

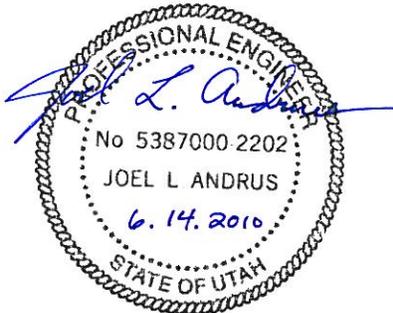
**PROJECT MANUAL
FOR
SUU INTRAMURAL SOCCER FIELDS**

DFCM PROJECT NO. 10058730:

June 2010

OWNER

Division of Facilities Construction & Management
4110 State Office Building
Salt Lake City, Utah 84114
Phone: (801) 538-3018
Fax: (801) 538-3267
Internet: <http://www.dfcu.utah.gov>



ENGINEER

Bowen, Collins & Associates
1664 S. Dixie Drive Ste. E-102
St. George, Utah 84770

**CONTRACT DOCUMENTS
TABLE OF CONTENTS**

Section Pages

BIDDING REQUIREMENTS, CONTRACT FORMS, AND
CONDITIONS OF THE CONTRACT

DIVISION 1 – GENERAL REQUIREMENTS

01010	Summary of Work	01010-1	–	01010-4
01300	Contractor Submittals	01300-1	–	01300-7
01301	Schedule of Values	01301-1	–	01301-2
01310	Bar Chart Schedule	01310-1	–	01310-4
01335	Site Conditions Surveys	01335-1	–	01335-1
01400	Quality Assurance/Quality Control	01400-1	–	01400-7
01530	Protection and Restoration of Existing Facilities	01530-1	–	01530-6
01700	Project Closeout	01700-1	–	01700-3

DIVISION 2 – SITE WORK

02230	Site Clearing	02230-1	–	02230-5
02300	Earthwork	02300-1	–	02300-11
02741	Hot-Asphalt Paving	02741-1	–	02741-6
02751	Cement Concrete Pavement	02751-1	–	02751-11
02764	Pavement Joint Sealants	02764-1	–	02764-5
02900	Landscaping	02900-1	–	02900-13

DIVISION 16 – ELECTRICAL

16050	Electrical General Provisions	16050-1	–	16050-20
16526	Sports Field Lighting	16526-1	–	16526-7

DRAWINGS

NO.	TITLE
G-1	Project Location Map, Index to Drawings, & Vicinity Map
G-2	Symbols
G-3	Abbreviations
G-4	General Notes
C-1	Site Demolition
C-2	Proposed Site Improvements
C-3	Irrigation Plan
D-1	Details - 1
D-2	Details - 2
D-3	Details - 3
D-4	Details – 4

D-5	Details - 5
D-6	Details - 6
D-7	Details - 7

DIVISION 1
GENERAL REQUIREMENTS

SECTION 01010 - SUMMARY OF WORK

PART 1 – GENERAL

1.1 GENERAL

- A. The Work to be performed under this Contract shall consist of furnishing all plant, tools, equipment, materials, supplies, and manufactured articles and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all Work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work shall be complete, and all Work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete, safe and proper construction of the Work in good faith shall be provided by the Contractor as though originally so indicated, at no increase in cost to the Owner.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of this Contract comprises the demolition of the existing City Pool facilities, and clearing and grubbing the adjacent property. The site will be re-graded to provide a new gravel parking lot and an intramural sports field complete with grass, irrigation and lighting.
- B. The Work is located in Cedar City, Utah as indicated on the Drawings.

1.3 CONTRACT METHOD

- A. The Work hereunder will be constructed under a single lump sum contract.

1.4 EXPRESSION OF CONTRACTOR RESPONSIBILITY IN THE TECHNICAL SPECIFICATIONS

- A. Whenever in the Technical Specifications, requirements are expressed with active verbs and no subjects, the words, "The Contractor shall," have been omitted as a matter of style, and it is intended that the Contractor is the party responsible for taking the action required.

1.5 WORK BY OTHERS

- A. The Contractor's attention is directed to the fact that work may be conducted at or adjacent to the Site by other contractors during the performance of the Work under this Contract. Conduct operations so as to cause a minimum of interference with the Work of such other contractors, and shall cooperate fully with such contractors to provide continued safe access to their respective portions of the Site, as required to perform Work under their respective contracts.
- B. Interference With Work On Utilities: Cooperate and coordinate fully with all utility forces of the Owner or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the Work, and shall schedule the Work so as to minimize interference with said relocation, altering, or other rearranging of facilities.
- C. Concurrent Work by Other Contractors: The Contractor's attention is directed to the fact that Work may be conducted adjacent to the site by other contractors during the performance of the Work of this Contract. Conduct operations so as to cause a minimum of interference with the Work of such other contractors.

1.6 WORK SEQUENCE AND SCHEDULING CONSTRAINTS

- A. The Contractor shall schedule and perform the Work in such a manner as to result in the least possible disruption to the public's use of roadways, driveways, and utilities. Utilities shall include but not be limited to water, sewerage, drainage structures, ditches and canals, gas, electric, cable television, and telephone. Refer to Contract Drawings for approximate location of utilities. However, there is no guarantee as to accuracy or completeness. The Contractor shall incorporate as-built locations on the reproducible record plans, in red ink, showing proper location on each sheet where these utilities are located.

1.7 CONTRACTOR USE OF PROJECT SITE

- A. The Contractor's use of the Project Site shall be limited to its construction operations, including on-Site storage of materials, on-Site fabrication facilities, and field offices.

1.8 OWNER USE OF THE PROJECT SITE

- A. The Owner may utilize all or part of the existing Site during construction for the conduct of the Owner's normal operations. Cooperate and coordinate with the Engineer to facilitate the Owner's operations and projects and to minimize interference with the Contractor's operations at the same time. In any event, the Owner shall be allowed safe access to the Project Site during the period of construction.

1.9 CONTRACTOR'S WORKING HOURS

Contractor shall work within Owner's regular working hours from 7:00 a.m. to 4:00 p.m. Monday through Friday. If Contractor permits overtime work or work on a Saturday, Sunday or any legal holiday, Contractor shall receive prior approval by the Engineer and Owner.

1.10 STORAGE

- A. Storage conditions shall be acceptable to Owner for all materials and equipment not incorporated into the Work but included in Applications for Payment. Such storage arrangements and conditions shall be presented in writing for Owner review and approval and shall afford adequate and satisfactory security and protection. Off-site storage facilities shall be accessible to Engineer. The stored materials shall be insured for full value. Certificates of liability insurance coverage must be submitted to the Engineer with the request for payment by the Contractor. All arrangements and costs for storage facilities shall be paid by the Contractor, unless specifically designated in the Contract Documents to be furnished by the Owner.

1.11 NOTICES TO OWNERS OF ADJACENT PROPERTIES AND UTILITIES

- A. Contractor shall notify Owners of adjacent property and utilities when prosecution of the Work may affect them.
- B. When it is necessary to temporarily deny access by owners or tenants to their property, or when any utility service connection must be interrupted, Contractor shall give notices sufficiently in advance to enable the affected persons to provide for their needs. Notices shall conform to any applicable local ordinance and, whether delivered orally or in writing, shall include appropriate information concerning the interruption and instructions on how to limit any resulting inconvenience.
- C. Utilities and other concerned agencies shall be contacted at least seven days prior to cutting or closing streets or other traffic areas or excavating near underground utilities or pole lines.
- D. Contractor shall review with the various utility companies the construction methods, safety procedures, Work to be done in the vicinity of utilities. When temporary relocation of utilities is necessary, sufficient advance notice shall be given by the Contractor to the utility involved.

1.12 LINES AND GRADES

- A. All Work shall be done to the lines, grades, and elevations shown on the Drawings.
- B. Basic horizontal and vertical control points will be established or designated as provided in Contract Documents. Use these points as datum for the Work. Any additional survey, layout, or measurement Work needed for proper construction of the Work shall be performed by Contractor as a part of the Work at no additional cost to the Owner.
- C. Employ experienced instrument personnel, competent assistants, and such instruments, tools stakes, and other materials required to complete the survey, layout, and measurement Work. In addition, furnish, without charge, competent personnel from its force and such tools, stakes, and other materials as Engineer may require in establishing or designating control points or in checking survey, layout, and measurement of Work performed by Contractor.
- D. Keep Engineer informed, a reasonable time in advance, of the times and places at which Contractor wishes to do Work, so that horizontal and vertical control points may be established and any checking deemed necessary by Engineer may be done with minimum delay to Contractor.
- E. Contractor shall remove and reconstruct Work which is improperly located.

1.13 PROJECT MEETINGS

A. Preconstruction Conference

- 1. Prior to the commencement of Work at the Site, a preconstruction conference will be held at a mutually agreed time and place which shall be attended by the Contractor's Project Manager, its Superintendent, its Safety Representative, and its Subcontractors as the Contractor deems appropriate. Other attendees will be:
 - a. Engineer;
 - b. Representatives of Owner;
 - c. Governmental representatives as appropriate;
 - d. Others as requested by Contractor, Owner, or Engineer; and
 - e. Engineer's Representative.
- 2. Bring to the conference the submittals indicated in Section 01300 – Contractor Submittals.
- 3. The purpose of the conference is to designate responsible personnel, discuss contract requirements and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the Contractor prior to the meeting date. However, Contractor shall be prepared to discuss all of the items listed below.
 - a. Contractor's assignments for safety and first aid, including Designated Competent person(s) and Contractor's safety Representative.
 - b. Status of Contractor's insurance and bonds.
 - c. Contractor's tentative schedules.
 - d. Transmittal, review, and distribution of Contractor's submittals.
 - e. Processing applications for payment.
 - f. Maintaining record documents.
 - g. Critical Work sequencing.
 - h. Field decisions and Change Orders.
 - i. Use of project site, office and storage areas, security, housekeeping, and Owner's needs.
 - j. Major equipment deliveries and priorities.
 - k. Permits required for construction.
 - l. Utilities required for construction.

- m. Contract Owner and channels of communication.
- n. Coordination with others.
- 4. The Engineer will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.

