2’x2’ lay-in ceiling application, units shall be Prodigy model PPD2 by E.H. Price or approved equal. A diffuser mounted temperature sensor shall be utilized in cooling mode. A wall mounted assembly will provide room temperature sensing in heating mode as well as setpoint adjustment for heating and cooling. Unit accessories to include a pressure relief collar to relieve excess static pressure during modulation of airflow and a unit mounted 115/24 VAC transformer for line voltage connection. Controls shall be microprocessor based (DDC) with the following features: Automatic heating/cooling changeover. Power and output signals to fully control Drone units at spaces with multiple units. Proportional plus integral control algorithms for cooling and heating. Pulsed 24 VAC contacts with auto-reset overload protection. Retention of setpoint and settings information during power loss.

2.4 SOURCE QUALITY CONTROL

A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

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PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install louvers.

B. Related Sections:
   1. Section 06 2001: Installation of architectural louvers not connected to ductwork.
   2. Section 23 3001: General Duct Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Louvers:
   1. General:
      a. Extruded aluminum, with blades welded or screwed into frames.
      b. Frames shall have mitered corners.
      c. Louvers shall be recessed, flanged, stationary, or removable as noted on Drawings.
      d. Finish:
         1) Polyvinyledene Fluoride (PVF_2) Resin-base finish (Kynar 500 or Hylar 5000) containing 70 percent minimum PVF_2 in resin portion of formula. Thermo-cured two coat system consisting of corrosion inhibiting epoxy primer and top coat factory applied over properly pre-treated metal.
         2) Color as selected by Architect from Manufacturer's standard colors.
   2. Louvers Connected To Ductwork:
      a. 1/2 inch mesh 16 ga aluminum bird screen.
      b. Approved Products.
         1) Air Control Products.
         2) Airolite.
         3) American Warming & Ventilating.
         4) Arrow United Industries.
         5) FKDA by Carnes.
         6) Ruskin.
      c. Aluminum bug screen.
      d. Approved Products.
         1) T608 by Airolite.
         2) LE57 by American Warming & Ventilating.
         3) Equals by Air Control Products, Arrow United Industries, Carnes, or Industrial Louvers as approved by Architect before installation. See Section 01600.

B. Exterior Sidewall Louvers:
   1. Rectangular Louvers:
      a. 12 ga extruded aluminum blades and frames.
      b. 45 degree blade angle with water baffle at center and return bends at upper edge.
      c. All welded construction. Screws or rivets will not be allowed.
   2. Bird Screen: 1/2 inch square mesh 16 ga aluminum in extruded aluminum, rewirable frame on interior of louvers.
   3. Finish: Powder-coated finish, custom color as selected by Architect.
   4. Approved Products.
      a. K6774 by Airolite.

b. 457 by Industrial Louvers.
c. 2850 by Vent Products.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor securely into openings.

B. Where louvers touch masonry or dissimilar metals, protect with heavy coat of asphaltum paint.

END OF SECTION

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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 custom air-handling units for indoor installations.

1. Factory-fabricated, field-assembled, double-wall casings for HVAC equipment Shop Drawings for each air handler are required. The drawings shall include field measurements of each existing room. Field measurements are to be by this Division.
2. Provide a concrete curb under each casing, coils, filters, etc.
3. This division shall be responsible for complete submittals which shall include the engineering of the Casings, concrete curbs, filters, coils. Dampers and fans. The Air Handlers shall be engineering and submitted with shop drawings of exact field conditions. A factory representative shall visit the project a minimum of 2 times during the construction of the air handling units to insure that the Air Handlers are being installed per manufacturers certified drawings. This Divisions shall commission the Air Handlers to insure the multiple fan arrangement is working properly.
4. *Provide all fan wired for single point power connection.*

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each central-station air-handling unit specified, including the following:

1. Certified fan-performance curves with system operating conditions indicated.
2. Certified fan-sound power ratings.
3. Certified coil-performance ratings with system operating conditions indicated.
4. Motor ratings and electrical characteristics plus motor and fan accessories.
5. Material gages and finishes.
6. Filters with performance characteristics.
7. Dampers, including housings, linkages, and operators.

C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

D. Coordination Drawings, including floor plans and sections drawn to scale. Submit with Shop Drawings. Show mechanical-room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

E. Field test reports indicating and interpreting test results relative to compliance with specified requirements.

F. Maintenance data for custom air-handling units to include in the operation and maintenance manual.

1.4 QUALITY ASSURANCE

A. UL and NEMA Compliance: Provide motors required as part of air-handling units that are listed and labeled by UL and comply with applicable NEMA standards.

B. Comply with NFPA 70 for components.

C. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

D. Coordination: Coordinate layout and installation of air-handling units with piping and ductwork and with other installations.

E. Air Handling units and major components shall be products of Manufacturing firms regularly engaged in manufacture of this equipment with characteristics and capacities required and whose products have been in satisfactory use in similar service for not less than 10 years.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver air-handling unit as a factory-assembled module with protective crating and covering.

B. Lift and support units with manufacturer's designated lifting or supporting points.

C. Field assemble units furnished in multiple sections per manufacturers instructions.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate size and location of concrete housekeeping bases. Cast anchor-bolt inserts into base.

B. Coordinate size and location of structural-steel support members.

1.7 WARRANTY

A. The special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

B. Special Warranty: Submit a written warranty signed by manufacturer and Installer agreeing to repair any leaks in the exterior units casings for a period 5 years from date of Substantial Completion.

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:

1. Climate Craft,
2. Haakon
3. Energy Labs

2.2 MANUFACTURED UNITS

A. General Description: Factory assembled, consisting of fans, motor and drive assembly, coils, damper, plenums, filters, drip pans, and mixing dampers.

B. Motor and Electrical Components: Refer to Division 23 Section "Motors."

2.3 CASING (See Section 233119)

2.4 ACCESS DOORS

A. Access doors shall be manufactured from 16 gauge galvanized steel. The doors shall be double wall construction with 22 gauge solid metal liner on the inside. Corners of the doors shall be continuously welded for rigidity. Two inch 3 lb/cu ft density insulation shall be sandwiched between the 16 gauge outer layer and the 22 gauge inner layer. Doors MUST be the same thickness as the unit casing to maximize thermal and acoustical resistance. A 12" round HERMETICALLY SEALED Double Glazed Laminated glass window shall be provided in each door. Hinges shall be continuous piano type stainless steel.

B. Two (2) Ventlock Model #310 high pressure latches operable from either side of the door shall be provided. Door opening shall be fully gasketed with continuous 1/2" closed cell hollow round black gasket with a metal encapsulated reinforcing backing that mechanically fastens to the door frame. Door frames shall be made from 16 gauge galvanized steel with the outside size of the door flush with the unit. Minimum door opening size shall be 18" x 70" (where height permits). Fan compartments must have a door of minimum width to remove the motor.

C. All access doors must swing against the air pressure (i.e. positive pressure plenum doors must swing in).

2.5 FANS

A. The Fan shall consists of plenum fans constructed per AMCA requirements for the duty specified operating Total Static Pressure and specified fan/motor speed. The Fan Wall Array shall be selected to operate at a system Total Static Pressure that does not exceed 90% of the specified fan's peak static pressure producing capability at the specified fan/motor speed. All motors shall include isolated bearings or shaft grounding, Each fan/motor cartridge shall be dynamically balanced to meet AMCA standard 204-96, category BV-5, to meet or exceed Grade 2.5 residual unbalance.

B. The Fans shall produce a uniform air flow profile and velocity profile within the airway tunnel of the air handling unit not to exceed the specified cooling coil and/or filter bank face velocity when measured at a point 12" from the intake side of Fans shall be a distance of 48" from the discharge side of Fan Wall intake plenum wall.

C. Each fan/motor assembly shall be removable through existing conditions.

D. Other fan arrangements that meet the efficiency, sound, and room requirements are acceptable such as the mixed flow fans from Twin City Fans.

2.6 MOTORS AND DRIVES

A. General: Refer to Division 23 Section "Motors" for general requirements.

2.7 COILS

A. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall be mounted in the unit casing to be accessible for service. Capacities, pressure drops and selection procedure shall be certified in accordance with ARI Standard 410.

B. Coils shall be fully enclosed within the casing and cooling coils shall be on mounted 304 stainless steel angle racks manufactured to allow coils to slide out individually. Heating coils shall be mounted on galvanized angle racks manufactured to allow coils to slide out individually.

C. Removable coil access panels shall be provided for removal of coils through the casing wall. Coils shall be individually removable towards the access side. Coils must be individually racked, removable through the side access panels.

D. The manufacturer shall provide drain pans for all cooling coils. Drain pans shall be continuously welded 304 stainless steel. The coil section must have intermediate drain pans and shall be interconnected with 1” stainless steel drain lines. Drain pans shall be IAQ sloped and fully drainable.

E. Coils shall be fully drainable by removing a single threaded plug for each coil row.

F. All pipe connections shall be on the same unit end, extended through the casing for ease of connection.

G. Water coils handling recently mixed air, or direct outside air, shall be fully drainable by removing a single threaded plug for each coil row.

H. The primary surface shall be round seamless 5/8” .020 O.D copper tube on 1½” centers, staggered in the direction of airflow. All joints shall be brazed.

I. The secondary surface shall consist of rippled aluminum plate fins for higher capacity and structural strength. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Bare copper tube shall not be visible between fins and the fins shall have no openings or holes which might accumulate lint and dirt. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates.

J. The casings shall be constructed of continuous galvanized steel. Coil side plates shall be of reinforced flange type.

K. The coil connection locations shall permit universal mounting of the coil for right or left hand airflow and have equal pressure drop through all circuits. Coils shall be circuited for counterflow heat transfer to provide the maximum mean effective temperature difference for maximum heat transfer rates.

L. Headers on water coils shall be seamless copper tubing. The headers shall have intruded tube holes to provide a large brazing surface for maximum strength and inherent flexibility.

M. The complete coil core shall be tested with 315 pounds air pressure under warm water and be suitable for operation at 250 psig working pressures. Individual tube and core tests before installation of headers is not considered satisfactory. Hydrostatic tests alone will not be acceptable. Water cooling coils shall be circuited for drainability.

2.8 AIR FOIL DAMPERS

A. General: Leakage rate, according to AMCA 500, "Test Methods for Louvers, Dampers and Shutters," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.

1. Damper operators are specified in Division 23.

B. Dampers shall be as follows:

1. Aluminum airfoil frames and blades shall be a minimum of 12 gauge (.081”) extruded aluminum. Blades shall be of single unit air foil design 6 in. wide.
2. Frames shall be extruded aluminum channel with grooved inserts for vinyl seals. Standard frames: 2 in x 4 in x 5/8 in on linkage side, 1 in x 4 in x 1 in on the other sides.
3. Pivot rods shall be 7/8 in hexagon extruded aluminum interlocking into blade section. Bearings shall be of a double sealed type with a Celcon inner bearing on rod withing a Polycannonate outer bearing inserted into frame so that the outer bearing cannot rotate.
4. Bearing shall be designed so that there is not a metal-to-metal or metal-to-bearing riding surfaces. Interconnecting linkage shall have a separate Celcon bearing to eliminate friction in linkage.
5. Blade linkage hardware shall be installed in frame out of air-stream. All hardware shall be on ono-corrosive reinforced material of cadmium plated steel.
6. Damper seals shall be designed for minimum air leakage by means of overlapping seals.
7. Jack shaft assemblies shall be provided for multiple damper installations.

2.9 FILTER SECTION

A. Pre Filters: Comply with NFPA 90A.
1. Pre Filter Section: Provide filter media holding frames arranged for flat or angular orientation, with access doors entering the service corridor of unit.
2. Filters shall be 30% efficient, pleated, disposable type. Each filter shall consist of a non-woven cotton and synthetic fabric media, media support grid and enclosing frame. The filter, shall be listed by Underwriters’ Laboratories as Class 2.
3. Filters shall be installed in a prefabricated channel rack.
4. Filters shall be lift-out where access is available upstream of the filter, or side out when access is not available.
5. Provide Dwyer 2000 magnehelic gauges.
6. Magnehelic gauges shall be accurate to "2% of full range.
7. Sensing probes and shut off valves shall be provided for each gauge.
8. One gauge shall be provided for each filter bank.
9. Gauges shall be recessed into cabinet casing.

2.10 LIGHTS

A. Marine lights with protective cast metal cage and glass globes complete with duplex receptacles shall be installed on the wall across from the access doors. A switch with an indicator light shall be installed on the unit. Electrical power shall be 120V/1/60.

2.11 PAINTING

A. The exterior of Indoor units shall be finish painted with two components, etch bond primer and alkyd enamel. The color shall be manufacturers standard. All uncoated steel shall be painted with gray enamel. All metal surfaces shall be pre-painted with vinyl wash primer to ensure paint bonds to metal.

2.12 ELECTRICAL

A. Label and number code all wiring and electrical devices in accordance with the unit electrical diagram. Mount the devices in a control panel inside the unit's service enclosure or on the outside. Ensure the control panel meets the CSA, ETL or UL.

B. This Division is to wire from the motors to a junction box mounted on the exterior of the unit. Wire from the motors to the junction box in accordance with CSA, ETL or UL and contained by EMT conduit with liquid tight connections. Seal the casing penetrations in a manner that eliminates air leaks.

C. Manufacturer to wire lighting and duplex receptacle circuit to a single switch with an indicator light near the supply fan access door. Wiring shall be in accordance with CSA, ETL or UL and contained by EMT conduit with liquid tight connections. Seal the casing penetrations in a manner that eliminates air leaks utilizing rubber gromets or other types of sealing compounds.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions to receive equipment, for compliance with installation tolerances and other conditions affecting performance of central-station air-handling units.

B. Examine roughing-in of steam, hydronic, condensate drainage piping, and electrical to verify actual locations of connections before installation.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install custom air-handling units level and plumb, according to manufacturer's written instructions.

1. Floor-Mounted Units: Support on concrete housekeeping curbs using neoprene pads. Secure units to anchor bolts.

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. The Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connection piping to air-handling units with flexible connectors.
3. Connect condensate drain pans using 1-1/4-inch NPS, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
4. Hot- and Chilled-Water Piping: Conform to applicable requirements of Division 23 Section "Hydronic Piping." Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

B. Duct installation and connection requirements are specified in other Division 23 Sections. The Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.