B. Progress Meetings

- 1. The Contractor shall schedule and hold regular on-Site progress meetings at least weekly and at other times as requested by Engineer or as required by progress of the Work. The Contractor, Owner's Representative and all Subcontractors active on the Site must attend each meeting. Contractor may at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors.
- 2. The Engineer or Owner's Representative shall preside at the meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings will be to review the progress of the Work, discuss safety, maintain coordination of efforts, discuss commercial issues, discuss changes in scheduling, and resolve other problems which may develop. During each meeting, the Contractor is required to present any issues which may impact his Work, with a view to resolve these issues expeditiously.

1.14 SUPPLEMENTAL REPORTS AVAILABLE TO CONTRACTOR

- A. **No additional reports are** available from Owner.]

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01300 - CONTRACTOR SUBMITTALS

PART 1 – GENERAL

1.1 GENERAL

- A. Contractor "Submittals" may be Shop Drawings, schedules, surveys, reports, samples, plans, lists, drawings, documents, findings, programs, manuals, data, or any other item or information required by the Contract Documents to be submitted or offered by the Contractor in accomplishing the Work.
- B. Wherever Submittals are required hereunder, all such documents shall be furnished to the Engineer.
- C. The Contractor shall be responsible for the accuracy, completeness, and coordination of all Submittals. The Contractor shall not delegate this responsibility in whole or in part to any Subcontractor. Submittals may be prepared by the Contractor, Subcontractor, or Supplier, but the Contractor shall ascertain that each Submittal meets the requirements of the Contract and the Project. The Contractor shall ensure that there is no conflict with other Submittals and shall notify the Engineer in each case where its Submittal may affect the work of another Contractor or the Owner. The Contractor shall ensure coordination of Submittals of related crafts and Subcontractors.
- D. Failure to make timely submittals in accordance with the requirements of the specifications shall constitute grounds for the Owner to withhold 20 percent of compensation for the equipment to which the submittal is related, or, in the case of information lists, record drawings, investigation findings, safety plans, quality plans, and similar items, the Owner may withhold 20 percent of the value of the information in the submittal.

1.2 PRECONSTRUCTION CONFERENCE SUBMITTALS

- A. At the preconstruction conference referred to in Section 01010 - Summary of Work, submit the following items for review:
 - 1. A preliminary schedule of Shop Drawings, Samples, and proposed Substitute ("Or-Equal") submittals listed in the Bid.
 - 2. A list of all permits and licenses the Contractor shall obtain indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.
 - 3. A preliminary Schedule of Values in accordance with Section 01301 – Schedule of Values.
 - 4. A preliminary Project Schedule in accordance with the project scheduling constraints outlined in Division 01 specifications.
 - 5. The names and qualifications of Designated Safety Representative and Designated Competent Persons.

[1.4 SITE CONDITIONS SURVEYS

- A. Submit the site conditions survey data as required in Section 01335 – Site Conditions Surveys.]

1.5 PROGRESS REPORTS

- A. Furnish a progress report to Engineer with each Application for Payment. If the Work falls behind schedule, submit additional progress reports at such intervals as Engineer may request.
- B. Each progress report shall include sufficient narrative to describe any current and anticipated delaying factors, effect on the construction schedule, and proposed corrective actions. Any Work reported complete, but which is not readily apparent to Engineer, must be substantiated with satisfactory evidence.

- C. Each progress report shall include a list of the activities completed with their actual start and completion dates, a list of the activities currently in progress, and the number of working days required to complete each.

1.6 SHOP DRAWINGS

- A. Wherever called for in the Contract Documents, or where required by the Engineer, furnish to the Engineer for review, six copies of each Shop Drawing Submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items. Whenever the Contractor is required to submit design calculations as part of a Submittal, such calculations shall bear the signature and seal of a professional engineer registered in the appropriate branch in Utah unless otherwise directed.
- B. All Shop Drawing Submittals shall be accompanied by a Submittal transmittal form acceptable to the Engineer. Any Submittal not accompanied by such a form, or where all applicable items on the form are not completed, will be returned for resubmittal.
- C. Organization
 - 1. A single Shop Drawing Submittal transmittal form shall be used for each technical specification section or item or class of material or equipment for which a Submittal is required. A single Submittal covering multiple sections will not be acceptable, unless the primary specification references other sections for components. Example: If a pump section references other sections for the motor, protective coating, anchor bolts, local control panel, and variable frequency drive, a single Submittal would be accepted; a single Submittal covering vertical turbine pumps and horizontal split case pumps would not be acceptable.
 - 2. On the transmittal form, index the components of the Submittal and insert tabs in the Submittal to match the components. Relate the Submittal components to specification paragraph and subparagraph, drawing number, detail number, schedule title, or room number or building name, as applicable.
 - 3. Unless indicated otherwise, terminology and equipment names and numbers used in Submittals shall match the Contract Documents.
- D. Format
 - 1. Minimum sheet size shall be 8.5 inches by 11 inches. Maximum sheet size shall be 24 inches by 36 inches. Every page in a Submittal shall be numbered in sequence. Each copy of a Submittal shall be collated and stapled or bound, as appropriate. The Engineer will not collate copies.
 - 2. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with all pertinent data, capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Sufficient level of detail shall be presented for assessment of compliance with the Contract Documents.
 - 3. Each Submittal shall be assigned a unique number. Submittals shall be numbered sequentially. The Submittal numbers shall be clearly noted on the transmittal. Original Submittals shall be assigned a numeric Submittal number. Resubmittals shall bear an alpha-numeric system which consists of the number assigned to the original Submittal for that item followed by a letter of the alphabet to represent that it is a subsequent Submittal of the original. For example, if Submittal 25 requires a resubmittal, the first resubmittal will bear the designation "25-A" and the second resubmittal will bear the designation "25-B" and so on.
- E. Disorganized Submittals which do not meet the requirements above will be returned without review.
- F. Except as may otherwise be indicated herein, the Engineer will return each Submittal to the Contractor, with its comments noted thereon, within 14 calendar days following their receipt by the Engineer. For resubmittal of Submittals, the Engineer will be allowed the same review period as for

the original Submittal. It is considered reasonable that the Contractor shall make a complete and acceptable Submittal to the Engineer by the second submission of a Submittal item. The Owner reserves the right to withhold monies due to the Contractor to cover additional costs of any review beyond the second Submittal.

- G. If three copies of a Submittal are returned to the Contractor marked "NO EXCEPTIONS TAKEN", formal revision and resubmission of said Submittal will not be required.
- H. If three copies of a Submittal are returned to the Contractor marked "MAKE CORRECTIONS NOTED", formal revision and resubmission of said Submittal will not be required.
- I. If a Submittal is returned to the Contractor marked "REVISE AND RESUBMIT", the Contractor shall revise said Submittal and resubmit the required number of copies. Resubmittal of portions of multi-page or multi-drawing Submittals will not be allowed. For example, if a Shop Drawing Submittal that consists of ten drawings contains only one drawing that needs to be amended and resubmitted, the Submittal as a whole is deemed as "REVISE AND RESUBMIT", and all ten drawings of the Submittal are required to be resubmitted.
- J. If a Submittal is returned to the Contractor marked "REJECTED-RESUBMIT", the Contractor shall revise said Submittal and resubmit the required number of copies. Resubmittal of portions of multi-page or multi-drawing Submittals will not be allowed. For example, if a Shop Drawing Submittal that consists of ten drawings contains only (one) drawing that is rejected and needs to be resubmitted, the Submittal as a whole is deemed as "REJECTED-RESUBMIT", and all ten drawings of the Submittal are required to be resubmitted.
- K. Any changes made on a resubmittal, other than those made or requested by Engineer or Engineer, shall be identified and flagged on the resubmittal.
- L. Fabrication of an item shall commence only after the Engineer has reviewed the pertinent Submittals and the Engineer has returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED". Corrections indicated on Submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis for changes to the Contract requirements.
- M. All Contractor Shop Drawing Submittals shall be carefully reviewed by an authorized representative of the Contractor prior to submission. Each Submittal shall be dated and signed with the following: "I have verified that the equipment or material in this Submittal meets all the requirements specified or shown in the Contract Documents without exception." In the case of Shop Drawings, each sheet shall be so dated, signed, and certified. No consideration for review of any submittals will be made for any items which have not been so certified. All non-certified submittals will be returned without action taken, and any delays caused thereby shall be the total responsibility of the Contractor. Submittals which the Contractor wishes to have reviewed that cannot bear this certification because they contain an exception or deviation to the Contract Documents shall be submitted in accordance with Section 01600 – Products, Materials, Equipment and Substitutions.
- N. The Engineer's and/or Engineer's review of Shop Drawing Submittals shall not relieve the Contractor of the entire responsibility for the correctness of details and dimensions and for compliance with the Contract Documents. The Contractor shall assume all responsibility and risk for any misfits due to any errors in Submittals. The Contractor shall be responsible for the dimensions and the design of adequate connections and details.
- O. No changes in the Contract times will be considered for schedule delays resulting from non-compliant Submittals.
- P. Within 30 days of the Notice to Proceed, the Contractor shall submit a complete list of anticipated Submittals which includes Specification and Drawing references. The list shall be updated with "early start" Submittal dates within 15 days of Submittal of the Contractor's construction schedule. The

Submittal dates shall be updated whenever the schedule is updated. Any additional Submittals identified after the initial Submittal shall be included in the updates.

- Q. If the Contractor submits an incomplete Submittal, the Submittal may be returned without review. A complete Submittal shall contain sufficient data to demonstrate that the items contained therein comply with the Contract Documents, meet the minimum requirements for Submittals as described in the Contract Documents, and include all corrections as required from previous Submittals.

1.7 CONTRACTOR'S SCHEDULE

- A. The Contractor's construction schedules and reports shall be prepared and submitted to the Engineer in accordance with the project schedule requirements outlined in Division 01 of the Specifications.

1.8 SAMPLES

- A. Whenever in the Specifications samples are required, submit not less than three samples of each item or material to the Engineer for acceptance at no additional cost to the Owner.
- B. Samples, as required herein, shall be submitted for acceptance a minimum of 21 days prior to ordering such material for delivery to the jobsite, and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the Work.
- C. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and Manufacturer's name for identification. Upon receiving acceptance of the Engineer, one set of the samples will be stamped and dated and returned to the Contractor, and one set of samples will be retained, and one set of samples shall remain at the job site until completion of the Work.
- D. Unless indicated otherwise, all colors and textures of specified items presented in sample Submittals shall be from the manufacturer's standard colors and standard materials, products, or equipment lines. If the samples represent non-standard colors, materials, products, or equipment lines and their selection will require an increase in contract time or price, clearly indicate same on the transmittal page of the Submittal.
- E. Contractor shall submit five gallons of topsoil to Engineer. A certified soils analysis of the topsoil proposed for use on project shall also be submitted to the Engineer.

1.9 SURVEY DATA

- A. The Contractor shall make available for examination throughout the construction period all field books, notes, and other data developed by Contractor in performing the surveys required by the Work and shall submit all such data to Engineer with documentation required for final acceptance of the Work.

1.10 UTILITY INVESTIGATION

- A. The Contractor shall submit the findings of the utility investigation.

1.11 QUALITY ASSURANCE/QUALITY CONTROL PLAN

- A. The Contractor shall prepare and submit a Quality Assurance/Quality Control Plan for the Work contained in the Contract in accordance with Section 01400 – Quality Assurance/Quality Control.

1.13 OPERATIONS AND MAINTENANCE MANUAL

- A. The Contractor shall submit technical operation and maintenance information for each item of mechanical, electrical and instrumentation equipment in an organized manner in the OPERATIONS

AND MAINTENANCE MANUAL. It shall be written so that it can be used and understood by the Owner's operation and maintenance staff.

- B. The initial submittal of the OPERATIONS AND MAINTENANCE MANUALS shall be furnished to the Engineer upon delivery of the respective equipment.
- C. The OPERATIONS AND MAINTENANCE MANUAL shall be subdivided first by specification section number; second, by equipment item; and last, by "Part." "Parts" shall conform to the following (as applicable):
1. Part 1 – Equipment Summary:
 - a. Summary: A summary table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.
 - b. Form: The Engineer will supply an Equipment Summary Form for each item of mechanical, electrical and instrumentation equipment in the Work. Fill in the relevant information on the form and include it in Part 1.
 2. Part 2 – Operational Procedures:
 - a. Procedures: Manufacturer-recommended procedures on the following shall be included in Part 2:
 - Installation
 - Adjustment
 - Startup
 - Location of controls, special tools, equipment required, or related instrumentation needed for operation
 - Operation procedures
 - Load changes
 - Calibration
 - Shutdown
 - Troubleshooting
 - Disassembly
 - Reassembly
 - Realignment
 - Testing to determine performance efficiency
 - Tabulation of proper settings for all pressure relief valves, low and high- pressure switches, and other protection devices
 - List of all electrical relay settings including alarm and contact settings
 - Lubrication.
 3. Part 3 – Preventive Maintenance Procedures:
 - a. Procedures: Preventive maintenance procedures shall include all manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by leaving the equipment in place.
 - b. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.
 4. Part 4 – Parts List:
 - a. Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.
 - b. Drawings: Cross-sectional or exploded view drawings shall accompany the parts list.
 5. Part 5 – Wiring Diagrams:
 - a. Diagrams: Part 5 shall include complete internal and connection wiring diagrams for electrical equipment items.
 6. Part 6 – Shop Drawings:
 - a. Drawings: This part shall include approved shop or fabrication drawings, complete with dimensions.
 7. Part 7 – Safety:
 - a. Procedures: This part describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

8. Part 8 – Documentation:
 - a. All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.
- D. The Contractor shall furnish to the Engineer four identical OPERATIONS AND MAINTENANCE MANUALS. Each set shall consist of one or more volumes, each of which shall be bound in a standard size, 3-ring, looseleaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches. A table of contents indicating all equipment in the manuals shall be prepared. The title of each volume shall be displayed on the cover and spine.
- E. OPERATIONS AND MAINTENANCE MANUALS shall be submitted in final form not later than the 75 percent of construction completion date. All discrepancies found by the Engineer or Engineer in the OPERATIONS AND MAINTENANCE MANUALS shall be corrected by the Contractor within 30 days from the date of written notification.
- F. Incomplete or unacceptable OPERATIONS AND MAINTENANCE MANUALS at the 75 percent construction completion point shall constitute sufficient justification to withhold the amount stipulated in paragraph "OPERATIONS AND MAINTENANCE MANUAL Submittals" of Section 01700 – Project Closeout, from any monies due the Contractor.

1.14 SPARE PARTS LIST

- A. The Contractor shall furnish to the Engineer five identical sets of spare parts information for all mechanical, electrical, and instrumentation equipment. The spare parts list shall include the current list price of each spare part. The spare parts list shall be limited to those spare parts which each manufacturer recommends be maintained by the Owner in inventory at the plant site. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to facilitate the Owner in ordering. Cross-reference all spare parts lists to the equipment numbers designated in the Contract Documents. The spare parts lists shall be bound in standard size, 3-ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches.

1.15 RECORD DRAWINGS

- A. The Contractor shall prepare and maintain one record set of Drawings at the job site. On these, mark, in red ink, all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches as necessary or directed to indicate, fully the Work as actually constructed. These master record drawings of the Contractor's representation of as-built conditions, including all revisions made necessary by addenda and change orders shall be maintained up-to-date during the progress of the Work.
- B. Copies of the record drawings shall be audited regularly by the Engineer after the month in which the notice to proceed is given as well as on completion of Work. Failure to properly maintain record drawings in an up-to-date condition may result in the withholding of payments due the Contractor at the sole discretion of the Owner.
- C. In the case of those drawings which depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers and the like, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.

- D. Record drawings shall be accessible for the Engineer's review at all times during the construction period.
- E. Final payment will not be acted upon until the record drawings have been prepared and delivered to the Engineer. Said up-to-date record drawings shall be in the form of a set of prints with carefully plotted information overlaid in red.
- F. Upon substantial completion of the Work and prior to final acceptance, finalize and deliver a complete set of record drawings to the Engineer for transmittal to the Owner, conforming to the construction records of the Contractor. This set of drawings shall consist of corrected drawings showing the reported location of the Work. The information submitted by the Contractor and incorporated by the Engineer into the Record Drawings will be assumed to be correct, and the Contractor shall be responsible for the accuracy of such information, and for any errors or omissions which may appear on the Record Drawings as a result.

1.16 SAFETY PROGRAM

- A. The Contractor shall prepare and submit safety plans, programs, and permits to the Engineer in accordance with the provisions of Section 01302 – Safety and Security Program.
- B. Engineer's receipt of any safety plans, programs or permits will not relieve Contractor in any way from the full and complete responsibility for safety.

1.17 REQUESTS FOR INFORMATION

- A. In the event that the Contractor, Subcontractor or supplier, at any tier, determines that some portion of the drawings, specifications, or other Contract Documents requires clarification or interpretation by the Owner, the Contractor shall submit a Request for Information in writing to the Engineer. Requests for Information may only be submitted by the Contractor and shall only be submitted on the Request for Information form provided by the Engineer. The Contractor shall clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed from the Owner. In the Request for Information the Contractor shall set forth their own interpretation or understanding of the requirement along with reasons why they have reached such an understanding.
- B. The Engineer will review all Requests for Information to determine whether they are Requests for Information within the meaning of this term. If the Engineer determines that the document is not a Request for Information it will be returned to the Contractor, unreviewed as to content, for resubmittal on the proper form and in the proper manner.
- C. Responses from the Engineer will not change any requirement of the Contract Documents unless so noted by the Engineer in the response to the Request for Information. In the event the Contractor believes that a response to a Request for Information will cause a change to the requirements of the Contract Documents the Contractor shall immediately give written notice to the Engineer stating that the Contractor considers the response to be a Change Order. Failure to give such written notice immediately shall waive the Contractor's right to seek additional time or cost under the Contract.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01301 - SCHEDULE OF VALUES

PART 1 – GENERAL

1.1 GENERAL

- A. This Section defines the process whereby the Schedule of Values shall be developed and incorporated into the cost loading function of the Bar Chart Schedule as specified in Section 01310 – Bar Chart Schedule. Monthly progress payment amounts shall be determined from the weekly progress updates of the scheduled activities. The Schedule of Values shall, as a minimum, list the value of every activity on the Bar Chart Schedule, and shall include such additional breakdowns as required herein. The values in the Schedule of Values do not establish a commitment by either the Contractor or the Owner when negotiating changes to the Contract Documents.

1.2 DETAILED SCHEDULE OF VALUES

- A. The Contractor shall prepare and submit a detailed Schedule of Values to the Engineer as part of the Bar Chart Schedule submittal. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts through resource loading of the Bar Chart Schedule activities, sufficient detailed breakdown shall be provided to meet this requirement. The Schedule of Values shall have a one-to-one relationship to the work activities of the Contractor's Bar Chart Schedule even though additional detailed breakdowns for the Schedule of Values may be required. The Owner will be the sole judge of acceptable breakdowns, details, and descriptions of the values established. If, in the opinion of the Engineer, a greater number of Schedule of Values items than proposed by the Contractor is necessary, the Contractor shall add the additional items so identified.
- B. The minimum details of a breakdown of the major Work components are indicated below. Greater detail shall be provided as directed by the Engineer.
1. Bar Chart Schedule shall be broken down by initial submittal and monthly updates as described in Section 01310 – Bar Chart Schedule.
 2. Civil site Work shall be broken down into demolition, excavation cut and fill, clearing and grubbing and any other items determined to be necessary for the establishment of Pay and Schedule Activity items.
 4. Electrical and Instrumentation Work shall be broken down within each structure to identify individual systems, equipment installation by equipment name and number, and equipment testing and checkout.
 5. All other Work not specifically included in the above items shall be broken down as necessary for establishment of pay and Schedule activity items.
 6. Operations and Maintenance (O & M) Manuals shall be broken down into one O & M Manual per piece of equipment or one O & M Manual per group of like-kind pieces of equipment for establishment of Pay and Schedule activity items.
- C. After submittal of the Schedule of Values, as part of the Bar Chart Schedule submittal, the Contractor and Engineer shall meet and jointly review the schedules. The value allocations and extent of detail shall be reviewed to determine any necessary adjustments to the values and to determine if sufficient detail has been proposed. Any adjustments deemed necessary to the value allocation or level of detail shall be made by the Contractor and a revised detailed Schedule of Values shall be submitted within 5 work days from receipt of comments from Engineer.