C. Electrical: Conform to applicable requirements of Division 23 Sections.

1. Connect fan motors to wiring systems and to ground. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
2. Temperature control wiring and interlock wiring is specified in Division 23.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

3.5 CLEANING

A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

3.6 COMMISSIONING

A. Manufacturer's Field Inspection: Engage a factory-authorized service representative to perform the following:

1. Inspect field assembly of components and installation of central-station air-handling units including piping, ductwork, and electrical connections.
2. Prepare a written report on findings and recommended corrective actions.

B. Final Checks before Startup: Perform the following before startup:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify that proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Set outside-air and return-air mixing dampers to minimum outside-air setting.

7. Comb coil fins for parallel orientation.
8. Install clean filters.
9. Verify that manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in fully open position.

C. Starting procedures for central-station air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

D. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for air-handling system testing, adjusting, and balancing.

3.7 DEMONSTRATION

A. Engage the services of a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

1. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout."
2. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION 238200

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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. Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of terminal unit work is indicated by drawings and schedules, and by requirements of this section.

B. Types of terminal units required for project include the following:

1. Coils.

C. Refer to other Division-23sections for piping; ductwork; and testing, adjusting and balancing of terminal units.

D. Refer to Division-26 sections for the following work.

1. Power supply wiring from power source to power connection on terminal unit. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

E. Provide the following electrical work as work of this section, complying with requirements of Division-26 sections:

1. Control wiring between field-installed controls, indicating devices, and terminal unit control panels.

a. Control wiring specified as work of Division-23 for Automatic Temperature Controls is work of that section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. I=B=R Compliance: Test and rate baseboard and finned tube radiation in accordance with I=B=R, provide published ratings bearing emblem of I=B=R.
2. ARI Compliance: Provide coil ratings in accordance with ARI Standard 410 "Forced-Circulation Air-Cooling and Air-Heating Coils".
3. ASHRAE Compliance: Test coils in accordance with ASHRAE Standard 33 "Methods of Testing Forced Circulation Air Cooling and Heating Coils".
4. ARI Compliance: Test and rate fan-coil units in accordance with ARI Standard 440 "Room Fan-Coil Air Conditioners".
5. UL Compliance: Construct and install fan-coil units in compliance with UL 883 "Safety Standards for Fan Coil Units and Room Fan Heater Units".
6. ARI Compliance: Test and rate unit ventilators in accordance with ARI Standard 330 "Unit Ventilators".

7. UL Compliance: Provide electrical components for terminal units which have been listed and labeled by UL.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's specifications for terminal units showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials, and installation instructions.

B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, and field connection details.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to terminal units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Samples: Submit 3 samples of each type of cabinet finish furnished.

E. Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle terminal units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged terminal units or components; replace with new.

B. Store terminal units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading terminal units, and moving them to final location.

PART 2 - PRODUCTS

2.1 COILS

A. General: Provide coils of size and in location indicated, and of capacities and having performance data as scheduled. Certify coil capacities, pressure drops, and selection procedures in accordance with ARI 410.

B. Heating Coils:

1. Fins: Construct of continuous aluminum or copper configurated plate-fin type with full fin collars for accurate spacing and maximum fin-tube contact.
2. Tubes: Construct of copper tubing, expanded into fin collars for permanent fin-tube bond and expanded into header for permanent leaktight joint.
3. Headers: Construct of gray cast iron for coils 33" high and smaller. Hydrostatically test to 400 psi before assembly. Construct of round seamless copper tube for coils over 33" high.
4. Casings: Construct of 16-ga continuous coated galvanized steel with fins recessed into channels to minimize air bypass.
5. Testing: Proof test coils at 300 psi, leak test at 200 psi under water.
6. Coil Types: Provide the following coil types as indicated, and as scheduled.

a. Hot Water to 200 psi, 250 degrees F (121 degrees C): Provide 1- row. 518" tubes, opposite-end connection coil.
b. Hot Water to 200 psi, 325 degrees F (163 degrees C): Provide 1- row, 518" tubes, opposite-end connection coil. Reinforce each tube-to-header joint with brass bushing.
c. Hot Water to 200 psi, 220 degrees F (104 degrees C): Provide 2- row, 518" tubes, same-end connection coil. Provide rolled tube-to-header joints for coil heights 33" and smaller. Provide brazed tube-to- header joints for coil heights over 33".
d. Hot Water to 225 psi, 325 degrees F (163 degrees C): Provide 1-or 2-row, 518" tubes, same-end connection, dual-tube-feed coil. Reinforce tube-to-header joints with brass bushings and provide expanded joints.
e. Hot Water to 225 psi, 325 degrees F (163 degrees C) and Steam to 200 psi, 400 degrees F (204 degrees C): Provide 1 - or 2-rows, 518" tubes, single tube continuous circuit, same-end connection coil. Roll connection tube.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF COILS

A. General: Install coils as indicated, and in accordance with manufacturer's installation instructions.

B. Mount coils on steel supports to form banks or stacks as indicated, brace, secure to air intake chamber. Place in location to permit installation of bypass damper if required, provide steel baffles where required to prevent bypassing of air.

C. Pitch coil casings for drainage, not less than 118" toward return connections, except where drainage feature is included in coil design.

D. Provide for each hot or chilled water coil unit, water supply, return connection, strainer, gate valves, automatic temperature regulating valve, balancing cocks, as indicated.

3.3 ELECTRICAL WIRING

A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electric Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.4 ADJUSTING AND CLEANING

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.

B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION 238240

DIVISION 25 – INTEGRATED AUTOMATION

DIVISION 26 – ELECTRICAL

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 are considered a part of the electrical documents insofar as they apply as if referred to in full.

1.2 DESCRIPTION OF WORK:

A. The extent of electrical work is indicated on drawings and/or specified in Divisions 26, 27 and 28 sections of the specification. Provide all labor, materials, equipment, supervision and service necessary for a complete electrical system. Work includes, but is not necessarily limited to, the following items.

	ITEM	SECTION
1.	Electrical General Provisions	260500
2.	Electrical Connections for Equipment	260507
3.	Conductors and Cables	260519
4.	Grounding	260526
5.	Supporting Devices	260529
6.	Conduit Raceways	260532
7.	Electrical Boxes and Fittings	260533
8.	Occupancy Lighting Control and Equipment	260923
9.	Wiring Devices	262726
10.	Motor and Circuit Disconnects	262816
11.	Motor Starters	262913
12.	Demolition	264119
13.	Interior and Exterior Building Lighting	265100
14.	Telephone/Data Systems (Raceways)	271501
15.	Fire Alarm and Detection Systems	283111

B. Use of standard industry symbols together with the special symbols, notes, and instructions indicated on the drawings describe the work, materials, apparatus and systems required as a portion of this work.

C. Visit the site during the bidding period to determine existing conditions affecting electrical and other work. 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.

1.3 DEFINITION OF TERMS

A. The following terms used in Divisions 26, 27 and 28 documents are defined as follows:

1. "Provide": Means furnish, install and connect, unless otherwise indicated.
2. "Furnish": Means purchase and deliver 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.

1.4 RELATED SECTIONS:

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A. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

B. General and Supplementary Conditions: Drawings and general provisions of contract and Division 1 of the Specifications, apply to all Division 26, 27 and 28 sections.

C. Miscellaneous Metal Work:

1. Provide fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, lighting fixtures, panelboards, distribution boards, switchboards, motor controls centers, etc. See Division 5, Metals for material and installation requirements.

D. Miscellaneous Lumber and Framing Work:

1. Provide wood grounds, nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment. See Division 6, Rough Carpentry for material and installation requirements.

E. Moisture Protection:

1. Provide membrane clamps, sheet metal flashing, counter flashing, caulking and sealants as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors and ceiling slabs and foundation walls. All penetrations through vapor barriers at slabs on grade shall be taped and made vaportight. See Division 7, Thermal and Moisture Protection for material and installation requirements.

F. Access panels and doors:

1. Provide in walls, ceiling, and floors for access to electrical devices and equipment. See Division 8, Doors and Windows for material and installation requirements.

G. Painting:

1. Provide surface preparation, priming and finish coating as required for electrical cabinets, exposed conduit, pull and junction boxes, poles, surface metal raceways, etc. See Division 9, Finishes for material and installation requirements.

1.5 WORK FURNISHED AND INSTALLED UNDER ANOTHER SECTION REQUIRING CONNECTIONS UNDER THIS SECTION:

A. Provide electrical service, make requisite connections and perform operational test. Items furnished and installed under other sections and connected under this section, include but are not limited to the following:

1. Electric motors.
2. Package mechanical equipment: fans, fan coil units, pumps, boilers, duplex compressors, etc.

1.6 WORK NOT INCLUDED IN THIS DIVISION:

A. Items of work provided under another contract include, but are not necessarily limited to, the following:

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1. Telephone cables and electronic equipment.
2. Data system cables, fittings, coverplates and electronic equipment.
3. Control wires for irrigation control valves.
4. Energy management/temperature control system; both line and low voltage including conductors and conduit.
5. Television monitors and projection equipment.
6. Security system equipment, cables, fittings, and coverplates.
7. CCTV and MATV cabling and electronic equipment.

1.7 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS:

A. Before bidding, Contractor shall familiarize himself with the drawings, specifications and project site. Submit requests for clarification to Architect/Engineer in writing prior to issuance of final addendum. After signing the contract, the Contractor shall meet the intent, purpose, and function of the Contract Documents. Any costs of materials, labor and equipment arising therefrom, to make each system complete and operable, is the responsibility of the Contractor.

1.8 QUALITY ASSURANCE:

A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies refers to the latest edition of such publications adopted and published prior to submittal of the bid proposed, unless noted otherwise herein. Such codes or standards are considered a part of this specification as though fully repeated herein.

B. When codes, standards, regulations, etc. allow work of lesser quality or extent than is specified under this Division, nothing in said codes shall be construed or inferred as reducing the quality, requirements or extent of the Drawings and Specifications. Perform work in accordance with applicable requirements of all governing codes, rules and regulations including the following minimum standards, whether statutory or not:

1. National Electric Code (NEC).
2. International Building Code (IBC).
3. International Fire Code (IFC).
4. International Mechanical Code (IMC).

C. Standards: Comply with the following standards where applicable for equipment and materials specified under this Division.

1.	UL	Underwriters' Laboratories
2.	ASTM	American Society for Testing Materials
3.	CBN	Certified Ballast Manufacturers
4.	IPCEA	Insulated Power Cable Engineers Association
5.	NEMA	National Electrical Manufacturer's Association
6.	ANSI	American National Standards Institute
7.	ETL	Electrical Testing Laboratories

D. All electrical apparatus furnished under this Section shall conform to (NEMA) standards and the NEC and bear the Underwriters' Laboratories (UL) label where such label is applicable.

E. Comply with requirements of State and Local Ordinances. If a conflict occurs between these requirements and the Contract Documents, the most stringent requirements shall govern. The Contractor accepts this responsibility upon submitting his bid, and no extra charge will be allowed after the contract is awarded. This shall not be construed as relieving the Contractor from complying with any requirements of the Contract

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Documents which may be in excess of the aforementioned requirements, and not contrary to same.

F. Obtain all permits, inspections, etc. required by authority having jurisdiction. Include all fees in bid. Furnish a certificate of approval to the Owner's Representative from the Inspection Authority at completion of the work.

G. Employ only qualified craftsmen with at least three years of experience. Workmanship shall be neat, have a good mechanical appearance and conform to best electrical construction practices. Provide a competent superintendent to direct the work at all times. Any person found incompetent shall be discharged from the project and replaced by satisfactory personnel.

H. Contractor shall have a current state contracting license applicable to type of work to be performed under this contract.

1.9 SUBMITTALS:

A. SHOP DRAWINGS AND PRODUCT DATA:

1. After the Contract is awarded but prior to manufacture or installation of any equipment, prepare complete Shop Drawings and Brochures for materials and equipment as required by each section of the specification. Submit 8 complete sets for review. All sets of shop drawing material shall be bound. Prior to submission of the Shop Drawings and Project Data, review and certify that they are in compliance with the Contract Documents. Verify all dimensional information to insure proper clearance for installation of equipment. Check all materials and equipment after arrival on the job site and verify compliance with the Contract Documents. A minimum period of two weeks, exclusive of transmittal time, will be required each time Shop Drawing and/or Brochure is submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling submittal data. If the shop drawings are rejected twice, the contractor shall reimburse the engineer the sum of $200.00 for the third review and any additional reviews required.

2. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from the Contract Document's requirements. It shall be clearly understood that the noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Document's shall govern and are not waived, or superseded in any way by the review of the Shop Drawings and Brochures.

3. Certifications shall be written or in the form of rubber stamp impressions as follows:

4. I hereby certify that this Shop Drawing and/or Brochure has been checked prior to submittal and that it complies in all respects with the requirements of the Contract Drawings and Specifications for this Project.

(Name of Electrical Subcontractor)

Signed_____.

Position_____ Date

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5. Observe the following rules when submitting the Shop Drawings and Brochures.

a. Each Shop Drawing shall indicate in the lower right hand corner, and each Brochure shall indicate on the front cover the following: Title of the sheet or brochure, name and location of the building; names of the Architect and Electrical Engineer, Contractor, Subcontractors, Manufacturer, Supplier/Vendor, etc., date of submittal, and the date of correction and revision. Unless the above information is included the submittal will be returned for resubmittal.

b. Shop Drawings shall be done in an easily legible scale and shall contain sufficient plans, elevations, sections, and isometrics to clearly describe the equipment or apparatus, and its location. Drawings shall be prepared by an Engineer/Draftsmen skilled in this type of work. Shop Drawings shall be drawn to at least 1/4" = 1'0" scale.

c. Brochures to be submitted shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information. Brochures submitted shall contain only information relevant to the particular equipment or materials to be furnished. The Contractor shall not submit catalogs which describe several different items in addition to those items to be used, unless all irrelevant information is marked out, or unless relevant information is clearly marked. Brochures from each manufacturer shall be identified and submitted separately.

1.10 OPERATION AND MAINTENANCE MANUALS:

A. Provide operating instruction and maintenance data books for all equipment and materials furnished under this Division.

B. Submit four copies of operating and maintenance data books for review at least four weeks before final review of the project. Assemble all data in a completely indexed volume or volumes and identify the size, model, and features indicated for each item. The binder (sized to the material) shall be a 2" slide lock unit (Wilson-Jones B3-367-44). The cover shall be engraved with the job title in 1/2" high letters and the name and address of the Contractor in 1/4" high letters. Provide the same information in 1/8" letters on the spine.

C. Include complete cleaning and servicing data compiled in clearly and easily understandable form. Show serial numbers of each piece of equipment, complete lists of replacement parts, motor ratings, etc. Each unit shall have its own individual sheet. (Example: If two items of equipment A and D appear on the same sheet, an individual sheet shall be provided for each unit specified).

D. Include the following information where applicable.

1. Identifying name and mark number.
2. Certified outline Drawings and Shop Drawings.
3. Parts lists.
4. Performance curves and data.
5. Wiring diagrams.
6. Light fixture schedule with the lamps and ballast data used on the project for all fixtures
7. Manufacturer's recommended operating and maintenance instructions.
8. Vendor's name and address for each item.

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E. The engineer shall review the manuals and when approved, will forward the manuals on to the architect. If the manuals are rejected twice, the contractor shall reimburse the engineer the sum of $200.00 for each review afterwards.

1.11 RECORD DRAWINGS:

A. Maintain, on a daily basis, a complete set of “Record Drawings”, reflecting an accurate record of work in accordance with the following:

1. Show the complete routing and location of all feeders rated 100 amps and larger. Locate work buried below grade or under slab, work concealed above ceilings, and work in concealed spaces, dimensionally from fixed structural elements (not partition walls, etc.)

2. Show the complete routing and location of all telecommunications conduits, systems raceways, and empty raceways, 1-1/4" and larger. Locate work buried below grade or under slab, work concealed above ceilings, and work in concealed spaces, dimensionally from fixed structural elements (not partition walls, etc.).

3. Show all changes, deviations, addendum items, change orders, job instructions, etc., which change the work from that shown on the contract documents, including wall relocations, fixtures and device changes, branch circuiting changes, etc. Where locations of boxes, raceways, equipment, etc. are adjusted in the field to fit conditions, but such new locations may not be obvious by referring to the contract document, show new locations on the record drawings.

B. At the discretion of the Architect/Engineer, the drawings will be reviewed on a periodic basis and used as a pre-requisite for progress payments. This requirement shall not be construed as authorization for the Contractor to make changes in the layout, or work without written authorization for such changes. The “Record Drawings” for daily recording shall consist of a set of blue line prints of the Contract Drawings.

C. Upon completion of the work, purchase a complete set of electronic drawings. Transfer all “Record” information from the blue line prints to the drawings via the current CAD program in which it was written. The Architect/Engineer shall review the drawings and the Contractor shall incorporate the resulting comments into the final record drawings. The Contractor shall make two complete copies of the drawings electronically and forward this to the Engineer.

D. Certify the “Record Drawings” for correctness by placing and signing the following certifications of the first sheet of the sepia:

1. "CERTIFIED CORRECT (3/8" high letters)

(Name of General Contractor)____

By _____ Date

(Name of Electrical Contractor)

By_____ Date

1.12 GUARANTEE:

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A. Ensure that electrical system installed under this contract is in proper working order and in compliance with drawings, specifications, and/or authorized changes. Without additional charge, replace any work or materials which develop defect, except from ordinary wear and tear, within one year from the date of substantial completion. Exception: Incandescent and fluorescent lamps shall be guaranteed for a period of two months from the date of substantial completion.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Products are specified by manufacturer name, description, and/or catalog number. Discrepancies between equipment specified and the intended function of equipment shall be brought to the attention of the Architect/Engineer in writing prior to bidding. Failure to report any conflict, including catalog numbers, discontinued products, etc., does not relieve the Contractor from meeting the intent of the contract documents nor shall it change the contract cost. If the Contractor is unable to interpret any part of the plans and/or specifications, or should he find discrepancies therein, he shall bring this to the attention of the Architect/Engineer who will issue interpretation and/or additional instructions to Bidders before the project is bid.

2.2 MANUFACTURERS:

A. Provide products of manufacturers specified. Manufacturers catalog numbers and descriptions establish the quality of product required. Substitutions will be considered if a duplicate written application (2-copies) is at the office of the Architect/Engineer eight (8) working days prior to the day of the bidding. The application shall include the following: 1) A statement certifying 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; 2) The specified and submittal catalog numbers of the equipment under consideration; 3) A pictorial and specification brochure.

B. Any conflict arising from the use of substituted equipment shall be the responsibility of the Contractor, who shall bear all costs required to make the equipment comply with the intent of the contract documents.

C. Samples may be required for non-standard or substituted items before installation during construction. Provide all samples as required.

D. No materials or apparatus may be substituted after the bid opening except where the equipment specified has been discontinued.

E. Provide only equipment specified in the Contract Documents or approved by addendum.

2.3 SPARE PARTS:

A. Provide spare parts (fuses, diffusers, lamps, etc.) as specified. Transmit all spare parts to Owner's Representative prior to substantial completion.

PART 3 – EXECUTION

3.1 INSTALLATION:

A. Layout electrical work in advance of construction to eliminate unnecessary cutting, drilling, channeling, etc. Where such cutting, drilling, or channeling becomes necessary for proper installation; perform with care. Use skilled mechanics of the trades involved.

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Repair damage to building and equipment at no additional cost to the contract. Cutting work of other Contractors shall be done only with the consent of that Contractor. Cutting structural members shall not be permitted.

B. Since the drawings of floor, wall, and ceiling installation are made at small scale; outlets, devices, equipment, etc., are indicated only in their approximate location unless dimensioned. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned, and coordinate such locations with work of other trades to prevent interferences. Verify all dimensions on the job. Do not scale the electrical drawings, but refer to the architectural and mechanical shop drawings and project drawings for dimensions as applicable.

C. Perform for other trades, the electrical wiring and connection for all devices, equipment or apparatus. Consult Architectural, Mechanical, and other applicable drawings, and all applicable shop drawings to avoid switches, outlets, and other equipment from being hidden behind doors, cabinets, counters, heating equipment, etc., or from being located in chalkboards, tackboards, glass panels, etc. Relocate buried electrical devices and/or connections as directed at no additional cost.

D. Coordinate the location of outlets, devices, connections, and equipment with the supplier of the systems furniture prior to rough-in.

E. Where conduit, outlets or apparatus are to be encased in concrete, it must be located and secured by a journeyman or foreman present at the point of installation. Check locations of the electrical items before and after concrete and/or masonry installation and relocate displaced items.

F. Provide block-outs, sleeves, demolition work, etc., required for installation of work specified in this division.

3.2 CLEAN:

A. Clean up all equipment, conduit, fittings, packing cartons and other debris that is a direct result of the installation of the work of this Division.

B. Clean fixtures, interiors and exteriors of all equipment, and raceways. Replace all filters in electrical equipment upon request for Substantial Completion.

3.3 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. Include all costs for overtime work in bid.

B. Submit written request at least 7 days in advance of scheduled outage and proceed with outage only after receiving authorization from the Owner's Representative.

C. Keep all outages to an absolute minimum.

3.4 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. In no case shall storage interfere with traffic conditions in any public thoroughfare or constitute a hazard to persons in the vicinity. Protect completed work, work underway, and apparatus against loss or damage.

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3.5 ROOF PENETRATIONS:

A. Where raceways penetrate roofing or similar structural area, provide appropriate roof jack coordinate with the roofing contractor and the Architect in order to match the vent with the roof construction. The jack shall be sized to fit tightly to raceway for weather-tight seal, and with flange extending a minimum of 9" under roofing in all sides or as required by the roof type of construction. Completely seal opening between inside diameter of roof flashing and outside diameter of penetrating raceways. Coordinate all work with work required under roofing section of specifications.

3.6 FIRE PENETRATION SEALS:

A. Seal all penetrations for work of this section through fire rated floors, walls and ceilings to prevent the spread of smoke, fire, toxic gas or water through the penetration either before, during or after fire. The fire rating of the penetration seal shall be at least that of the floor, wall or ceiling into which it is installed, so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electrical Code. Where applicable, provide OZ Type CFSF/I and CAFSF/I fire seal fittings for conduit and cable penetrations through concrete and masonry walls, floors, slabs, and similar structures. Where applicable, provide 3M fire barrier sealing penetration system, and/or IPC Flame Safe Fire Stop System, and/or Chase Foam fire stop system, including wall wrap, partitions, caps, and other accessories as required. All materials to comply with UL 1479 (ASTM E-814). Comply with manufacturer's instructions and recommendations for installation of sealing fittings and barrier sealing systems.

3.7 PROJECT FINALIZATION AND START-UP:

A. Upon completion of equipment and system installation, assemble all equipment Factory Representatives and Subcontractors for system start-up.

B. Each Representative and Subcontractor shall assist in start-up and check out their respective system and remain at the site until the total system operation is accepted by the Owner's representative.

C. The Factory Representative and/or System Subcontractor shall give personal instruction on operating and maintenance of their equipment to the Owner's maintenance and/or operation personnel. To certify acceptance of operation and instruction by the Owner's Representative, the contractor shall prepare a written statement as follows:

D. This is to certify that the Factory Representative and System Subcontractor for each of the systems listed below have performed start-up and final check out of their respective systems.

E. The Owner's Representative has received complete and thorough instruction in the operation and maintenance of each system.

1.	SYSTEM	FACTORY REPRESENTATIVE
	(List systems included)	(List name and address of Factory Representative).
	_____	_____
	Owner's Representative	Contractor

F. Send copy of acceptance to Architect/Engineer.

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3.8 FINAL REVIEW:

A. At the time of final review, the project foreman shall accompany the reviewing party, and remove coverplates, panel covers and other access panels as requested, to allow review of the entire electrical system.

END OF SECTION 260500

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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 Basic Materials and Methods section, and is part of each Division-26 section making reference to electrical connections.

1.2 DESCRIPTION OF WORK:

A. Extent of electrical connection for equipment includes final electrical connection of all equipment having electrical requirements. Make final connections for all owner furnished equipment. See other applicable portions of specification for building temperature control wiring requirements.

B. Refer to Division-23 sections for motor starters and controls furnished integrally with equipment; not work of this section.

C. Refer to Division- 23 section for control system wiring; not work of this section.

D. Refer to sections of other Divisions for specific individual equipment power requirements.

1.3 QUALITY ASSURANCE:

A. NEC COMPLIANCE: Comply with applicable portions of NEC as to type products used and installation of electrical power connections.

B. UL LABELS: Provide electrical connection products and materials which have been UL-listed and labeled.

PART 2 – PRODUCTS

2.1 GENERAL:

A. For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, raceways, conductors, cords, cord caps, wiring devices, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories as needed to complete splices, terminations, and connections as required. Crimp on or slip-on type splicing materials (insulation displacement type) designed to be used without wire stripping are not acceptable. See Section 260532, Conduit Raceways; Section 262726 Wiring Devices: and Section 260519 Wire and Cable for additional requirements. Provide final connections for equipment consistent with the following:

B. Permanently installed fixed equipment - flexible seal-tite conduit from branch circuit terminal equipment, or raceway; to equipment, control cabinet, terminal junction box or wiring terminals. Totally enclose all wiring in raceway.

C. Movable and/or portable equipment - wiring device, cord cap, and multi-conductor cord suitable for the equipment and in accordance with NEC requirements (Article 400).

D. Other methods as required by the National Electrical Code and/or as required by special equipment or field conditions.

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PART 3 – EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS:

A. Make electrical connections in accordance with connector manufacturer's written instructions and with recognized industry practices, and complying with requirements of NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.

B. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams.

C. Coordinate installation of electrical connections for equipment with equipment installation work.

D. Verify all electrical loads (voltage, phase, full load amperes, number and point of connections, minimum circuit ampacity, etc.) for equipment furnished under other Divisions of this specification, by reviewing respective shop drawings furnished under each division. Meet with each subcontractor furnishing equipment requiring electrical service and review equipment electrical characteristics. Report any variances from electrical characteristics noted on the electrical drawings to Architect before proceeding with rough-work.

E. Obtain and review the equipment shop drawings to determine particular final connection requirements before rough-in begins for each equipment item.

F. Refer to basic materials and methods Section 260519, Conductors, for identification of electrical power supply conductor terminations.

END OF SECTION 260507

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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 Basic Materials and Methods section, and is part of each Division-26 section making reference to conductors and cables specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of electrical conductor and electrical cable work is indicated by drawings and schedules.

B. Types of conductors and cables in this section include the following:

1. Copper Conductors (600V)

C. Applications for conductors and cables required for project include:

1. Branch Circuits

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to construction and installation of electrical conductors and cable. Comply with UL standards and provide electrical conductors and cables which have been UL-listed and labeled.

B. Comply with applicable portions of NEMA/Insulated Cable Engineers Association standards pertaining to materials, construction and testing of conductors and cable.

C. Comply with applicable portions of ANSI/ASTM and IEEE standards pertaining to construction of conductors and cable.

1.4 SUBMITTALS:

A. FIELD TEST DATA:

1. Submit megohmmeter test data for circuits under 600 volts.

PART 2 - PRODUCTS

2.1 COPPER CONDUCTORS (600V):

A. Provide factory-fabricated conductors of sizes, ratings, materials, and types indicated for each service. Where not indicated provide proper selection to comply with project's installation requirements and NEC standards. Provide conductors in accordance with the following:

1. Branch Circuit Conductors and All Conductors #3 AWG and Smaller - Copper conductor, with THHN/THWN insulation. Size all conductors in accordance with NEC; minimum size to be #12 AWG. Provide stranded conductors for #8 AWG and larger.

B. Provide color and coding of conductors as follows:

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120/208V	277/480V
A-Phase - Black	A-Phase - Brown
B-Phase - Red	B-Phase - Purple
C-Phase - Blue	C-Phase - Yellow
Neutral - White	Neutral - Gray
Ground - Green	Ground - Green

C. Provide colors for switch legs, travelers and other wiring for branch circuits different than listed above.

D. Provide #10 AWG neutral conductor for all three and four wire fluorescent circuit home runs.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Install electric conductors and cables as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standards of Installation", and in accordance with recognized industry practices.