1.3 CHANGES TO SCHEDULE OF VALUES

- A. Changes to the Bar Chart Schedule which add activities not included in the original Bar Chart Schedule but included in the original Work (schedule omissions) shall have values assigned as

approved by the Engineer. Other activity values shall be reduced to provide equal value adjustment increases for added activities as approved by the Engineer.

- B. In the event that the Contractor and Engineer agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made. The Engineer may direct changes to the schedule when inequities are discovered and agreement on the reallocation cannot be achieved.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

**SECTION 01310
BAR CHART SCHEDULE**

PART 1 – GENERAL

1.1 GENERAL

- A. A bar chart schedule shall be employed by the Contractor for the planning and scheduling of all work required under the Contract Documents.
- B. In addition to the scheduling aspect, the same chart shall show an “S” curve for scheduled dollar expenditures versus time.
- C. Contractor hereby agrees that in the process of preparing its baseline schedule and monthly updates, it will consult with all key Subcontractors and suppliers to assure concurrence with the feasibility and achievability of Contractor’s planned start dates, sequencing, durations, and completion dates.

1.2 QUALIFICATIONS

- A. The Contractor shall demonstrate competence through the submission of a fully compliant Construction Schedule with the initial schedule submission. In the event the Contractor fails to so demonstrate competence in scheduling, the Engineer may direct the Contractor to employ the services of a Scheduler that can demonstrate competence. The Contractor shall comply with such directive.

1.3 SUBMITTAL PROCEDURES

A. Submittal Requirements

- 1. Schedule will be submitted on a standard drawing sheet, size 11 inches x 17 inches.
- 2. The time scale (horizontal) shall be in weeks. The activities shall be listed on the left hand side (vertical).
- 3. Activities shall be broken down into sufficient detail to show all work activities. The listing from top to bottom shall be in a logical manner of which the work will be accomplished. Space shall be provided between activities or within bars to allow for marking of actual progress.
- 4. A written narrative of the planning logic along with a description of work and quantities included in each activity shall be submitted with the bar chart schedule.
- 5. Duration: The duration indicated for each activity shall be in units of whole working days and shall represent the single best time considering the scope of the Work and resources planned for the activity including time for holidays and inclement weather. The calendar for the network shall be in calendar days. Except for certain nonlabor activities, such as curing concrete or delivering materials, activity durations shall not exceed 14 days, be less than one Day, nor exceed \$50,000 in value unless otherwise accepted by the Engineer.

B. Time of Submittals

- 1. Within fifteen (15) working days after Notice to Proceed, Contractor shall submit a bar chart schedule with “S” curves and narrative for review by the Engineer. The schedule submitted shall indicate a project completion date the same as the contract completion date.
- 2. A copy of the schedule, clearly showing progress made and actual “S” curves, shall be submitted on a two or four week basis depending on the duration of the project and reporting time agreed to in the preconstruction meeting.

C. Acceptance

1. The bar chart schedule and “S” curves, when accepted by the Engineer, shall constitute the Construction Schedule unless a revised schedule is required due to one or more of the following:
 - a. Substantial changes in the Work scope.
 - b. A change in contract time.
 - c. Delinquency by Contractor that requires a recovery schedule.
2. The Owner's review and acceptance of the Contractor's Construction Schedule is for conformance to the requirements of the Contract Documents only. Review and acceptance by the Owner of the Contractor's Construction Schedule does not relieve the Contractor of any of its responsibility whatsoever for the accuracy or feasibility of the Construction Schedule, or of the Contractor's ability to meet interim milestone dates and the Contract completion date, nor does such review and acceptance expressly or impliedly warrant, acknowledge, or admit the reasonableness of the logic, durations, and resource value loading of the Contractor's Construction Schedule.

1.4 SCHEDULE UPDATES

- A. The Construction Schedule shall be updated to reflect the as-built conditions of the Work and to accurately forecast the status of incomplete activities. Progress reports shall be given at each weekly progress meeting, stating actual percent earned versus percent planned. Construction Schedule updates shall be submitted to the Engineer with each payment request. Updates shall include approved changes in the Work and shall accurately depict the current status and sequence of all activities.
- B. The updated Construction Schedule shall be submitted in the form, sequence, and number of copies requested for the initial schedule.
- C. The Engineer shall review each monthly Construction Schedule update and provide the Contractor comments within seven days of the submittal. The Contractor shall revise and resubmit the schedule within five days of receipt of comments from the Engineer. The Engineer will review the re-submittal within five days and provide comments if the schedule update is still unacceptable. The Contractor shall revise and resubmit the schedule within five days of receipt of comments from the Engineer.

1.5 PROGRESS MEETINGS AND LOOK-AHEAD SCHEDULES

- A. For the weekly progress meetings, the Contractor shall submit a Look-Ahead Schedule. This schedule will cover four weeks: the immediate past week, the current week, and the forthcoming two weeks. This schedule shall list all activities from the accepted Construction Schedule which are complete, are scheduled for Work during the period, are currently planned to be worked, even if out of sequence, and Work which is unfinished but scheduled to be finished. Actual start and completion dates shall be provided for the Work that has been completed the prior week; forecast early start and early finish dates shall be provided for the Work that is in process or upcoming.
- B. Each activity noted above shall be identified by activity number corresponding to the accepted Construction Schedule and detailed description of the activity.
- C. The Look-Ahead Schedule shall be delivered to the Engineer 24 hours prior to the weekly progress meeting.
- D. The Look-Ahead Schedule shall be in a format approved by the Engineer.

1.6 CONSTRUCTION SCHEDULE REVISIONS

- A. The Engineer may direct and, if so directed, the Contractor shall propose, revisions to the Construction Schedule upon occurrence of any of the following instances:

1. The actual physical progress of the Work falls more than five percent (5%) behind the accepted Construction Schedule, as demonstrated by comparison to the accepted monthly Construction Schedule updates or as determined by the Engineer if a current accepted Construction Schedule does not exist.
 2. The Engineer considers milestone or completion dates to be in jeopardy because of "activities behind schedule". "Activities behind schedule" are all activities that have not or cannot be started or completed by the dates shown in the Construction Schedule.
 3. A Change Order has been issued that changes, adds, or deletes scheduled activities or affects the time for completion of scheduled activities.
- B. When the instances requiring revision to the Construction Schedule occur, the Contractor shall submit the proposed revised Construction Schedule within ten (10) working days after receiving direction from the Engineer to provide such Schedule. No additional payment will be made to the Contractor for preparation and submittal of proposed revised Construction Schedules. However, if the Engineer accepts the proposed revised Construction Schedule, it shall replace and supersede all previous Construction Schedules and substitute for the next monthly Construction Schedule update that would otherwise be required.
- C. Revisions to the Construction Schedule shall comply with all of the same requirements applicable to the original schedule.

1.7 SCHEDULE RECOVERY

- A. If a revised Construction Schedule accepted by the Engineer requires the Contractor to employ additional manpower, equipment, hours of work or work shifts, or to accelerate procurement of materials or equipment, or any combination thereof, as schedule recovery measures to meet Contract milestones, the Contractor shall implement such schedule recovery measures without additional charge to the Owner.

1.8 EARLY COMPLETION SCHEDULES

- A. Early completion schedules are generally not acceptable to the Owner but may be accepted as a convenience to the Contractor and under the following conditions.
1. The Contractor must submit a specific written request outlining the specific reasons for using the early completion schedule.
 2. Contractor acknowledges and agrees in writing that the proposed reduction in time represents Project time already paid for by the Owner as part of the Bid Price, and available to both the Contractor and the Owner for the mitigation of impacts to the Project from any source. The Contractor shall not be entitled to any increase in Contract price for failure to achieve the early completion and waives all claim to same.
 3. Early completion schedules shall not be based upon or rely on expedited approvals by the Owner, the Engineer, or the Engineer.
 4. Early completion schedules must meet all other requirements of the Contract.
- B. Early completion schedules which have activities behind schedule shall be revised as and when requested by the Engineer.

1.9 BASIS OF SCHEDULE NARRATIVES

- A. Contractor shall furnish a basis of schedule narrative to the Engineer with each Application for Payment. If the Work falls behind schedule, Contractor shall submit additional narrative at such intervals as the Engineer may request.
- B. Each narrative shall include a summary of progress for the month, description of any current and anticipated delaying factors, a variance analysis for varying activities, impacts on the construction

schedule, and proposed corrective actions. Any Work reported complete, but which is not readily apparent to the Engineer, must be substantiated with satisfactory evidence.

- C. Each narrative shall include a list of the activities completed during the preceding month and a list of the activities started during the month but not yet completed.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01335 - SITE CONDITIONS SURVEYS

PART 1 – GENERAL

1.1 REQUIREMENTS

- A. Contractor shall conduct thorough preconstruction and postconstruction Site conditions surveys of the entire job. Site conditions surveys shall consist of photographs and video recordings on DVD and spot elevations using project control points noted in Drawings. Sufficient photographs, supplemented by videotape shall be provided by Contractor and submitted to Engineer to resolve any damage claims which may arise due to the construction of this Project.
- B. Video or photograph surveys shall include, but not be limited to, all access roads used to transport material or equipment to and from the Project site and elevation of roadways, drives, walks, and buildings.
- C. Video recordings required as part of this Section and by Section 02230 – Site Clearing and Section 02300 - Earthwork may be combined into a single DVD provided that the requirements for video specified in both Sections are met.
- D. Contractor, as a minimum, shall note pre- and post- construction conditions and perform videotape surveys of the following:
 - 1. Areas used to access the Site or haul materials and equipment to the site.
 - 2. The access road, both original and relocated locations and ultimately to the Work Site.
 - 3. All Work areas, including, but not limited to, access corridors, disposal areas, and staging areas.
 - 4. Any work completed by other contractors at the Site that will be impacted or otherwise affected by Contractor's Work.
- E. Supplement videotape surveys with photographs and spot elevation surveys as required to document the original condition and location of existing features and facilities.
- F. Video records shall be DVD format.