B. Coordinate installation work with electrical raceway and equipment installation work, as necessary for proper interface.

C. Cables may be pulled by direct attachment to conductors or by use of basket weave pulling grip applied over cables. Attachment to pulling device shall be made through approved swivel connection. Nonmetallic jacketed cables of small size may be pulled directly by conductors by forming them into a loop to which pull wire can be attached; remove insulation from conductors before forming the loop. Larger sizes of cable may be pulled by using basket weave pulling grip, provided the pulling force does not exceed limits recommended by manufacturer; if pulling more than one cable, bind them together with friction tape before applying the grip. For long pulls requiring heavy pulling force, use pulling eyes attached to conductors.

D. Do not exceed manufacturer's recommendations for maximum allowable pulling tension, side wall pressure, and minimum allowable bending radius. In all cases, pulling tension applied to the conductors shall be limited to 0.008 lbs. per circular mil of conductor cross-section area.

E. Pull in cable from the end having the sharpest bend; i.e. bend shall be closest to reel. Keep pulling tension to minimum by liberal use of lubricant, and turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one in pullhole during this operation.

F. For training of cables, minimum bend radius to inner surface of cable shall be 12 times cable diameter.

G. Where cable is pulled under tension over sheaves, conduit bends, or other curved surfaces, make minimum bend radius 50% greater than specified above for training.

H. Use only wire and cable pulling compound recommended by the specific cable manufacturer, and which is listed by UL.

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I. Seal all cable ends unless splicing is to be done immediately. Conduit bodies shall not contain splices.

3.2 AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW:

A. Prior to energization, test cable and wire for continuity of circuitry, and for short circuits,

B. Subsequent to wire and cable connections, energize circuitry and demonstrate functioning in accordance with requirements.

END OF SECTION 260519

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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. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Provide grounding as specified herein, and as indicated on drawings.

B. Provide grounding and bonding of all electrical and communication apparatus, machinery, appliances, building components, and items required by the NEC to provide a permanent, continuous, low impedance, grounding system.

C. Unless otherwise indicated, ground the complete electrical installation, metallic conduits and raceways, boxes, fittings, devices, cabinets, and equipment in accordance with all code requirements.

D. Ground each separately derived system, as described in NEC Section 250-30, unless otherwise indicated.

E. Types of grounding in this section include the following:

1. Enclosures
2. Equipment
3. Other items indicated on drawings

F. Requirements of this section apply to electrical grounding work specified elsewhere in these specifications.

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to electrical grounding and ground fault protection systems. Comply with applicable ANSI and IEEE requirements. Provide products which have been UL listed and labeled.

PART 2 – PRODUCTS

2.1 MATERIALS AND COMPONENTS:

A. GENERAL: Except as otherwise indicated, provide each electrical grounding system as specified herein, and as shown on drawings, including but not necessarily limited to, cables/wires, connectors, terminals (solderless lugs), and other items and accessories needed for complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

B. ELECTRICAL GROUNDING CONDUCTORS: Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC. Provide with green insulation.

PART 3 - EXECUTION

3.1 INSTALLATION OF GROUNDING SYSTEMS:

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A. Install electrical grounding systems in accordance with manufacturer's written instructions and with recognized industry practices to ensure grounding devices comply with requirements.

B. Install clamp-on connectors only on thoroughly cleaned and metal contact surfaces, to ensure electrical conductivity and circuit integrity.

C. Provide grounding for the entire raceway, enclosure, equipment and device system in accordance with NEC. All raceways shall include copper grounding conductor sized in accordance with NEC.

D. EQUIPMENT BONDING/GROUNDING: Provide a 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. Provide grounding bushings and bonding jumpers for all conduit terminating in reducing washers, concentric, eccentric or oversized knockouts at panelboards, cabinets and gutters.

E. 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.

F. Provide bonding wire in all flexible conduit.

END OF SECTION 260526

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PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification section, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is a part of each Division-26, 27 and 28 section making reference to supports, anchors, sleeves, and seals, specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of supports, anchors, and sleeves is indicated by drawings and schedules and/or specified in other Division-26 sections. See Section 260532, Raceways, for additional requirements.

B. Work of this section includes supports, anchors, sleeves and seals required for a complete raceway support system, including but not limited to: clevis hangers, riser clamps, C-clamps, beam clamps, one and two hole conduit straps, offset conduit clamps, expansion anchors, toggle bolts, threaded rods, U-channel strut systems, threaded rods and all associated accessories.

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to construction and installation of electrical supporting devices. Comply with applicable requirements of ANSI/NEMA Std. Pub No. FB 1, "Fittings and Supports for Conduit and Cable Assemblies". Provide electrical components which are UL-listed and labeled.

PART 2 - PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES:

A. GENERAL:

1. Provide supporting devices; complying with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation; and as herein specified. See drawings for additional requirements.

PART 3 - EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES:

A. Install hangers, anchors, sleeves, and seals as required, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support piping properly from building structures. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. For pre-and post tensioned construction, use pre-set inserts for support of all electrical work. Do not use toggle bolts,

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moly bolts, wood plugs or screws in sheetrock or plaster as support for any equipment or raceway.

D. RACEWAYS:

1. Support raceways which are rigidly attached to structure at intervals not to exceed 8 feet on center, minimum of two straps per 10 foot length of raceway, and within 12" of each junction box, coupling, outlet or fitting. Support raceway at each 90 degree bend. Support raceway (as it is installed) in accordance with the following:

NUMBER OF RUNS	3/4" TO 1-1/4" 0	1-1/2" & LARGER 0
1	Full straps, clamps or hangers.	Hanger
2	Full straps, clamps or hangers.	Mounting Channel
3 or more	Mounting Channel	Mounting Channel

2. Support suspended raceways on trapeze hanger systems; or individually by means of threaded rod and straps, clamps, or hangers suitable for the application. Do not use "tie wire" as a portion of any raceway support system; do not support raceway from ceiling support wires.

END OF SECTION 260529

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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 Basic Materials and Methods section, and is part of each Division-26 section making reference to electrical raceways and specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of raceways is indicated by drawings and schedules.

B. Types of raceways in this section include the following:

1. Electrical Metallic Tubing
2. Flexible Metal Conduit
3. Intermediate Metal Conduit
4. Liquid-tight Flexible Metal Conduit
5. Rigid Metal Conduit
6. Rigid Non-metallic Conduit

1.3 QUALITY ASSURANCE:

A. MANUFACTURERS: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than three (3) years.

B. STANDARDS: Comply with applicable portions of NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL-listed and labeled. Comply with NEC requirements as applicable to construction and installation of raceway systems.

C. SUBMITTALS: Not required.

PART 2 – PRODUCTS

2.1 METAL CONDUIT AND TUBING:

A. GENERAL:

1. Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4".

B. RIGID METAL CONDUIT (RMC): FS WW-C-0581 and ANSI C80.1.

C. INTERMEDIATE STEEL CONDUIT (IMC): FS WW-C-581.

D. PVC EXTERNALLY COATED RIGID STEEL CONDUIT: ANSI C80.1 and NEMA Std. Pub. No. RN 1.

E. ALUMINUM CONDUIT: Not acceptable.

F. MC CABLE: Not acceptable.

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G. RIGID AND INTERMEDIATE STEEL CONDUIT FITTINGS:

1. Provide fully threaded malleable steel couplings; raintight and concrete tight where required by application. Provide double locknuts and metal bushings at all conduit terminations. Install OZ Type B bushings on conduits 1-1/4" and larger.

H. ELECTRICAL METALLIC TUBING (EMT): FS WW-C-563 and ANSI C80.3.

I. EMT FITTINGS:

1. Provide insulated throat nylon bushings with non-indenter type malleable steel fittings at all conduit terminations. Install OZ Type B bushings on conduits 1" larger. Cast or indenter type fittings are not acceptable.

J. FLEXIBLE METAL CONDUIT: FS WW-C-566, of the following type;

1. Zinc-coated steel.

K. FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1, Class 1, and Style A.

L. LIQUID TIGHT FLEXIBLE METAL CONDUIT:

1. 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).

M. LIQUID-TIGHT FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1, Class 3, Style G.

N. EXPANSION FITTINGS: OZ Type AX, or equivalent to suit application.

2.2 NON-METALLIC CONDUIT AND DUCTS:

A. GENERAL:

1. Provide non-metallic conduit, ducts and fittings of types, sizes and weights as indicated; with minimum trade size of 3/4".

B. UNDERGROUND PVC PLASTIC UTILITIES DUCT:

1. Minimum requirements shall be schedule 40 for encased burial in concrete and for Type II for direct burial.

C. PVC AND ABS PLASTIC UTILITIES DUCT FITTINGS:

D. ANSI/NEMA TC 9, match to duct type and material.

E. HDPE CONDUIT: Not acceptable.

2.3 CONDUIT; TUBING; AND DUCT ACCESSORIES:

A. Provide conduit, tubing and duct accessories of types and sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing. Provide manufactured spacers in all duct bank runs.

2.4 SEALING BUSHINGS:

A. Provide OZ Type FSK, WSK, or CSMI as required by application. Provide OZ type CSB internal sealing bushings.

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PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS:

A. Install electrical raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and in accordance with the following:

1. BRANCH CIRCUITS, SIGNAL AND CONTROL CIRCUITS, AND INDIVIDUAL EQUIPMENT CIRCUITS RATED LESS THAN 100 AMPS:
   a. Install in electric metallic tubing (EMT); except in poured walls, with one side in contact with grade, below concrete slab-on-grade or in earth fill, install in non-metallic plastic duct. In areas exposed to weather, moisture, or physical damage, install in GRC or IMC. In suspended slabs, install in EMT. Encase non-metallic duct 1-1/4" and larger in concrete. See duct banks.

B. Coordinate with other work including metal and concrete deck work, as necessary to interface installation of electrical raceways and components.

C. Install raceway in accordance with the following:

1. Provide a minimum of 12" clearance measured from outside of insulation from flues, steam and hot water piping, etc. Avoid installing raceways in immediate vicinity of boilers and similar heat emitting equipment. Conceal raceways in finished walls, ceilings and floor (other than slab-on-grade), except in mechanical, electrical and/or communication rooms, conceal all conduit and connections to motors, equipment, and surface mounted cabinets unless exposed work is indicated on the drawings. Run concealed conduits in as direct a line as possible with gradual bends. Where conduit is exposed in mechanical spaces, etc., install parallel with or at right angles to building or room structural lines. Do not install lighting raceway until piping and duct work locations have been determined in order to avoid fixtures being obstructed by overhead equipment.

2. Where cutting raceway is necessary, remove all inside and outside burrs; make cuts smooth and square with raceway. Paint all field threads (or portions of raceway where corrosion protection has been damaged) with primer and enamel finish coat to match adjacent raceway surface.

D. Comply with NEC for requirements for installation of pull boxes in long runs.

E. Cap open ends of conduits and protect other raceways as required against accumulation of dirt and debris. Pull a mandril and swab through all conduit before installing conductors. Install a 200 lb. nylon pull cord in each empty conduit run.

F. Replace all crushed, wrinkled or deformed raceway before installing conductors.

G. Do not use flame type devices as a heat application to bend PVC conduit. Use a heating device which supplies uniform heat over the entire area without scorching the conduit.

H. Provide rigid metal conduit (RMC) for all bends greater than 22 degrees in buried conduit. Provide protective coating for RMC bend as specified herein.

I. Where raceways penetrate building, area ways, manholes or vault walls and floors below grade, install rigid metal conduit (RMC) for a minimum distance of 10 feet on the exterior

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side of the floor or wall. Provide OZ, Type FSK, WSK or CSMI sealing bushings (with external membrane clamps as applicable) for all conduit penetrations entering walls or slabs below grade. Provide segmented type CSB 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.

J. Install liquid-tight flexible conduit for connection of motors, transformers, and other electrical equipment where subject to movement and vibration.

K. Install spare 3/4" conduits (capped) from each branch panelboard into the ceiling and floor space. Run five into the ceiling space and five into the floor space. Where the floor is not accessible run six conduits into the ceiling space. Run conduits the required distance necessary to reach accessible ceiling space.

L. Provide OZ expansion fittings on all conduits crossing building expansion joints, both in slab and suspended.

M. Complete installation of electrical raceways before starting installation of cables/conductors within raceways.

N. Raceway installation below grade:

1. Apply protective coating to metallic raceways in direct contact with earth or fill of any type; consisting of spirally wrapped PVC tape (1/2" minimum overlap of scotch wrap tape or equal); or factory applied vinyl cladding (minimum thickness .020 inches). Completely wrap and tape all field joints.

2. Mark all buried conduits which do not require concrete encasement by placing yellow plastic marker tape (minimum 6" wide) along entire length of run 12" below final grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.

3. Burial depths must comply with NEC Section 300-5 but in no case be less than 24", unless noted otherwise on drawings.

O. Raceway installation below slab-on-grade, or below grade:

1. For slab-on-grade construction, install runs of rigid plastic conduit (PVC) below slab. All raceway shall be located a minimum of 4” below gravel sub-base. Install RMC (with protective coating) for raceways passing vertically through slab-on-grade. Slope raceways as required to drain away from electrical enclosures and to avoid collection of moisture in raceway low points.

2. Apply protective coating to metallic raceways in direct contact with earth or fill of any type; consisting of spirally wrapped PVC tape (1/2" minimum overlap of scotch wrap tape or equal); or factory applied vinyl cladding (minimum thickness .020 inches). Completely wrap and tape all field joints.

3. Mark all buried conduits which do not require concrete encasement by placing yellow plastic marker tape (minimum 6" wide) along entire length of run 12" below final grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.

4. Burial depths must comply with NEC Section 300-5 but in no case be less than 24", unless noted otherwise on drawings.

P. Raceway installation in suspended slabs:

1. Install conduit as close to the middle of concrete slab as practicable without

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disturbing reinforcement. Do not install conduits of diameter greater than 1/3 of the slab thickness. Space conduits not less than 3 diameters on center (except at stub up locations). Provide OZ expansion fittings at all expansion joints. All raceways shall be installed with concrete tight fittings. Include copper ground conductor in all raceways installed in suspended slabs.

Q. Raceway installation in hazardous locations:

1. Install RMC in all hazardous locations as defined by NEC. Provide suitable fittings, seal-offs, boxes, etc. to comply with requirements.

2. Engage at least five full threads on all fittings. Provide inspection fittings with explosion proof drains to prevent water accumulation in conduit runs. Install seal-offs for arcing or high temperature equipment, at housing with splices or taps and where conduits enter or leave the hazardous area. Provide seal-offs of the appropriate type for vertical or horizontal installation. Ground all metallic parts.

END OF SECTION 260532

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PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is a part of each Division-26, 27 and 28 section making reference to electrical wiring boxes and fittings specified herein. See Section 260532, Raceways, for additional requirements.

1.2 DESCRIPTION OF WORK:

A. The extent of electrical box and electrical fitting 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. Conduit Bodies
5. Bushings
6. Locknuts
7. Knockout Closures
8. Miscellaneous Boxes and Fittings

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to construction and installation of electrical boxes and fittings. Comply with ANSI C 134,1 (NEMA Standards Pub No. OS 1) as applicable to sheet-steel outlet boxes, device boxes, covers and box supports. Provide electrical boxes and fittings which have been UL-listed and labeled.

1.4 SUBMITTALS: None required

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS:

A. INTERIOR OUTLET BOXES:

1. Provide one piece, galvanized flat rolled sheet steel interior outlet wiring boxes with accessory rings, of types, shapes and sizes, including box depths, to suit each respective location and installation, construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box and covers and wiring devices; minimum size 4"x4"x1-1/2". Provide minimum 2-1/8" depth for boxes with three or more conduit entries.
2. Provide an ‘FS’ box, with no knockouts when surface mounted in a finished, non-utility space. Surface mounting is only acceptable when approved by the Architect.

B. INTERIOR OUTLET BOX ACCESSORIES:

1. Provide outlet box accessories as required for each installation, including mounting brackets, hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes

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being used and fulfilling requirements of individual wiring applications.

C. WEATHERPROOF OUTLET BOXES:

1. Provide corrosion-resistant cast-metal weatherproof outlet wiring boxes, of types, shapes and sizes (including depth) required, with threaded conduit ends, cast-metal face plates with spring-hinged waterproof caps suitably configured for each application, with face plate gaskets and corrosion-resistant fasteners.

D. JUNCTION AND PULL BOXES:

1. Provide code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

E. CONDUIT BODIES:

1. Provide galvanized cast-metal conduit bodies, of types, shapes and sizes to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws.

F. BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS:

1. Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and malleable steel conduit bushings and offset connectors, of types and sizes to suit respective uses and installation.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:

A. GENERAL:

1. Install electrical boxes and fittings where indicated, complying with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

2. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.

3. Provide coverplates for all boxes. See Section 262726, Wiring Devices.
4. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.

5. Provide knockout closures to cap unused knockout holes where blanks have been removed.

6. Install boxes and conduit bodies to ensure ready accessibility of electrical wiring. Do not install boxes above ducts or behind equipment. Install recessed boxes with face of box or ring flush with adjacent surface. Seal between switch, receptacle and other outlet box openings and adjacent surfaces with plaster, grout, or similar suitable material.

7. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall with minimum 10" of conduit between them.

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8. Provide electrical connections for installed boxes.

END OF SECTION 260533

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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 Basic Materials and Methods section, and is part of each Division-26 section making reference to wiring devices specified herein.

1.2 DESCRIPTION OF WORK:

A. The extent of occupancy sensor work is indicated by drawings and schedules.

B. Types of occupancy sensors in this section include the following:

1. Dual Technology Ceiling Sensor w/ Control Pack

1.3 QUALITY ASSURANCE:

A. Comply with NEC and NEMA standards as applicable to construction and installation of occupancy sensors. Provide occupancy sensors which have been UL listed and labeled.

B. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems, motor loads and any other passive infrared or microwave systems.

1.4 SUBMITTALS:

A. PRODUCT DATA: Submit manufacturer's data on occupancy sensors, control modules, wiring diagrams, interconnection diagrams and any related accessories.

B. Submit scaled drawings with lighting fixtures shown clearly marked by manufacturer showing proper product, location and orientation of each sensor.

PART 2 - PRODUCTS

2.1 MANUFACTURER: The manufacturer shall have a minimum of five years of experience in the sensor and lighting control industry. Sensors and related relays shall be compatible with the specific lighting types controlled. All sensors shall be of the same manufacturer, mixing brands of sensors is not acceptable.

A. DUAL TECHNOLOGY CEILING SENSOR: Where units are indicated, provide a sensor that meets the following minimum requirements:

1. Sensor shall incorporate ultrasonic (microphonics) and infrared technologies in a single unit.
2. Sensor shall be Class 2, low voltage; capable of mounting in the ceiling for maximum coverage.
3. Sensor shall use internal microprocessor for motion signal analysis and automatic self-adjustment.
4. Sensor shall have automatic self-adjustment algorithm which adjusts timer and sensitivity settings to maximize performance and minimize energy usage.
5. Sensor shall have manual time-out adjustment from 8 minutes to 32 minutes and automatic time out from 8 minutes to 100 minutes.
6. Sensor shall have test time-out setting of 8 seconds, with automatic return to 8 minutes after one hour if sensor is left in test mode.
7. Sensor’s microprocessor shall automatically extend timer by 1 hour in response

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to recognition to false off condition. After 5 hours, sensor reduces extended time by 30 minutes and continues to reduce by 30 minute increments over the next few days.

8. Sensor's microprocessor shall automatically reduce either PIR or ultrasonic sensitivity in response to false on condition.
9. Sensor microprocessor will automatically monitor PIR background threshold signal level and makes corresponding sensitivity adjustments automatically.
10. Sensor microprocessor algorithm shall incorporate automatic adaptation to continuous airflow.
11. For airflow which is so intense as to mask motion, sensor shall flash indicator LED code to indicate excessive airflow.
12. Sensor's microprocessor shall use a four week learning period and develop a circadian calendar.
13. An internal 24 hour 7 day clock establishes what periods the room is typically occupied, biasing sensor to keep lights on while normally occupied and off when normally unoccupied.
14. Sensor shall have selection settings for the following dual technology schemes:

    a. High Sensitivity and High Confidence (miser mode)

15. Sensor shall be available with either 180 degrees or 360 degrees coverage pattern.
16. Infrared lens shall have 360 degree field of view. Two types of lens shall be available, standard and extra dense.
17. Sensor shall have a variety of mask inserts for PIR coverage rejection to prevent false tripping.
18. Transducers shall be protected from tampering.
19. Sensor shall have manual adjustments for timer and sensitivities and override switches to force manual adjustment mode.
20. Sensor shall have adjustable sensitivity from 0% to 100% for both ultrasonic and infrared.
21. Controls shall be behind cover to resist tampering. All adjustments shall be accessible from the front of the sensor.
22. Sensor shall be available with a photocell adjustment from 20 to 3,000 Lux.
23. Sensor shall provide internal operating status and settings confirmation via LED motion lamp indicator.
24. Sensor shall have two (if 180 degree) or three (if 360 degree) real time LED motion indicators visible from the front of the unit: Red = infrared; green = ultrasonic.
25. Subject to compliance with the above requirements, provide models of one of the following:

    a. Hubbell-ATD Series
    b. Sensor Switch-CM-PDT Series
    c. Wattstopper-DT Series
    d. Mytech-Omni-DT Series
    e. Lithonia - LMTO Series
    f. Novitas – 01-300/310
    g. Leviton – OSC UOW Series

B. 24 VDC POWER/CONTROL PACK: Where units are indicated, provide a power/control pack that meets the following minimum requirements:

1. Control module shall consist of a DC power supply and a dry contact relay for switching a lighting load.
2. Control module shall be available in versions to accept 120, and 277 VAC line voltages.
3. Output shall be 24VDC nominal, and shall be inherently safe, low voltage, limited

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power output (Class 2).

4. Output shall supply 100mA current, in addition to current consumed internally to operate internal relay.
5. Relay shall utilize normally open, silver alloy dry contacts, and shall be rated for a 20A ballast load at 120V and 277V.
6. Relay function shall not require more than 5 mA control current to operate.
7. Control module shall have line voltage wiring, consisting of input voltage and relay contact connections, exiting from one end, and low voltage DC connections, consisting of ground, power, and control wires, exiting from the other end.
8. Control module shall be sized to fit inside a standard 4” x 4” junction box.
9. Control module shall be equipped with a 1/2” EMT threaded male fitting on the line voltage end, such that it may be mounted to the outside of a junction box with the line voltage wiring internal to the box and the low voltage wiring external.
10. Control module shall be equipable with accessory 1/2” EMT threaded male fitting on the low voltage end, such that it may be mounted to the inside of a ballast cavity with the box and line voltage wiring internal to the cavity and the low voltage wiring external.
11. Slave module shall be available for switching additional circuits. Slave module has same construction and specifications as control module except without power supply function.
12. Subject to compliance with the above requirements, provide models of one of the following:

    a. Hubbell-CU Series
    b. Sensor Switch-PP-20 Series
    c. Wattstopper-BEP Series
    d. Mytech-MP Series
    e. Lithonia - LPCS Series
    f. Novitas – 13-051
    g. Leviton – OSC/OSA Series

PART 3 – EXECUTION

3.1 INSTALLATION OF LIGHTING CONTROL EQUIPMENT:

A. Install occupancy lighting control system components and ancillary equipment as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that lighting control equipment complies with requirements.

B. Comply with requirements of NEC, and applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices.

C. Coordinate with other electrical work, including raceways, and electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.

D. Contractor shall be on site as required, to adjust lighting control units for proper operation.

E. Mount the switchpack in a standard 4" junction box or extension through a ½" KO in the cover plate. Refer to manufacturer supplied mounting instructions.

3.2 FIELD QUALITY CONTROL:

A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements.
B. Where possible, correct malfunctioning units at site, then retest to demonstrate

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compliance; otherwise, remove and replace with new units, and proceed with retesting.

C. Contractor shall visit the job site 3 months after the owner has taken occupancy and adjust any units not operating properly, otherwise remove and replace with new units.

3.3 MANUFACTURER AUTHORIZED PERSONNEL TRAINING:

A. Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing and operating lighting control system equipment.

END OF SECTION 260923

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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 Basic Materials and Methods section, and is part of each Division-26 section making reference to wiring devices specified herein.

1.2 DESCRIPTION OF WORK:

A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electric energy.

B. Types of electrical wiring devices in this section include the following:

1. Receptacles
2. Switches

1.3 QUALITY ASSURANCE:

A. Comply with NEC and NEMA standards as applicable to construction and installation of electrical wiring devices. Provide electrical wiring devices which have been UL listed and labeled.

1.4 SUBMITTALS:

A. PRODUCT DATA:

1. Submit manufacturer's data on electrical wiring devices.

PART 2 - PRODUCTS

A. FABRICATED WIRING DEVICES:

B. GENERAL:

1. Provide factory-fabricated wiring devices, in types, and electrical ratings for applications indicated and complying with NEMA Stds. Pub No. WD 1.

2. Provide wiring devices (of proper voltage rating) as follows:

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MFGR.	RECEPTACLE	SWITCHES 1-POLE	3-WAY	4-WAY	W-PILOT
Hubbell	HBL5352	HBL 1221	HBL 1223	HBL1224	HBL1221-PL
Bryant	5352	1221	1223	1224	1221-PL
Pass Seymour	5352	20AC1	20AC3	20AC4	20AC1-RPL
Leviton	5362	1221	1223	1224	
Cooper	5352	1221	1273	1224	1221-PL

C. GROUND-FAULT INTERRUPTER:

1. Provide general-duty, duplex receptacle, ground-fault circuit interrupters; feed-thru types, capable of protecting connected downstream receptacles on single circuit; grounding type UL-rated Class A, Group A, 20-amperes rating; 120-volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5 milliamperes ground-fault trip level; color as selected by Architect. Provide Hospital grade where required elsewhere by specification or drawings. Provide units of one of the following:

   a. P&S/Sierra
   b. Hubbell
   c. Leviton
   d. Square D

D. CORD CAPS AND CONNECTORS:

1. Provide 3, 4 and 5-wire grounding, cap plugs, and connectors of ampere and voltage rating required, for final equipment, and as indicated otherwise on drawings.

2. Provide products of one of the following:

   a. Cooper
   b. General Electric
   c. Hubbell
   d. Leviton
   e. P&S

E. WIRING DEVICE ACCESSORIES:

1. WALL PLATES:

   a. Provide coverplates for wiring devices; plate color to match wiring devices to which attached. Provide nylon or Lexan coverplates in all finished areas. Provide galvanized steel plates in unfinished areas. Provide blank coverplates for all empty outlet boxes. Engrave all receptacle plates other than those serving 120 volt, single phase devices. State voltage and amperage characteristics. Example "208V, 30A".

F. WEATHER-PROTECTING DEVICE ENCLOSURES:

1. Where required for compliance with NEC 406-8 (receptacles installed outdoors for use other than with portable tools or equipment), provide weather-tight device

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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:

a. Intermatic WP1020 or WP1030
b. P&S WIUC10C or WIUC20c

PART 3 – EXECUTION

A. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation" and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical box and wiring work, as necessary to interface installation of wiring devices with other work. Install devices in boxes such that front of device is flush and square with coverplate. Drawings are small scale and, unless dimensioned, indicate approximate locations only of outlets, devices, equipment, etc. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned and coordinate with other work. Verify all dimensioned items on job site. Consult architectural cabinet, millwork, and equipment shop drawings before beginning rough-in of electrical work. Adjust locations of all electrical outlets as required to accommodate work in area, and to avoid conflicts with wainscoat, back splash, tackboards, and other items.

C. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris. Mark each device box (for each type of wiring device) with a permanent ink felt tip marker, indicating the circuit to which the device is connected. Example: "CKT A-1".

D. Install blank plates on all boxes without devices.

E. Delay installation of wiring devices until wiring work and painting is completed. Provide separate neutral conductor from panel to each GFI receptacle.