1.2 CONTRACTOR SUBMITTALS

- A. All photographs and video of the preconstruction conditions shall be submitted to Engineer for record purposes prior to, but not more than three weeks before, commencement of any construction activities.
- B. All photographs, video, and survey data of the post-construction conditions shall be completed and submitted to Engineer prior to final Project inspection by Owner and Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01400 - QUALITY ASSURANCE/QUALITY CONTROL

PART 1 – GENERAL

1.1 SITE INVESTIGATION AND CONTROL

- A. Contractor shall check and verify all dimensions and conditions in the field continuously during construction. Contractor shall be solely responsible for any inaccuracies built into the Work due to Contractor's (including Subcontractor's) failure to comply with this requirement.
- B. Contractor shall inspect related and appurtenant Work and report in writing to the Engineer any conditions which will prevent proper completion of the Work. Failure to report and such conditions shall constitute acceptance of all Site conditions, and any required removal, repair, or replacement caused by unsuitable conditions shall be performed by the Contractor solely and entirely at Contractor's expense.

1.2 INSPECTION OF THE WORK

- A. All work performed by the Contractor and Subcontractors shall be inspected by the Contractor and nonconforming Work and any safety hazards in the work area shall be noted and promptly corrected. The Contractor is responsible for the Work to be performed safely and in conformance to the Contract Documents.
- B. The Work shall be conducted under the general observation of the Engineer and is subject to inspection by representatives of the Owner acting on behalf of the Owner to ensure strict compliance with the requirements of the Contract Documents. Such inspection may include mill, plant, shop, or field inspection, as required. The Engineer, Owner's Representative, or any inspector(s) shall be permitted access to all parts of the Work, including plants where materials or equipment are manufactured or fabricated.
- C. The presence of the Engineer, or any Owner's Representative(s), however, shall not relieve the Contractor of the responsibility for the proper execution of the Work in accordance with all requirements of the Contract Documents. Compliance is the responsibility of the Contractor. No act or omission on the part of the Engineer, or any inspector(s) shall be construed as relieving Contractor of this responsibility. Inspection of Work later determined to be nonconforming shall not be cause or excuse for acceptance of the nonconforming Work. The Owner may accept nonconforming Work when adequate compensation is offered and it is in the Owner's best interest as determined by the Owner.
- D. All materials and articles furnished by the Contractor or Subcontractors shall be subject to rigid documented inspection, by qualified personnel, and no materials or articles shall be used in the Work until they have been inspected and accepted by the Contractor's Quality Control representative and the Engineer or other designated representative. No Work shall be backfilled, buried, cast in concrete, covered, or otherwise hidden until it has been inspected. Any Work covered in the absence of inspection shall be subject to uncovering. Where uninspected Work cannot be easily uncovered, such as in concrete cast over reinforcing steel, all such Work shall be subject to demolition, removal, and reconstruction under proper inspection.
- E. All materials and articles furnished to the Contractor by the Owner shall be subject to rigid inspection by Contractor's Quality Control representative before being used or placed by Contractor. Contractor shall inform Engineer, in writing, of the results of said inspections within one working day after completion of inspection. In the event Contractor believes any material or articles provided by Owner to be of insufficient quality for use in the Work, Contractor shall immediately notify Engineer.

1.3 TIME OF INSPECTION AND TESTS

- A. Samples and test specimens required under these Specifications shall be furnished and prepared for testing in ample time for the completion of the necessary tests and analyses before said articles or materials are to be used. Contractor shall furnish and prepare all required test specimens at Contractor's own expense. As provided in the Contract Documents, performance of the certain tests will be by the Owner, and all costs therefore will be borne by the Owner at no cost to the Contractor except that the costs of any test which shows unsatisfactory results shall be backcharged to the Contractor.

1.4 SAMPLING AND TESTING

- A. When not otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered. However, the Engineer reserves the right to use any generally-accepted system of inspection which, in the opinion of the Engineer, will ensure the Engineer that the quality of the workmanship is in full accord with the Contract Documents.
- B. The Owner reserves the right to waive tests or quality assurance measures, but waiver of any specific testing or other quality assurance measure, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial work, shall not be construed as a waiver of any technical or qualitative requirements of the Contract Documents.
- C. Notwithstanding the existence of such waiver, the Owner shall reserve the right to make independent investigations and tests as specified in the following paragraph and failure of any portion of the Work to meet any of the qualitative requirements of the Contract Documents, shall be reasonable cause for the Owner to require the removal or correction and reconstruction of any such Work.
- D. In addition to any other inspection or quality assurance provisions that may be specified, the Owner shall have the right to independently select, test, and analyze, at the expense of the Owner, additional test specimens of any or all of the materials to be used. Results of such tests and analyses shall be considered along with the tests or analyses made by the Contractor to determine compliance with the applicable specifications for the materials so tested or analyzed provided that wherever any portion of the Work is discovered, as a result of such independent testing or investigation by the Engineer, which fails to meet the requirements of the Contract Documents, all costs of such independent inspection and investigation and all costs of removal, correction, reconstruction, or repair of any such Work shall be borne by the Contractor.

1.5 RIGHT OF REJECTION

- A. The Engineer or designated representative, acting for the Owner, shall have the right at all times and places to reject any articles or materials to be furnished hereunder which, in any respect, fail to meet the requirements of the Contract Documents, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after completion of the Work at the Site. If the Engineer or designated representative, through an oversight or otherwise, has accepted materials or Work which are defective or in any way contrary to the Contract Documents, such materials, no matter in what stage or condition of manufacture, delivery, or erection, may be rejected.
- B. Contractor shall promptly remove or replace rejected articles or materials from the Site of the Work after notification of rejection.
- C. All costs of removal and replacement of rejected articles or materials, as specified therein, shall be borne by the Contractor.
- D. Failure to promptly remove and replace rejected Work shall be considered a breach of this Contract and the Owner may, after 7 days notice, terminate the Contractor's right to proceed with the affected Work and remove and replace the Work and issue a backcharge to cover the cost of the Work.

1.6 CONTRACTOR'S QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

- A. The Contractor shall establish and execute a Quality Assurance/Quality Control (QA/QC) program for the services which are being procured from the Contractor. The program shall provide the Contractor with adequate measures for verification and conformance to defined requirements by his personnel and lower-tier subcontractors (including fabricators, suppliers, and sub-subcontractors). This program shall be described in a Plan responsive to this Section.
- B. Within the submittal requirements of Section 01300 - Contractor Submittals, the Contractor shall furnish the Engineer a project specific QA/QC Plan. The Plan shall contain a comprehensive account of Contractor's QA/QC procedures as applicable to this job. The detailed requirements for this Plan are delineated in the following paragraphs. No payments will be made to the Contractor until the QA/QC Plan is fully accepted by the Engineer.
- C. The QA/QC Plan shall describe and define the personnel requirements described herein. The Contractor shall provide personnel with assigned QA/QC functions reporting to a Field QA/QC representative. The Field QA/QC representative shall report to a Senior Manager of the Contractor and shall have no supervisory or managerial responsibility over the work force. Persons performing QA/QC functions shall have sufficient qualifications, authority, and organizational freedom to identify quality problems and to initiate and recommend solutions. The Contractor QA/QC representative(s) shall be on-site as often as necessary (but not less than the daily hours specified in the Contract Documents) to remedy and demonstrate that Work is being performed properly and to make multiple observations of all Work in progress. The QA/QC Plan shall include a statement by the Senior Manager designating the QA/QC representative and specifying authorities delegated to the QA/QC representative to direct cessation or removal and replacement of defective Work.
- D. The Contractor's QA/QC program shall ensure the achievement of adequate quality throughout all applicable areas of the contract. The QA/QC Plan shall describe the program and include procedures, work instructions and records. In addition, the Plan shall describe methods relating to areas which require special testing and procedures as noted in the specifications.
- E. Identification And Control of Items And Materials: Procedures to ensure that items or materials that have been accepted at the site are properly used and installed shall be described in the QA/QC Plan. The procedures shall provide for proper identification and storage, and prevent the use of incorrect or defective materials.
- F. Inspection and Tests: The Contractor shall have written procedures defining a program for control of inspections performed and these procedures shall be described in the QA/QC Plan.
1. Inspections and tests shall be performed and documented by qualified individuals. At a minimum, "qualified" shall mean having performed similar QA/QC functions on similar type projects. Records of personnel experience, training and qualifications shall be maintained and made available for review by the Engineer upon request.
 2. The Contractor shall maintain and provide to the Engineer, within two working days of completion of each inspection and test, adequate records of all such inspections and tests. Inspection and test results shall be documented and evaluated to ensure that requirements have been satisfied.
 3. Procedures shall include:
 - a. Specific instructions defining procedures for observing all Work in process and comparing this Work with the Contract requirements (organized by specification section).
 - b. Maintaining and providing Daily Inspection Reports. Such reports shall, at a minimum, include the following:
 - 1) Item(s) inspected
 - 2) Quality characteristics in compliance
 - 3) Quality characteristics not in compliance