F. Install GFI receptacles for all receptacles installed in restrooms, kitchens, outdoors or within six feet of any sink. Provide in elevator equipment rooms and pits.

G. Where wall box dimmers are specified, provide a separate neutral for each phase of the branch circuits on which dimmers are installed.

3.2 PROTECTION OF WALL PLATES AND RECEPTACLES:

A. At time of substantial completion, replace those items, which have been damaged, including those stained, burned and scored.

3.3 GROUNDING:

A. Provide electrically continuous, tight grounding connections for wiring devices, unless otherwise indicated.

3.4 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.

END OF SECTION 262726

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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 Basic Materials and Methods section, and is part of each Division-26 section making reference to motor and circuit disconnect switches specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of motor and circuit disconnect switch work is indicated by drawings and schedule. Work includes complete installations and electrical connections.

1.3 QUALITY ASSURANCE:

A. Provide motor and circuit disconnect switches which have been UL listed and labeled. Comply with applicable requirements of NEMA Standards Pub. No. KS 1, and NEC.

1.4 SUBMITTALS:

A. PRODUCT DATA: Submit manufacturer's data including specifications, installation and general recommendations, for each type of motor and circuit disconnect switch required.

B. SHOP DRAWINGS: Submit dimensioned drawings of electrical motor and circuit disconnect switches which have rating of 100 amperes and larger.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. MANUFACTURER: Subject to compliance with requirements, provide products of one of the following (for each type of switch):

1. Cutler Hammer Products, Eaton Corp.
2. Square D Company
3. General Electric Company
4. Siemens Energy & Automation, Inc.

2.2 FABRICATED SWITCHES:

A. GENERAL: Provide disconnect and safety switches as indicated herein. Provide:

1. General duty switches on 240 Volt rated circuits.
2. Heavy duty switches on 480 volt rated circuits.
3. HP rated switches on all motor circuits.

B. HEAVY-DUTY SWITCHES: Provide heavy-duty type, sheet-steel enclosed safety switches, fusible or non-fusible as indicated, of types, sizes and electrical characteristics indicated; rated 600 volts, 60 hertz; incorporating quick-make, quick-break type mechanisms. Provide single phase or 3 phase, and with solid neutral as required by application, Equip with operating handle which is capable of being padlocked in OFF position. Provide NEMA 1 or NEMA 3R as required by application unless noted. Provide fusible switches with Class R rejection fuse clip kits.

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C. FUSES: Provide fuses for switches, as required of classes, types and ratings needed to fulfill electrical requirements for service indicated. Provide spare fuses amounting to one spare fuse for each 10 installed but not less than three of any one type and size. See Section 16180 Overcurrent Protective Devices for fuse types.

D. IDENTIFICATION: Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each disconnect. Provide red plastic laminate labels on disconnects supplied with emergency power.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR AND CIRCUIT DISCONNECT SWITCHES:

A. Install motor and circuit disconnect switches where indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation" and in accordance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate motor and circuit disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.

C. Install disconnect switches used with motor driven appliances, and motors and controllers within sight of controller position.

END OF SECTION 262816

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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 Basic Materials and Methods section, and is part of Division-26 sections making reference to motor starters specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of motor starter work is indicated by drawings and schedules.

B. Types of motor starters in this section include the following:

1. AC Fraction Horsepower Manual Starters

1.3 QUALITY ASSURANCE:

A. Comply with NEC and NEMA Standards as applicable to wiring methods, construction and installation of motor starters. Comply with applicable requirements of UL 508, "Electric Industrial Control Equipment", pertaining to electrical motor starters. Provide units which have been UL-listed and labeled.

1.4 SUBMITTALS:

A. PRODUCT DATA: Submit manufacturer's data on motor starters.

B. SHOP DRAWINGS: Submit dimensioned drawings of motor starters showing accurately scaled equipment layouts.

C. MOTOR VOLTAGE/CURRENT REPORT: After installation is complete, including water and air balancing, measure voltage (L-L and L-N) and full load current of each phase of each motor. Submit report showing field readings of voltage, amperage, service factor, and thermal heater size installed for each motor.

PART 2 - PRODUCTS

A. MANUFACTURER: Subject to compliance with requirements, provide products of one of the following (for each type and rating of motor starter):

1. Allen-Bradley Co.
2. Appleton Electric Co.
3. Crouse-Hinds Co.
4. Eaton Corp., Cutler Hammer Products
5. General Electric Co.
6. Siemens Energy & Automation, Inc.
7. Square D Co.

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 5 units of each, for both power and control circuit fuses.

2.2 MOTOR STARTERS:

A. GENERAL: Except as otherwise indicated, provide motor starters and ancillary

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components; of types, sizes, ratings and electrical characteristics indicated which comply with manufacturer's standard materials, design and construction in accordance with published information and as required for complete installations.

B. THERMAL OVERLOAD UNITS: Provide thermal overload units, sized to actual running full load current, not to motor plate current. Size heaters for mechanical equipment after air and water balancing have been completed.

C. AC FRACTIONAL HP MANUAL STARTERS (EQUAL TO SQUARE D CLASS 2510): Provide manual, single-phase, 1 and 2 pole, 300 volt AC max, fractional HP motor starters, of types, ratings and electrical characteristics indicated; equip with one piece thermal overload relay with field adjustment capability of plus or minus 10 percent of nominal overload heater rating; for protection of AC motors of 1 HP and less. (For manually controlled motors in excess of 1 HP, see Line Voltage Manual Starters specified herein). Provide starter with quick-make, quick-break trip free toggle mechanisms, green pilot lights, and with lock-off toggle operated handle. Mount surface units in NEMA 1 enclosures, unless noted otherwise. Provide NEMA 3R enclosure in exterior or damp location unless noted otherwise. Provide flush mounted units with coverplate to match wiring device coverplates.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR STARTERS:

A. Install motor starters as indicated, 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.

B. Install fuses in fusible disconnects, if any. Mount chart inside each starter indicating heater type, size, and ampere ratings available.

C. IDENTIFICATION: 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 starters supplied by emergency power. Include mechanical equipment designation, horsepower and voltage.

3.2 ADJUST AND CLEAN:

A. Inspect operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL:

A. Subsequent to wire/cable hook-up, energize motor starters and demonstrate functioning of equipment in accordance with requirements.

END OF SECTION 262913

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PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Special Provisions, Division 1 and Division-2 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to demolition.

1.2 DESCRIPTION OF WORK:

A. Extent of major items of demolition work is indicated by drawings. Other demolition work shall be performed as required to maintain system operation.

B. The intent of the drawings is to indicate major items affected and not to show every device, outlet, fixture, etc. affected by demolition work.

C. The drawings do not necessarily reflect as-built conditions. The contractor shall visit the jobsite prior to bidding to determine the overall scope of demolition work.

D. Refer to sections of other Divisions for applicable requirements affecting demolition work.

E. Refer to Section 260500 for requirements with regard to power outages affecting the operation of existing electrical systems.

1.3 QUALITY ASSURANCE:

A. NEC COMPLIANCE:

1. Comply with applicable portions of NEC as to methods used for demolition work.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Demolition work shall be laid out in advance to eliminate unnecessary cutting, drilling, channeling, etc. Where such cutting, drilling, or channeling becomes necessary, perform with care, use skilled mechanics of the trades involved. Repair damage to building and equipment. Cutting work of other Contractors shall be done only with the consent of that Contractor. Cutting of structural members shall not be permitted.

2.2 PATCHING AND REPAIR

A. The Contractor is responsible for all demolition, patching and repair of all finished interior surfaces pertaining to the installation of this particular phase of work. All surfaces shall be finished (painted, etc.) to match the adjacent materials, finishes and colors.

B. Hard surfaces: Whenever demolition or excavation is required for the installation of the electrical system, it shall be the responsibility of this contractor to make repairs and/or replacements of hard finish surfaces such as concrete, asphalt, roofing, etc.

C. The method of patching and repair shall follow good construction practices and all finished surfaces shall match materials and finish wherein the demolition occurred.

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2.3 EXISTING EQUIPMENT

A. The following is a part of this project and all costs pertaining thereto shall be included in the base bid.

B. The new electrical equipment and apparatus shall be coordinated and connected into the existing system as required. Auxiliary systems shall comply, unless otherwise specified.

C. The existing electrical devices, conduit and/or equipment that for any reason obstructs construction shall be relocated. Provide conduit, wiring, junction boxes, etc. as required to extend existing circuits and systems to relocated devices or equipment.

D. The new fixtures indicated for existing outlets shall be installed in accordance with the fixture specifications.

E. When installing equipment in the existing building, it shall be concealed.

F. All existing electrical equipment and systems in portions of the building not being remodeled shall be kept operational, in service and in working condition throughout the entire construction period. Restore any circuits and systems interrupted. Provide temporary panels, temporary wiring and conduit, etc. as required.

G. Maintain circuit integrity and continuity of all existing circuits and systems that interfere with or are interrupted by remodel work unless those circuits are to be abandoned completely. Maintain all circuits and systems in operation during construction. Provide temporary panels, temporary wiring and conduit, etc. as required.

H. Existing raceways may be used where possible in place, except as noted. All circuits, conduit and wire that are not used in the remodeled area shall be removed back to the panelboard, where it shall be labeled a spare with circuit number indicated. Re-used raceway shall meet all requirements for new installations.

I. The existing light fixtures which are not used in the remodeled area shall be carefully removed, and properly disposed of.

J. Obtain permission from the Architect and Owner's representative before penetrating any ceiling, floor, and wall surfaces.

K. Any and all equipment having electrical connections that require disconnecting and reconnection at the same or another location throughout the course of construction shall be included as part of this contract.

END OF SECTION 264119

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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. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Types of lighting fixtures in this section are indicated by schedule and include the following:

1. Fluorescent
2. LED (Light Emitting Diode)

1.3 QUALITY ASSURANCE:

A. Comply with NEC, NEMA and ANSI 132,1 as applicable to installation and construction of lighting fixtures. Comply with NEC 410-65C for all recessed incandescent light fixtures. Provide lighting fixtures which have been UL-listed and labeled.

1.4 SUBMITTALS:

A. PRODUCT DATA:

1. Submit manufacturer's data on interior and exterior building lighting fixtures.

B. SHOP DRAWINGS:

1. Submit dimensioned drawings of lighting fixtures. Submit fixture shop drawings in booklet form with separate sheet for each fixture, assembled in luminaire "type" alphabetical order, with proposed fixture and accessories clearly indicated on each sheet. Submit all available standard color samples with the shop drawings. If standard colors are not acceptable, a color sample will be provided to the fixture manufacturer. Return of the shop drawings will be delayed until color samples are provided. Submit ballast manufacturer cut sheets. Submit a list of all lamps used on all projects.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Subject to compliance with requirements, provide products of one of the following (for each type of fixture):

1. INCANDESCENT AND FLUORESCENT LAMPS:

a. General Electric Co.
b. Osram Sylvania
c. Phillips Lighting Corp.

2.2 INTERIOR AND EXTERIOR LIGHTING FIXTURES:

A. GENERAL:

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1. Provide lighting fixtures, of sizes, types and ratings indicated complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, starters, and wiring. Label each fixture with manufacturer's name and catalog number. Provide all enclosed fixtures with positive latch mechanisms; spring tension clips not acceptable. Provide all exterior fixtures with damp or wet location label as required by application.

B. SUPPORT REQUIREMENTS:

1. Provide all pendant and stem hung fixtures with flexible ball joint hangers at all points of support. Equip hooks used to hang fixtures with safety latches. Provide all detachable fixture parts, luminous ceiling accessories, louvers, diffusers, lenses, and reflectors with locking catches, screws, safety chain, or safety cable.

2. Comply with manufacturer's written recommendations for all lamp ballast combinations.

3. Equip outdoor fixtures with low temperature starting ballasts.

C. FLUORESCENT LAMP BALLASTS: - (ELECTRONIC):

1. Provide rapid start, fluorescent programmable start lamp ballasts capable of operating lamp types indicated, with power factor(ratio of actual power to apparent power) above 95%, ballast factor of .71, and operating with audible noise level lower than the quietest C.B.M. certified ballast for the same application, listed as class A. Provide ballasts which comply with applicable state, federal, and industry standards and:

   a. Are UL listed,
   b. Comply with FCC requirements governing electromagnetic and radio frequency interference.
   c. Comply with IEEE standards for line voltage transient protection, and ANSI C.62.41 for location director A3 in the normal mode and location category A1 in the common mode.
   d. Comply with ANSI and IEEE standards for harmonic distortion

2. Light output shall not vary by more than 1% over a plus or minus 10% variation in line voltage, and shall not vary more than 5% of light output of equivalent C.B.M. certified ballast. See drawings and schedules for input voltage requirements. Ballasts shall consistently start and operate lamps from a supply line voltage of plus or minus 10% from nominal line voltage.

3. Provide ballasts which operate at a frequency above 20K hz from an input frequency of 60 hz; have an efficacy factor (relative light output per watt consumed) at least 10% above the C.B.M. certified electromagnetic system for the same application; and have a lamp crest factor (ratio of peak to R.M.S. lamp current) of 1.7 or less. Ballasts shall have a total current harmonic distortion of less than 10%.

4. All T5 and Compact electronic ballasts shall be programmed rapid 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. T8 ballasts shall be rapid start unless specified on the fixture schedule otherwise.

5. Ballasts for lamps of T5, T4, and T2 diameter shall contain end-of-life sensing

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circuitry to prevent lamp, lamp base, or socket damage at end-of-life.

6. Ballast manufacturer shall warrant ballasts for T8 and T5 lamps to be free from defects in material or workmanship for at least 5 years from date of manufacture. Ballasts for T4 and smaller shall be 3 years. Contractor shall provide warrantee in accordance with other sections of this specification. Warranty shall include an allowance for nominal replacement labor and replacement of defective product.

7. Comply with manufacturer's written recommendations for all lamp ballast combinations. Provide electronic ballasts of one of the following:

   a. Motorola
   b. Advance Transformer Company
   c. Howard Industries
   d. Osram Sylvania
   e. Universal Lighting Technologies Co.

8. CBM LABELS:

   a. Provide fluorescent-lamp ballasts which comply with Certified Ballast Manufacturers Association standards and carry the CBM label.