- 4) Corrective/remedial actions taken
 - 5) Statement of certification
 - 6) QC Manager's signature
 - c. Specific instructions for recording all observations and requirements for demonstrating through the reports that the Work observed was in compliance or a deficiency was noted and action to be taken.
 - d. Procedures to preclude the covering of deficient or rejected Work.
 - e. Procedures for halting or rejecting Work.
 - f. Procedures for resolution of differences between the QA/QC representative(s) and the production representative(s).
- 4. The QA/QC Plan shall identify all contractual hold/inspection points as well as any Contractor imposed hold/inspections points.
- 5. The QA/QC Plan shall include procedures to provide verification and control of all testing provided by Contractor including:
 - a. Maintaining and providing to the Engineer Daily Testing Records. Such records shall, at a minimum, contain the following:
 - 1) Item(s) tested
 - 2) Quality characteristics in compliance
 - 3) Statement of correctness & certification
 - 4) Quality characteristics not in compliance
 - 5) Corrective/remedial actions taken
 - 6) QC Manager's signature
 - b. Individual test records will contain the following information:
 - 1) Item tested –item number and description
 - 2) Test results
 - 3) Test designation
 - 4) Test work sheet including location sample was obtained
 - 5) Acceptance or rejection
 - 6) Date sample was obtained
 - 7) Retest information, if applicable
 - 8) Control requirements
 - 9) Tester signature
 - 10) Testing QC staff initials
 - c. Providing for location maps for all tests performed or location of Work covered by the tests.
 - d. Maintaining copies of all test results.
 - e. Ensuring Engineer receives independent copy of all tests.
 - f. Ensuring testing lab(s) are functioning independently and in accordance with the specifications.
 - g. Ensuring re-tests are properly taken and documented.
- G. Control of Measuring and Test Equipment: Measuring and/or testing instruments shall be adequately maintained, calibrated and adjusted to maintain accuracy within prescribed limits. Calibration shall be performed at specified periods against valid standards traceable to nationally recognized standards and documented.
- H. Supplier Quality Assurance: The QA/QC Plan shall include procedures to ensure that procured products and services conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to lower-tier suppliers and/or Subcontractors.
- I. Deficient and Nonconforming Work And Corrective Action: The QA/QC Plan shall include procedures for handling of deficiencies and nonconformances. Deficiencies and Nonconformances are defined as documentation, drawings, material, equipment or Work not conforming to the specified requirements or procedures. The procedure shall prevent Nonconformances by identification, documentation, evaluation, separation, disposition and corrective action to prevent recurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior

level management. The cause of conditions adverse to quality shall be determined and documented and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:

1. Personnel responsible for identifying deficient and non-complying items within the work.
 2. How and by whom deficient and non-compliant items are documented "in the field".
 3. The personnel and process utilized for logging deficient and non-compliant work at the end of each day onto a Deficiency Log.
 4. Tracking processes and tracking documentation for Deficient and Non-Compliant items.
 5. Personnel responsible for achieving resolution of outstanding deficiencies.
 6. Once resolved, how are the resolutions documented and by whom.
- J. Special Processes And Personnel Qualifications
1. The QA/QC Plan shall include detailed procedures for the performance and control of special process (e.g. welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).
 2. Personnel performing special process tasks shall have the experience, training and certifications commensurate with the scope, complexity, or nature of the activity. They shall be approved by the Engineer before the start of Work on the Project.
- K. Audits: The Contractor's QA/QC program shall provide for documented audits to verify that QA/QC procedures are being fully implemented by the Contractor as well as its subtiers. Audit records shall be made available to the Engineer upon request.
- L. Documented Control/Quality Records
1. The Contractor shall establish methods for control of Contract Documents which describe how Drawings and Specifications are received and distributed to assure the correct issue of the document being used. The methods shall also describe how as-built data are documented and furnished to the Engineer.
 2. The Contractor shall maintain evidence of activities affecting quality, including operating logs, records of inspections and tests, audit reports, material analyses, personnel qualification and certification records, procedures, and document review records.
 3. Quality records shall be maintained in a manner that provides for timely retrieval, and traceability. Quality records shall be protected from deterioration, damage, and destruction.
 4. The Contractor shall provide a list with specific records as specified in the Contract Documents which will be furnished to the Engineer at the completion of activities.
- M. Acceptance of QA/QC Plan: Engineer's review and acceptance of the Contractor's QA/QC Plan shall not relieve the Contractor from any of its obligations for the performance of the Work. The Contractor's QA/QC staffing is subject to the Engineer's review and continued acceptance. The Owner, at its sole option, without cause, may direct the Contractor to remove and replace the QA/QC representative. No Work covered by the QA/QC Plan shall start until Engineer's acceptance of Contractor's QA/QC plan has been obtained.
- N. Engineer may perform independent quality assurance audits to verify that actions specified in Contractor's QA/QC Plan have been implemented. No Engineer audit finding or report shall in any way relieve Contractor from any requirements of this Contract.

1.8 TESTING SERVICES

- A. All tests which require the services of a laboratory to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to Engineer. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped and fully qualified to perform the tests in accordance with the specified standards.

- B. Contractor's independent testing laboratory shall be accredited by the American Association of State Highway and Transportation Officials (AASHTO) for the tests they will perform and as appropriate to the construction work being performed. The Contractor's laboratory shall also be AASHTO accredited in: ASTM C1077-92, "Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation"; ASTM D3740, "Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design/Construction"; and ASTM D3666, "Specifications for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials".
- C. The Engineer shall have the right to inspect work performed by the independent testing laboratory both at the project and at the laboratory. This shall include inspection of the independent testing laboratory's internal quality assurance records (quality assurance manual, equipment calibrations, proficiency sample performance, etc.).
- D. Contractor shall obtain Engineer's acceptance of the testing firm before having services performed, and shall pay all costs for these testing services.
- E. Testing services provided by Owner, if any, are for the sole benefit of Owner, however, test results shall be available to Contractor. Testing necessary to satisfy Contractor's internal quality control procedures shall be the sole responsibility of Contractor.
- F. Testing Services furnished by Contractor: Unless otherwise specified, and in addition to all other specified testing requirements, Contractor shall provide all testing services in connection with the following materials as required for Engineer's review:
1. Concrete materials and mix designs.
 2. Embankment, fill, and backfill materials.
 3. QC testing of all precast concrete.
 4. All other tests and engineering data required for Engineer's review of materials and equipment proposed to be used in the Work.
 5. In addition, the following QC tests shall be performed by Contractor:
 - a. Holiday testing of pipeline coatings.
 - b. Air testing of field-welded joints for steel pipe or pipe cylinders and fabricated specials.
 - c. All testing and inspection of welding work including, but not limited to, welding procedure qualifications, welder operator qualifications, all work performed by the certified welding inspector, all appropriate nondestructive testing of welds and all repair and retest of weld defects.
- G. Testing Services furnished by Owner: Unless otherwise specified, Owner will provide Quality Control testing services in connection with the following materials and equipment incorporated in the Work;
1. Concrete strength tests.
 2. Moisture-density and relative density tests on embankment, fill, and backfill materials.
 3. In-place field density test on embankments, fills, and backfill.
 4. Other materials and equipment as specified herein.
 5. Testing, including sampling, shall be performed by Engineer or the Engineer's or the testing firm's laboratory personnel, in general manner and frequency indicated in the Specifications.
 6. The testing firm's laboratory shall perform all laboratory tests within a reasonable time consistent with the specified standards and will furnish a written report of each test.
 7. Contractor shall furnish all sample materials and cooperate in the testing activities, including sampling. Contractor shall interrupt the Work when necessary to allow testing, including sampling to be performed. Contractor shall have no claim for an increase in Contract Price or Contract Times due to such interruption. When testing activities, including sampling, are performed in the field by the testing firm's laboratory personnel, Contractor shall furnish personnel and facilities to assist in the activities.

8. The testing firm's laboratory shall perform all laboratory tests within a reasonable time consistent with the specified standards and will furnish a written report of each test.
- H. Transmittal of Test Reports: Written reports of tests and engineering data furnished by Contractor for Engineer's review of materials and equipment proposed to be used in the Work shall be submitted as specified for Shop Drawings.
- I. The testing firm retained by Contractor for material testing shall furnish five copies of written report of each test. Three copies of each test report will be transmitted to the Engineer within three Work Days after each test is completed. Each report for each type of test shall be consecutively numbered.
- J. Engineer will furnish one copy of each field and laboratory QC test to Contractor.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 01530 - PROTECTION AND RESTORATION OF EXISTING FACILITIES

PART 1 – GENERAL

1.1 GENERAL

- A. The Contractor shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, in accordance with the Contract Documents.
- B. The Contractor shall call Bluestakes before commencing any digging for location of underground utility lines and cable locations.

1.2 RIGHTS-OF-WAY

- A. The Contractor shall not do any work that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, nor enter upon the rights-of-way involved until Contractor has secured authority therefore from the proper party.
- B. After authority has been obtained, the Contractor shall give said party due notice of its intention to begin work, if required by said party, and remove, shore, support or otherwise protect such pipeline, transmission line, ditch, fence, or structure or replace the same.

1.3 PROTECTION OF STREET OR ROADWAY MARKERS

- A. The Contractor shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. Survey markers or points disturbed by the Contractor shall be accurately replaced after all street or roadway resurfacing has been completed.

1.4 RESTORATION OF PAVEMENT

- A. General: All paved areas cut or damaged during construction shall be replaced with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing a permit. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base and pavement. Temporary and permanent pavement shall conform to the requirements of the affected jurisdictional agency. Pavements which are subject to partial removal shall be neatly saw cut in straight lines. Refer to Division 02 for specific pavement restoration requirements.
- B. Temporary Resurfacing: Wherever required by the public authorities having jurisdiction, the Contractor shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.

- C. Permanent Resurfacing: In order to obtain a satisfactory junction with adjacent surfaces, the Contractor shall saw cut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement. Refer to plans for minimum dimension of T-patch replacement width over disturbed pipeline trenches in paved areas.
- D. Pavement Crown: In areas where pipeline trenching impacts the an existing crown of asphalt, Contractor shall survey, and submit to the Engineer documentation showing the pre-construction location of the crown prior to trenching. Crown of asphalt shall be replaced to its pre-construction location to the satisfaction of the governing agency and Engineer.
- E. Restoration of Sidewalks or Private Driveways: Wherever sidewalks or private roads have been removed for purposes of construction, the Contractor shall place suitable temporary sidewalks or roadways promptly after backfilling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions before proceeding with the final restoration. If no such period of times is so fixed, maintain said temporary sidewalks or roadways until the final restoration thereof has been made.
- F. Restoration of Curb and Gutter: Wherever curb and gutter, including driveway and sidewalk approaches, have been removed for purposes of construction, the Contractor shall replace these improvements following construction to the specific dimension and requirements of the authority having jurisdiction. Improvements, including required ADA access details, shall be replaced to the latest version of the authoritative standard regardless of their preconstruction condition.

1.5 EXISTING UTILITIES AND IMPROVEMENTS

- A. General. The Contractor shall protect underground utilities and other improvements which may be impaired during construction operations, regardless of whether or not the utilities are indicated on the Drawings. The Contractor shall take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.
- B. Except for utilities specifically located on the Drawings, the Contractor shall be responsible for exploratory excavations (potholing) as it deems necessary to determine the exact locations and depths of utilities which may interfere with its work. All such exploratory excavations shall be performed as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of construction to avoid possible delays to the Contractor's progress. When such exploratory excavations show the utility locations as shown on the Drawings to be in error, the Contractor shall so notify the Engineer.
- C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility.
- D. Utilities to be Moved: In case is shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder must be notified by the Owner to move such property within a specified reasonable time. When utility lines that are to be removed are encountered within the area of operations, the Contractor shall notify the

Engineer a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.

- E. Utilities to be Removed: where the proper completion of the Work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement which is indicated, the Contractor shall remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the Engineer and the owner of the facility. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished by the Contractor in a manner that will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.
- F. Owner's Right of Access: The right is reserved to the Owner and to the owner's of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the Work of this Contract.
- G. Underground Utilities Indicated: Existing utility lines that are indicated or the locations of which are made known to the Contractor prior to excavation and that are to be retained, and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by the Contractor unless otherwise repaired by the Owner of the damaged utility. If the Owner of the damaged facility performs its own repairs, the Contractor shall reimburse said Owner for the costs of repair.
- H. Underground Utilities Not Indicated: Utilities indicated on the Drawings are for the Contractors reference only. Contractor shall verify the locations of all utilities prior to commencing work. In the event that the Contractor damages existing utility lines that are not indicated or the locations of which are not made known to the Contractor prior to excavation, a verbal report of such damage shall be made immediately to the Engineer and a written report thereof shall be made promptly thereafter. The Contractor shall also notify the utility owner of the damage. The Contractor shall be responsible for all damage to utilities.
- I. Damages. Costs of locating and/or repairing damage, removing or relocating such utility facilities and for equipment on the project which was actually working on that portion of the Work which was interrupted or idled by removal or relocation of such utility facilities, and which was necessarily idled during such Work are the responsibility of the Contractor.
- J. Approval of Repairs: All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the utility or improvement Owner before being concealed by backfill or other work.
- K. Fire Hydrants: All fire hydrants and water control valves shall be kept free from obstruction and available for use at all times.
- L. Maintaining in Service: Unless indicated otherwise, all oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Engineer are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain,

pole, or wire or cable. The Contractor shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

- M. Utility Service Laterals: Utility service laterals are not shown on the plans. Contractor shall anticipate that there are no less service laterals than there are homes where project trenches are located in the vicinity of a street between a home and the utility main. It is the Contractor's responsibility to protect in place, or remove and replace to the satisfaction of the utility owner, all utility service laterals encountered during construction. Duration of utility service outages and public notification procedures shall conform to the standards of the controlling agency and these Contract documents.

1.6. TREES OR SHRUBS WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

- A. General: Except where trees or shrubs are indicated to be removed, the Contractor shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or Owner. Existing trees and shrubs which are damaged during construction shall be trimmed or replaced by the Contractor or a certified tree company under permit from the jurisdictional agency and/or the Owner.
- B. Trimming; symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. Cuts over 1-1/2 inches in diameter shall be coated with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosenes, coal tar, creosote, or other material injurious to the life of the tree.
- C. Replacement: The Contractor shall immediately notify the jurisdictional agency and/or the Owner if any tree or shrub is damaged by the Contractor's operations. If, in the opinion of said agency or the Owner, the damage is such that replacement is necessary, the Contractor shall replace the tree or shrub at its own expense. The tree or shrub shall be of a like size and variety as the one damaged, or, if of a small size, the Contractor shall pay to the owner of said tree a compensatory payment acceptable to the tree or shrub owner, subject to the approval of the jurisdictional agency or Owner. The size of the tree or shrub shall be not less than 1-inch diameter nor less than 6 feet in height. Planting of replacement trees and shrubs shall be in accordance with the recommendations of the nursery furnishing the plants. Unless otherwise indicated, the Contractor shall water and maintain the replacement trees and shrubs for 6 months after planting.

1.7 LAWN AREAS

- A. Lawn or landscaped areas damaged during construction shall be repaired to match the pre-construction condition to the satisfaction of the land owner and the Owner. Contractor shall use high quality sod to restore all lawn areas. Location and quality of irrigation system equipment shall be confirmed by Contractor prior to construction. Where lawn irrigation systems have been removed or damaged during construction, Contractor shall be responsible for replacement of systems in kind to the satisfaction of the land owner. Contractor shall anticipate that pressurized irrigation systems are present in all maintained lawn areas that will be impacted by construction. Verify proper operation of the irrigation

system with land owner as required for maintenance of newly installed sod prior to transferring of watering responsibilities.

1.8 UNIMPROVED AREAS

- A. Remove and stockpile topsoil prior to construction in accordance with Division 01 specifications. Replace topsoil prior to restoration of unimproved areas.
- B. Unimproved areas, including unclassified open spaces, fields, and unimproved rights-of-way, damaged during construction shall be repaired to match pre-construction conditions to the satisfaction of the land owner and the Owner. At a minimum, unimproved areas shall be smoothed and finished graded with topsoil to match preconstruction topography, and reseeded using a native seed mix acceptable to the land owner and Owner.
- C. All slopes greater than 2H:1V shall be protected with erosion control matting prior to reseeding in accordance with Division 01 specifications.

1.9 OTHER SURFACE IMPROVEMENTS

- A. Contractor shall be responsible for conducting a pre-construction survey of all properties that will be impacted by construction operations. All improvements that have the potential to be impacted by construction, including but not limited to fencing, landscaping, boulders, retaining walls, irrigation systems, and other public and/or private improvements, shall be protected in place, or if necessary, removed and replaced with like kind or better quality following construction.

1.10 NOTIFICATION BY THE CONTRACTOR

- A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, the Contractor shall notify the owners or agencies responsible for such facilities not less than three days nor more than seven days prior to excavation so that a representative of said owner or agencies can be present during such Work if they so desire.
- B. When it is necessary to temporarily deny access to property, or when any utility service connection must be interrupted, Contractor shall give notices sufficiently in advance to enable the affected persons to provide for their needs. Notices shall conform to any applicable local ordinance and, whether delivered orally or in writing, shall include appropriate information concerning the interruption and instructions on how to limit inconvenience caused thereby.
- C. The Contractor shall contact, cooperate with, and provide written notice (including the Contractor's phone number) at least seven days prior to beginning Work on each street. The written notice shall include the approximate schedule and explanation of Work and shall be given to each homeowner, business, all emergency agencies, schools, and residents which will be affected by the project; particularly in reference to temporary interruptions to vehicular access. At least twenty-four hours prior to initiation of Work, a second notice shall confirm the scope of scheduled Work. A copy of the notifications shall be submitted to the Engineer, for approval, prior to the start of construction. Verbal door-to-door communication shall be made prior to construction to remind all affected parties of the construction to take

place. In addition, the Contractor is responsible to answer and resolve any conflicts that may arise between a homeowner or business owner and the Contractor's construction process.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01700 - PROJECT CLOSEOUT

PART 1 – GENERAL

1.1 FINAL CLEANUP

- A. The Contractor shall promptly remove from the vicinity of the completed work, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final completion of the Work by the Owner will be withheld until the Contractor has satisfactorily complied with the requirements for final cleanup of the project site and the requirements below.

1.2 CLOSEOUT TIMETABLE

- A. Establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established not less than one week prior to beginning any of the foregoing items, to allow the Owner, the Engineer, and their authorized representatives sufficient time to schedule attendance at such activities.

1.3 COMPLETION PROCEDURES

- A. When the Contractor believes Substantial Completion has been achieved, request in writing to the Engineer that Substantial completion be recognized as having been achieved and request that the Owner issue a Certificate of Substantial Completion. Prior to making such a request, the Contractor must have:
1. Completed all work necessary for the safe, proper, and complete use or operation of the facility as intended.
 2. Prepared a Contractor-generated punch list for submission with the request for issuance of a Certificate of Substantial Completion.
 3. Submitted and received acceptance of accurate record drawings for all work completed to date.
 4. Submitted and received acceptance of all specified warranties, bonds, guarantees and operation and OPERATIONS AND MAINTENANCE MANUALS.
 5. Completed all required vendor training, testing, and where required, start-up.
 6. Delivered all required spare parts, maintenance stock items, and special tools.
 7. All equipment testing shall be successfully completed.
- B. Upon receipt of the request from the Contractor, the Engineer and designated representatives will review the request, the Work and the above requirements to determine whether the Contractor has achieved Substantial Completion. If this review fails to support Substantial Completion, the Engineer will notify the Contractor in writing citing the reasons for rejection. If the Engineer determines the Contractor has reached Substantial Completion, the following procedures will be followed:
1. The Engineer, his/her representative and user representatives will review the Work and the Contractor's punch list to assure all deficiencies are noted on a final punch list.
 2. The Engineer will schedule and conduct a pre-final walk-through of the facility with representatives of the Owner, the Engineer, the Contractor, and others, for the purpose of formally reviewing the Work, the final punch list, and the readiness of the Work for use. A copy of the final punch list will be furnished to all participants and any additional items noted during the walk-through will be added to the list.
 3. Upon completion of the pre-final walk-through, the Engineer will prepare a request to the Owner requesting establishing the date for Substantial Completion as date of the walk-through, provided the walk-through has verified that the Work is in fact ready for use and

occupancy by the Owner for its intended purpose. Upon approval of this request by the Owner, the facility will be considered Substantially Complete.

- C. Final Completion will be deemed to have occurred when all Work is completed including the following:
1. All final punch list items have been corrected, signed off by the Contractor and the Engineer, and demonstrated to the Owner during a final walk-through.
 2. All updates to the record drawings, and operations and maintenance manuals have been made.
 3. Demobilization and site clean up are complete.
 4. All facilities and/or equipment have been properly demonstrated to be functioning as required.
 5. The Contractor has furnished to the Owner releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.
 6. Provided new permanent cylinders and key blanks for all locks.
- D. Partial Utilization may be desired at the Owner's option, as described in the General Conditions. If Partial Utilization is requested, the same procedure for completion of that portion of the Work as indicated in paragraphs A and B above, will be used.