D. FLUORESCENT LUMINAIRES

1. Fluorescent luminaries that utilize double-ended lamps and contain ballast(s) that can be serviced in place shall have a disconnecting means internal to the luminaries to disconnect simultaneously from the source of supply all conductors of the ballast, including the grounded conductor. Disconnects shall not be required under the following exceptions::

   a. Luminaries located in hazardous locations.
   b. Luminaries used for egress lighting.
   c. Cord-and-plug luminaries.
   d. In industrial establishments with restricted public access where conditions of maintenance and supervision ensure that only qualified persons service the installation.
   e. Where more than one luminaire is installed in a space and where disconnecting the supply conductors to the luminaire will not leave the space in total darkness.

E. FLUORESCENT LAMPS:

1. Equip interior fluorescent fixtures with full light output, T8 lamps where available as standard products. Where applicable, equip fixtures with lamps as follows:

4' T8	3150	Initial Lumens, average life of 24,000 hours.

   a. Sylvania Octron
   b. General Electric
   c. Phillips.

2. Provide fluorescent lamps with low levels of mercury, capable of acceptance of the Environmental Protection Agency (EPA) through the TCLP (Toxic Characteristic Leaching Procedure).

F. DIFFUSERS:

1. Where plastic diffusers are specified, provide 100 percent virgin acrylic compound; minimum thickness, .125 inches.

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PART 3 - EXECUTION

3.1 INSTALLATION OF LIGHTING FIXTURES

A. Install lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standards of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.

B. Coordinate with other work as appropriate to properly interface installation of lighting fixtures with other work. Consult architectural reflected ceiling plan for exact location of all lighting fixtures.

C. Provide all necessary supports, brackets, and miscellaneous equipment for mounting of fixtures. Support all ceiling mounted fixtures from the building structure; independent of the ceiling system, unless noted. Support each recessed fixture (fluorescent incandescent, and/or HID) from the building structure with #12 ga. steel wire attached to each corner (in addition to supports normally provided for attachment to the ceiling system). Provide backing supports above (or behind) sheetrock, plaster and similar ceiling and wall materials. Support surface mounted ceiling fixtures from channel. Support ceiling mounted outlet boxes independent of the raceway system, and capable of supporting 200 pounds. Feed each recessed fixture directly from an outlet box with flex conduit as required; do not loop from fixture to fixture. See plans for additional details.

D. Provide each lay-in light fixture with at least 36" (Not to exceed 72") of 3/8" steel flexible conduit.

E. Coordinate lighting in mechanical room with duct and equipment locations.

F. Provide gypsum board protection as required, (acceptable to fire official having jurisdiction) to insure fire rating of each ceiling in which fixtures are installed.

G. COORDINATION MEETINGS:

1. Meet at least twice with the ceiling installer. Hold first meeting before submittal of shop drawings to coordinate each light fixture mounting condition with ceiling type. During second meeting, coordinate fixture layout in each area.

2. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of all fixtures and duct work in all areas.

H. ADJUST AND CLEAN:

1. Clean lighting fixtures of dirt and debris upon completion of installation.

2. Protect installed fixtures from damage during remainder of construction period. Repair all nicks and scratches to appearance of original finish.

I. SPARE PARTS:

1. Provide a spare set of diffusers (acrylic and/or glass only) for each fixture type and one for each additional 10 fixtures of each type; not to exceed 10 spares for any single fixture type.
2. In addition, furnish stock of replacement lamps amounting to 15 percent (but not less than one lamp) of each type and size used. Deliver replacement stock as directed to Owner's storage space.

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3.2 FIELD QUALITY CONTROL:

A. Upon completion of installation of lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements.

B. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise remove and replace with new units, and proceed with retesting.

C. At the time of Substantial Completion, replace lamps in interior lighting fixtures which are observed to be noticeably dimmed after the Contractor's use and testing, as judged by Architect/Engineer.

D. GROUNDING:

1. Provide equipment grounding connections for each lighting fixture.

END OF SECTION 265100

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DIVISION 27 – COMMUNICATION

SECTION 271501 - TELEPHONE/DATA SYSTEM (RACEWAYS) June 2, 2008

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. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. The extent of telephone/data system work is indicated by drawings and is hereby defined to include, but not be limited to raceway, outlets, device plates, backboards, grounding and miscellaneous items required for complete raceway system.

B. Refer to other Division-26 sections for requirements for raceways, trays, boxes and fittings, wiring devices (plates), and supporting devices, and other sections, as applicable.

1.3 QUALITY ASSURANCE:

A. Comply with applicable portions of NEC as to type products used and installation of components. Provide products and materials which have been UL-listed and labeled.

PART 2 - PRODUCTS

A. GENERAL: Provide complete raceway system for telephone/data including but not limited to, raceway, outlets, device plates, backboards, grounding and miscellaneous items as required.

B. Provide 4" square box with appropriate plaster or tile ring.

C. Provide telephone/data coverplates for wall outlets to match color and material of wiring device plates; for floor outlets, match color and material of floor power outlet covers.

PART 3 - EXECUTION

3.1 INSTALLATION OF TELEPHONE/DATA SYSTEM:

A. GENERAL: Install raceway system as indicated to comply with NEC and recognized industry practices. Run ¾" conduit from each telephone/data outlet to terminal backboard, cable tray, or terminal cabinet. Provide nylon pull cord in all empty raceway.

.

END OF SECTION 271501

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DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

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. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Extent of fire alarm and detection systems work is indicated by drawings, schedules and as specified herein.

B. Comply with NEC as applicable to construction and installation of fire alarm and detection system components and accessories. Provide components and systems which are UL-listed and labeled for fire alarm. Provide fire alarm and detection systems and accessories which are FM approved. Comply with State and local requirements as applicable.

C. Comply with applicable provisions of current NFPA Standards 72A for Local Protective Signaling Systems, 72B Auxiliary Protective Signaling Systems, 72C Remote Station Protective Signaling Systems (as applicable), local building codes, and meet requirements of local authorities having jurisdiction.

1.3 SUBMITTALS:

A. PRODUCT DATA: Submit manufacturer's data on fire alarm and detection systems including, but not limited to, roughing-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.

B. SHOP DRAWINGS: Provide shop drawings showing equipment/device locations and connecting wiring of entire fire alarm and detection system. Include wiring diagrams and riser diagrams of panel. Provide dimensioned drawing of Fire Alarm Control Panel and Building Graphic.

C. CERTIFICATION: Submit a written statement to the Architect and the state and local Fire Marshal's Office that each device of the fire alarm system will be installed, inspected and tested in accordance with applicable requirements of NFPA Standard 72.

D. Provide to the Fire Marshall's office the following:

1. A complete set of shop drawings indicating:

    a. Location of all alarm-initiating and alarm-signaling devices.
    b. Point-to-point wiring diagrams for all alarm-initiating and alarm-signaling devices.

2. Wiring diagrams for:

    a. Alarm control panels.
    b. Auxiliary function relays and solenoids.
    c. Remote signaling equipment.
    d. Standby battery calculations, including voltage drop calculation.

3. A complete equipment list identifying:

    a. Type

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b. Model
c. Manufacturer
d. Manufacturer catalog data sheets
e. UL Listing and/or FM approval showing compatibility of device with Fire Alarm Control Panel (FACP)

4. A complete zone list identifying all:

a. Alarm-initiating and alarm-signaling devices.
b. Remote signaling and auxiliary function zones.
c. Specific devices associated with each zone.

E. Submit to State and Local Fire Marshall, a complete Certificate of Compliance

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. MANUFACTURER: Subject to compliance with requirements, provide fire alarm and detection systems of one of the following:

1. Match existing fire alarm system manufacturer

2.2 FIRE ALARM AND DETECTION SYSTEMS:

A. GENERAL: Provide new devices to tie into existing fire alarm system. Include power supplies, alarm initiating and indicating devices, conduit, wire, fittings and accessories required to provide a complete operating system. Enclose entire system in raceway. Provide basic wiring materials which comply with Division 26, Basic Materials and Methods Sections for raceways, conductors, boxes, fittings, supports, etc. Minimum wire size to be #14 AWG copper.

B. SYSTEM TYPE: Existing Analog addressable, non-coded.

C. SYSTEM OPERATION: Provide all conductors, raceway, equipment and labor to accomplish the following:

D. For fans which are not part of the smoke evacuation system, deactivate air supply and return fan units simultaneously by means of a supervised master fan shutdown relay with slave relays as required. Restart air units automatically after panel has been reset. Provide a bypass switch for master fan shut down relay for drill purposes, and indicate by a locked-in lamp that the circuit has been bypassed.

2.3 SCOPE OF THE WORK:

A. Upgrade existing batteries as required for new devices.

B. Provide all fire alarm devices.

C. Provide duct smoke detectors and fan relays at all fan units 2000 CFM and over. Shut down all supply and return fans upon a general alarm signal.

D. All initiating devices connected to the fire alarm control panel shall be analog addressable.

E. All wiring shall be in conduit (3/4" minimum). All conduit and connectors, shall be made of steel. All conduit runs shall form a complete loop from the fire alarm control panel.

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2.4 AUDIOVISUAL ALARM HORNS:

A. Provide audio-visual alarm horns with the following features:

1. Die cast or stamped steel construction, finished in red enamel, suitable for indoor or ourdoor application.
2. Capable of 90 db (UL rating) sound level at 10 feet.
3. Flush mounted
4. Integrally mounted flashing light unit, with Lexan lens with block letters “FIRE”, and minimum flash rate of ONE per second, and 110 candela minimum.
5. Electrically compatible with system requirements.
6. Horns shall sound the temporal pattern (code 3) until silenced.
7. Audiovisual alarm horns shall have the ability to silence horns while maintaining the strobe flash, until reset.
8. Mechanical horn mechanism only, electronic horns are not acceptable.
9. Maximum 24 horns per circuit, maximum 8 strobes per circuit.

B. Strobes shall be synchronized when there are three or more within sight and less than 55 feet of viewer..

2.5 SUPPLEMENTAL NOTIFICATION CIRCUITS (FCI SNAC-4):

A. Provide supplementary notification appliance circuit panel(s) as required. The ‘SNAC’ shall be capable of supplying up to four Class A, Style Z notification appliance circuits. The panel shall contain its own battery charger, regulated power supply, and shall be supervised for ground fault, overcurrent, open circuits and low battery conditions. Ground fault, battery and circuit trouble conditions shall transmit a trouble signal to the main fire alarm control panel.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS:

A. Install fire alarm and detection systems as indicated, in accordance with equipment manufacturer’s written instructions and complying with applicable portions of NEC and NECA’s “standard of installation”.

B. Install wiring, raceways, and electrical boxes and fittings in accordance with Division 26 Basic Materials and Methods section, “Raceways”, “Wires and Cables”, and “Electrical Boxes and Fittings”, and in accordance with other sections, as applicable.

C. All wire used on the fire alarm system shall be U.L. Listed as fire alarm protective signaling circuit cable per NEC, Article 760.

D. If twisted or shielded wire is required or recommended by the manufacturer it must be used.

E. Review proper installation procedure for each type of device with equipment supplier before installation. Label each junction box throughout system, “fire alarm”, and paint cover of junction boxes red.

F. Where smoke or heat detectors are specified, install device a minimum of three feet from adjacent air supply diffusers to ensure proper operation of device.

G. Refer to NFPA for spacing and exact placement of fire alarm devices.

PART 4 FINAL ACCEPTANCE AND GUARANTEE

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4.1 FINAL TEST:

A. Before the installation shall be considered completed and acceptable, a test on the system shall be performed as follows:

1. The contractor's job foreman, a representative of the manufacturer, a representative of the owner, shall operate every new building fire alarm device to ensure proper operation and correct annunciation at the control panel. Fan shutdown and door holder circuits shall operate.
2. Conduct a full 24 hour test of battery operation. System shall be put on the batteries for a full 24 hours and all notification appliances shall be operational for a period of 5 minutes.

B. The supervisory circuitry of the initiating and indicating circuits shall also be verified.

PART 5 AS BUILT DRAWINGS AND OPERATION AND MAINTENANCE MANUALS:

5.1 LABELING:

A. All devices shall be labeled with their appropriate address. The labels shall be 18 point pressure sensitive labels.

B. All initiating devices shall be programmed to include the device address and a complete user text English location description, i.e. Device L4S76, Smoke Detector, 1st floor Rm.17

END OF SECTION 283111

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DIVISION 31 – EARTHWORK

Section 31 23 00 Earthwork

SECTION 31 23 00 - EARTHWORK June 2, 2008

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. Preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches within building lines.
8. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:
1. Division 22, 23 and 26 Sections for excavating and backfilling buried mechanical and electrical utilities and buried utility structures.

1.3 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Layer placed between the subbase course and asphalt paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations.
1. Bulk Excavation: Excavations more than 10 feet (3 m) in width and pits more than 30 feet (9 m) in either length or width.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

K. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
   1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
   2. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill.

1.5 PROJECT CONDITIONS

A. Site Information: A Geotechnical Investigation of this site has been prepared. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for convenience of Contractor.
   1. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

B. No additional monies for exporting or importing of soil.
   1. As part of the Construction Documents, Owner may have provided Contractor with a Topographic Survey performed by manual or aerial means. Such Survey was prepared for project design purposes and is provided to the Contractor as a courtesy. It is expressly understood that such survey may not accurately reflect existing topographical conditions and typically will vary from actual conditions by a significant degree. It is the Contractor's responsibility to verify actual existing conditions by whatever means the Contractor deems appropriate. The Contractor shall be responsible for determining their own earthwork quantities and not rely on any estimate prepared by the Owners, it's Agents or outside parties. The Contractor is responsible as part of it's lump sum bid price for the project, for importing and/or exporting soils to achieve final sub-grades with suitable soils per the plans and specifications. No additional monies will be allowed beyond the Contractor's Lump Sum Bid Price for the project, for the exporting and/or importing of soils.

C. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.
   1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

2. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated:
3. Notify Architect not less than two days in advance of proposed utility interruptions.
4. Do not proceed with utility interruptions without Architect's written permission.
5. Contact utility-locator service for area where Project is located before excavating.

D. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

E. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
1. Operate warning lights as recommended by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Backfill and Fill: Satisfactory soil materials.

E. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2- inch (38-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

F. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; conforming to the 1 inch gradation requirements of Section 301 of the UDOT Standard Specification for Road and Bridge Construction.

G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (38-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

H. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

I. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (38-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

C. Trace Wire: Insulated 10 gage copper, suitable for direct bury.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
   2. Excavation for Underground Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended for bearing surface.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.
   1. Clearance: 12 inches (300 mm) on each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
   1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
   2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
   3. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
   1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 APPROVAL OF SUBGRADE

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Architect.
   1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for record documents.
   3. Inspecting and testing underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Removing temporary shoring and bracing, and sheeting.
   7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.12 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings; fill with concrete to elevation of bottom of footings.

C. Provide 4-inch- (100-mm-) thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase.

D. Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit.
   1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utilities testing.

F. Place and compact final backfill of satisfactory soil material to final subgrade.

G. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.13 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

C. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill.
   5. Under footings and foundations, use engineered fill.

3.14 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and

uniformly along the full length of each structure.

C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
   1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill material at 95 percent.
   2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 95 percent.
   3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 90 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus or minus 1 inch (25 mm).
   2. Walks: Plus or minus 1 inch (25 mm).
   3. Pavements: Plus or minus 1/2 inch (13 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.17 SUBBASE AND BASE COURSES

A. Under pavements and walks, place subbase course on prepared subgrade and as follows:
   1. Place base course material over subbase.
   2. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
   3. Shape subbase and base to required crown elevations and cross-slope grades.
   4. When thickness of compacted subbase or base course is 6 inches (150 mm) or less, place materials in a single layer.
   5. When thickness of compacted subbase or base course exceeds 6 inches (150 mm), place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick when compacted.

B. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.18 DRAINAGE COURSE

A. Under slabs-on-grade, place drainage course on prepared subgrade and as follows:
   1. Compact drainage course to required cross sections and thickness to not less than

95 percent of maximum dry unit weight according to ASTM D 698.

2. When compacted thickness of drainage course is 6 inches (150 mm) or less, place materials in a single layer.
3. When compacted thickness of drainage course exceeds 6 inches (150 mm), place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick when compacted.

3.19 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
   1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.
   2. Foundation Wall/Continuous Footing Backfill: At each compacted backfill layer, at least one test for each 15 linear feet or less of wall length, but no fewer than two tests.
   3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 40 feet or less of trench length, but no fewer than two tests.
   4. Spot Footings: Minimum of 1 compaction test for each lift for each spot footing.
   5. Sidewalks, Curbs, Gutters, Pads: Minimum of 1 test for each lift for each 40 lineal feet or 1 test for every 1000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 23 00

DIVISION 32 – EXTERIOR IMPROVEMENTS

Section 32 12 16	Hot-Mix Asphalt Paving
Section 32 13 13	Cement Concrete Pavement

SECTION 32 12 16 - HOT-MIX ASPHALT PAVING June 2, 2008

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. Hot-mix asphalt paving.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving overlay.
4. Asphalt surface treatments.
5. Pavement-marking paint.

B. Related Sections include the following:
1. Division 31 Section "Earthwork" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

B. UDOT: Utah Department of Transportation.

1.4 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of standard specifications of UDOT.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Material Certificates: For each paving material, signed by manufacturers, certifying that each material item complies with, or exceeds, specified requirements.

1.6 QUALITY ASSURANCE

A. Codes and Standards: Comply with UDOT=s Standard Specifications, latest edition.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Apply prime and tack coats when ambient temperature is above 50 deg.F (10 deg.C), and when temperature has not been below 35 deg.F (1 deg.C) for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.
1. Construct asphalt concrete surface course when atmospheric temperature is above

40 deg.F (4 deg.C), and when base is dry. Base course may be placed when air temperature is above 30 deg. F (-1 deg.C) and rising.

B. Grade Control: Establish and maintain required lines and elevations.

C. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4 deg C) for oil-based materials, 50 deg F (10 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use locally available materials and gradations which exhibit a satisfactory record of previous installations.

B. Base Course Aggregate: Sound, non-expansive angular crushed stone, crushed gravel, or crushed slag, sand, stone or slag screenings, conforming to the 1 inch gradation requirements of Section 301 of the Utah Department of Transportation, Standard Specifications for Road and Bridge Construction.
   1. Uncrushed gravel may be used in base course mixture if required to suit local material availability.

C. Base Course Gradation Table (1 inch gradation)

Sieve Size	Ideal Gradation (Percent Passing)
1"	100
1/2"	79-91
No. 4	49-61
No. 16	27-35
No. 200	7-11

D. Base Course Thickness: Minimum 6 inches in automobile parking areas, and 8 inches in truck and entry areas.

E. Surface Course Aggregate: Crushed stone, crushed gravel, crushed slag, and sharp-edged natural sand.

F. Sand prepared from stone, blast-furnace slag, or gravel, or combinations thereof may be used if required to suit local material availability.

G. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with AASHTO M 17 (ASTM D 242).

H. Asphalt Cement: AASHTO M 226 (ASTM D 3381) for viscosity-graded material and AASHTO M 20 (ASTM D 946) for penetration-graded material.

I. Prime Coat: Cut-back asphalt type; AASHTO M 82 (ASTM D 2027) MC-30, MC-70 or MC-250.

J. Tack Coat: Emulsified asphalt, AASHTO M 140 (ASTM D 997) or M 208 (D 2397); SS-1

SS-1h, CSS-1 or CSS-1h, diluted with one part water to one part emulsified asphalt.

K. Paving Marking Paint: Alkyd-resin type, ready-mixed, complying with FS TT-P-115, Type I, or AASHTO M-248, Type N or latex, water-base emulsion, ready-mixed, complying with FS TT-P-1952., colors: White, Yellow, Red, Blue. Submit for approval.

2.2 ASPHALT-AGGREGATE MIXTURE:

A. Provide plant-mix, hot-laid asphalt-aggregate mixture complying with ASTM D 3515 and as recommended by local paving authorities to suit project conditions.

B. The percentage of bituminous material by weight added to aggregate will be between 4% and 7% of the weight of the bituminous mixture. Aggregate gradation shall conform to the 1/2 inch gradation requirements of Section 402 of the Utah Department of Transportation, Standard Specifications for Road and Bridge Construction.:

Ideal Gradation per Grading Table ACC (1/2" Maximum)

Sieve Size	(Percent Passing)
1/2"	100
No. 4	60-80
No. 16	28-42
No. 50	11-23
No. 200	5-9

PART 3 - EXECUTION

3.1 SURFACE PREPARATION:

A. Remove loose material from compacted base coarse surface immediately before applying herbicide treatment or prime coat.
   1. Proof roll prepared base coarse surface to check for unstable areas and areas requiring additional compaction.
   2. Notify Architect of unsatisfactory conditions. Do not begin paving work until deficient base coarse areas have been corrected and are ready to receive paving.

B. Herbicide Treatment: Apply chemical weed control agent in strict compliance with manufacturer's recommended dosages and application instructions. Apply to compacted dry base coarse prior to application of prime coat.

C. Prime Coat: Apply at rate of 0.20 to 0.50 gal. per sq. yd., over compacted base coarse. Apply material to penetrate and seal, but not flood, surface. Cure and dry as long as necessary to attain penetration and evaporation of volatile.

D. Tack Coat: Apply to contact surfaces of previously constructed asphalt or Portland Cement Concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.05 to 0.15 gal. per sq. yd. of surface.
   1. Allow to dry until at proper condition to receive paving.
   2. Exercise care in applying bituminous materials to avoid smearing on adjoining concrete surfaces. Remove and clean damaged surfaces.

3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 PLACING MIX:

A. General: Place asphalt concrete mixture on prepared surface, spread and strike-off. Spread mixture at minimum temperature of 225 deg.F (107 deg.C). Place inaccessible and small areas by hand. Place each course to required grade, cross-section, and compacted thickness.

B. Paver Placing: Place in strips not less than 10' wide, unless otherwise acceptable to Engineer. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.

C. Joints: Make joints between old and new pavements or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

D. Asphalt adjacent to concrete curb and gutter, concrete waterways, catch basins or other drainage structures shall be compacted to an elevation of 1/4 inch above adjacent drainage structure (edge of concrete).

E. Asphalt Concrete Thickness: Provide a minimum compacted asphalt thickness in automobile parking areas of 3 inches and 4 inches in truck and entry areas.

3.4 COMPACTION:

A. Percentage of Maximum Density Requirements: Compact asphalt to 96% of reference laboratory density according to ASTM D-1559, but not less than 94 percent nor greater than 100 percent.

3.5 ROLLING:

A. General: Begin rolling when mixture will bear roller weight without excessive displacement.
   1. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

2. Complete compaction before mix temperature cools to 185 deg. F. (85 deg. C.).

B. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.

C. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.

D. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.

E. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.

F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 LANE, CURB, AND TRAFFIC MARKINGS

A. Striping: Use water-based or oil-based Atraffic@ grade lane-marking paint, factory-mixed, quick-drying, and non-bleeding manufactured specifically for this purpose.
   1. Colors:
      a. White: Traffic, lane, and parking stalls.
      b. Yellow: Bus Zones.
      c. Red: No parking, and fire zone curbs.
      d. Blue: Handicap stalls.

B. Do not apply traffic and lane marking paint until layout and placement has been verified with Architect.

C. Apply paint with mechanical equipment to produce uniform straight edges. Apply in 2 coats at manufacturer's recommended rates.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will employ and pay a qualified independent testing agency to perform field quality-control testing services specified in this section. Retesting of materials failing to meet specified requirements shall be done at Contractor=s expense.

B. Test in-place asphalt concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by Engineer.

C. Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:
   1. Base Course: 1/2-inch, plus or minus.
   2. Surface Course: 1/4-inch, plus or minus.

D. Base Course Testing: Contractor shall perform at least one density test on aggregate base course for each 200 c.y. (1200 s.y. at 6-inch) of material placed.

E. Asphalt Testing: Contractor shall have at least one (1) coring sample of asphalt taken for every 100 C.Y. (1200 S.Y. at 3-inches) of asphalt installed to verify asphalt density, temperature and thicknesses are in conformance with specifications. Locate coring sites as directed by Architect. Contractor is responsible for costs of tests and repair of core holes. Contractor shall also provide laboratory testing for materials check on bituminous materials, including but not limited to: gradation, extraction, compaction, marshall density, stability, flow and % AC.

F. Surface Smoothness: Test finished surface of each asphalt concrete courses for smoothness, using 10-foot straightedge applied parallel with, and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness.
   1. Base Course Surface: 1/4-inch.
   2. Wearing Course Surface: 3/16-inch.
   3. Check surface areas at intervals as directed by Engineer.

3.8 DISPOSAL

A. Remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 32 12 16

SECTION 32 13 13 - CEMENT CONCRETE PAVEMENT June 2, 2008

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 exterior cement concrete pavement for the following:
   1. Pavements.
   2. Curbs and gutters.
   3. Walkways.

B. Related Sections include the following:
   1. Division 31 Section "Earthwork" for subgrade preparation, grading, and subbase course.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.

D. Concrete Testing Service: The Owner will engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.

E. Comply with local governing regulations and the following:
   1. UOSH Construction Standards Chapter G: Signs, Signals, and Barricades.
   2. UDOT Instructions to Flaggers.

3. ANSI D6.1: Manual on Uniform Traffic Control Devices for Streets and Highways.
4. ATSSA: American Traffic Safety Services Association.
5. State of Utah Standard Specifications for Road and Bridge Construction, latest edition.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
   1. Use flexible or curved forms for curves of a radius 100 feet (30.5 m) or less.

B. 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.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

C. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars; assembled with clips.

D. Plain Steel Wire: ASTM A 82, as drawn.

E. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.

F. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

G. Hook Bolts: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

H. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
   1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.

B. Portland Cement: ASTM C 150, Type I or II.
   1. Fly Ash: ASTM C 618, Class F or C.

C. Aggregate: ASTM C 33, uniformly graded, from a single source, with coarse aggregate as follows:
   1. Class: 4S.
   2. Maximum Aggregate Size: 1 inch (25 mm) nominal.
   3. Do not use fine or coarse aggregates containing substances that cause spalling.

D. Water: ASTM C 94.

2.4 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.

B. Air-Entraining Admixture: ASTM C 260.

2.5 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

2.6 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.7 CONCRETE MIXES

A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.
   1. Do not use Owner's field quality-control testing agency as the independent testing agency.

C. Proportion mixes to provide concrete with the following properties:
   1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
   2. Maximum Water-Cementitious Materials Ratio: 0.45.
   3. Slump Limit: 3 inches (75 mm).

D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash: 25 percent.

E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus or minus 1.5 percent:
   1. Air Content: 6.0 percent for 1-inch (25-mm) maximum aggregate.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.

PART 3 - EXECUTION

3.1 PREPARATION

A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. 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 of adjoining widths to prevent continuous laps in either direction.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap to adjacent mats.

3.4 JOINTS

A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
   1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.
   1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
   2. Provide tie bars at sides of pavement strips where indicated.
   3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
   1. Locate expansion joints at intervals of 50 feet (15.25 m), unless otherwise indicated.
   2. Extend joint fillers full width and depth of joint.
   3. Terminate joint filer less than 1/2 inch (12 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
   4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
   5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
   6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

E. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
      a. Radius: 1/4 inch (6 mm).
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

F. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
   1. Radius: 1/4 inch (6 mm).

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery, at Project site, or during placement.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

H. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments.

I. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

J. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

K. 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 air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

L. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). 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. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.7 CONCRETE PROTECTION 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 follow recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to 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. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
   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.

3.8 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:
   1. Elevation: 1/4 inch (6 mm).
   2. Thickness: Plus 3/8 inch (9 mm), minus 1/4 inch (6 mm).
   3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/4

inch (6 mm).

4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch (25 mm).
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch (6 mm).
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch (13 mm).
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches (6 mm per 300 mm).
8. Joint Spacing: 3 inches (75 mm).
9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
10. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

B. Testing Services: Testing shall be performed according to the requirements of Section 03 30 00 - Concrete Work.

3.10 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.

B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13