1.4 OPERATIONS AND MAINTENANCE MANUAL SUBMITTALS

- A. The Contractor's attention is directed to the condition that one percent of the contract price will be withheld from any monies due the Contractor as progress payments, if at the 75 percent construction completion point, the approved OPERATIONS AND MAINTENANCE MANUAL complying with Section 01300 – Contractor Submittals has not been submitted. The aforementioned amount will be withheld by the Owner as the agreed, estimated value of the approved OPERATIONS AND MAINTENANCE MANUALS. Any such retention of money for failure to submit the approved OPERATIONS AND MAINTENANCE MANUALS on or before the 75 percent construction completion point shall be in addition to the retention of any payments due to the Contractor under Article 14 of the General Conditions.

1.5 CLOSE-OUT PROCEDURE

- A. Engineer and Contractor shall meet and resolve all outstanding issues including, but not limited to:
1. Claims and adjustments for time or costs
 2. Outstanding, unused allowances
 3. Procedures for handling warranty issues.
- B. A Final Change Order shall be processed if required. Final payment and close out procedures shall comply with all requirements of the Contract Documents.

1.6 FINAL SUBMITTALS

- A. Prior to requesting final payment, obtain and submit the following items to the Engineer for transmittal to the Owner:
1. Written guarantees, where required.
 2. Operating manuals and instructions.
 3. Maintenance stock items; spare parts; special tools.
 4. Completed record drawings.
 5. Bonds for roofing or maintenance, if indicated.
 6. Certificates of inspection and acceptance by local governing agencies having jurisdiction.
 7. Release of liens or release of claims forms submitted by all Subcontractors and Suppliers, if requested by Owner.
 8. Post construction topographic mapping and surveys.

1.7 MAINTENANCE AND GUARANTEE

- A. Comply with the maintenance and guarantee requirements contained in Article [] of the General Conditions.
- B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the Contractor shall have obtained a statement in writing from the affected private authority or public agency releasing the Owner from further responsibility in connection with such repair or resurfacing.
- C. Make all repairs and replacements promptly upon receipt of written order from the Owner. If the Contractor fails to make such repairs or replacements promptly, the Owner reserves the right to do the Work and the Contractor and his surety shall be liable to the Owner for the cost thereof.

1.8 BOND

- A. Furnish a Performance Bond as required by the General Conditions.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

DIVISION 2

SITE WORK

SECTION 02230 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protecting existing trees and vegetation to remain.
 - 2. Removing trees and other vegetation.
 - 3. Clearing and grubbing.
 - 4. Topsoil stripping.
 - 5. Removing site improvements.
 - 6. Disconnecting, capping or sealing, and abandoning site utilities in place.
 - 7. Disconnecting, capping or sealing, and removing site utilities.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.

1.4 MATERIALS OWNERSHIP

- A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the site.

1.5 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
- B. Record drawings according to Division 1 Section "Contract Closeout."
 - 1. Identify and accurately locate utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Notify utility locator service for area where Project is located before site clearing.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 2 Section "Earthwork."
 - 1. After Owner's written permission is obtained, import approved soil materials when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated.
- D. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Owner will arrange to shut off SUU utilities when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Engineer not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.

3.3 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 - 3. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
 - 4. Use only hand methods for grubbing within drip line of remaining trees.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding 8-inch loose depth, and compact each layer to a density equal to adjacent original ground.

3.4 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within drip line of remaining trees.
 - 3. Dispose of excess topsoil as specified for waste material disposal.

3.5 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.6 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 02230

SECTION 02300 - EARTHWORK

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 1 Section "Construction Facilities and Temporary Controls."
 - 2. Division 2 Section "Site Clearing" for site stripping, grubbing, removing topsoil, and protecting trees to remain.
- C. This Section does not include Topsoil, which is specified in Section 02900 – Landscaping.

1.3 UNIT PRICES

- A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following:
 - 1. 24 inches outside of concrete forms other than at footings.
 - 2. 12 inches outside of concrete forms at footings.
 - 3. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - 4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - 5. 6 inches beneath bottom of concrete slabs on grade.
 - 6. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.
- B. Unit prices for rock excavation include replacement with approved materials.

1.4 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. Additional Excavation: Excavation below subgrade elevations as directed by Engineer. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, short-tip-radius rock bucket; rated at not less than 120-hp flywheel power with bucket-curling force of not less than 25,000 lbf and stick-crowd force of not less than 18,700 lbf; measured according to SAE J-1179.
 - 2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 45,000-lbf breakout force; measured according to SAE J-732.
- I. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material 3/4 cu. yd. or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard penetration resistance of 100 blows/2 inches.
- J. 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.
- K. 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.

- L. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- M. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of plastic warning tape.
 - 2. Drainage fabric.
 - 3. Separation fabric.
 - 4. Import Soil Report and Classification

1.6 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.
- B. Preexcavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.7 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Engineer not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. 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.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: After Owner's written permission is obtained, import approved soil materials when satisfactory soil materials are not available on-site.
- 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 2 inches 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 sieve and not more than 12 percent passing a No. 200 sieve.
- F. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- 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 sieve and not more than 12 percent passing a No. 200 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 sieve and not more than 8 percent passing a No. 200 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 sieve and 0 to 5 percent passing a No. 8 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 sieve and 0 to 5 percent passing a No. 4 sieve.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils 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 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.
- B. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
1. Grab Tensile Strength: 110 lbf; ASTM D 4632.
 2. Tear Strength: 40 lbf; ASTM D 4533.
 3. Puncture Resistance: 50 lbf; ASTM D 4833.
 4. Water Flow Rate: 150 gpm per sq. ft.; ASTM D 4491.
 5. Apparent Opening Size: No. 50; ASTM D 4751.
- C. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
1. Grab Tensile Strength: 200 lbf; ASTM D 4632.
 2. Tear Strength: 75 lbf; ASTM D 4533.
 3. Puncture Resistance: 90 lbf; ASTM D 4833.
 4. Water Flow Rate: 4 gpm per sq. ft.; ASTM D 4491.
 5. Apparent Opening Size: No. 30; ASTM D 4751.

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. Classified Excavation: Excavation to subgrade elevations classified as earth and rock. Additional payment for rock excavation will be not allowed.
 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
 2. Rock excavation includes removal and disposal of rock.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. 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 Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. 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 according to Drawings and governing Utility requirements .
 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

3.8 APPROVAL OF SUBGRADE

- A. Notify Engineer when excavations have reached required subgrade.
- B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 - 1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- 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 Engineer.

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 Engineer.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

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 of bottom of footings; fill with concrete to elevation of bottom of footings.
- C. Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- D. Place and compact initial backfill of subbase material, free of particles larger than 1 inch, to a height of 12 inches 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. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.
- G. Place and compact final backfill of satisfactory soil material to final subgrade.
- H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 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 in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches 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, compact each layer of backfill or fill material at 95 percent.

2. Under walkways, compact top 6 inches below subgrade and compact each layer of backfill or fill material at 92 percent.
3. Under lawn or unpaved areas, compact top 6 inches below subgrade and compact each layer of backfill or fill material at 85 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.
 2. Walks: Plus or minus 1 inch.
 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBSURFACE DRAINAGE

- A. Drainage Piping: Drainage pipe is specified in Division 2 Section "Subdrainage."
- B. Subsurface Drain: Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place a 6-inch course of filter material on drainage fabric to support drainage pipe. Encase drainage pipe in filter material and wrap in drainage fabric, overlapping sides and ends at least 6 inches.

3.18 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 or less, place materials in a single layer.
 5. When thickness of compacted subbase or base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.19 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 or less, place materials in a single layer.
 - 3. When compacted thickness of drainage course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.20 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor 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 Engineer.
- 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 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 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 150 feet or less of trench length, but no fewer than two 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.

3.21 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 Engineer; 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.

3.22 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 02300

SECTION 02741 - HOT-MIX ASPHALT PAVING

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. Pavement-marking paint.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for aggregate subbase and base courses and for aggregate pavement shoulders.
 - 2. Division 2 Section "Pavement Joint Sealants" for joint sealants and fillers at paving terminations.

1.3 DEFINITIONS

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.
- B. DOT: 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 Owner and SUU.
 - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
- B. Job-Mix Designs: For each job mix proposed for the Work.
- C. Samples: For each paving fabric, **12 by 12 inches** minimum.
- D. Qualification Data: For manufacturer.
- E. Material Certificates: For each paving material, signed by manufacturers.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer.

- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.
- C. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.
- D. 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. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
 - 1. Prime and Tack Coats: Minimum surface temperature of **60 deg F**.
 - 2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
 - 3. Asphalt Base Course: Minimum surface temperature of **40 deg F** and rising at time of placement.
 - 4. Asphalt Surface Course: Minimum surface temperature of **60 deg F** at time of placement.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of **40 deg F** for oil-based materials, **50 deg F** for water-based materials, and not exceeding **95 deg F**.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations and meet Owner's design requirements.
- B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 10 percent by weight of the total aggregate mass.
- D. Mineral Filler: ASTM D 242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

- A. Asphalt Cement AC-10 or AC-20.
- B. Asphalt Cement: ASTM D 3381 for viscosity-graded material ASTM D 946 for penetration-graded material.
- C. Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-30 or MC-70.
- D. Tack Coat: ASTM D 977 or AASHTO M 140, emulsified asphalt or ASTM D 2397 or AASHTO M 208, cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- E. Water: Potable.
- F. Undersealing Asphalt: ASTM D 3141 or AASHTO M 238, pumping consistency.

2.3 AUXILIARY MATERIALS

- A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than 3 minutes.
 - 1. Color: Blue for handicapped requirements, yellow for fire lanes, white elsewhere.

2.4 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types."
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
 - 2. Provide mixes complying with composition, grading, and tolerance requirements in ASTM D 3515 for the following nominal, maximum aggregate sizes:
 - a. Base Course: 1 inch.
 - b. Surface Course: 1/2 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

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 6 inches minimum 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.**
 - 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: Fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.

3.3 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt base course in 8-inch lifts maximum.
 - 2. Place hot-mix asphalt surface course in 4-inch lifts maximum.
 - 3. Spread mix at minimum temperature of **250 deg F.**
 - 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
 - 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than **10 feet** wide unless infill edge strips of a lesser width are required.
 - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of **6 inches.**
 - 3. Offset transverse joints, in successive courses, a minimum of **24 inches.**
 - 4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
 - 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 - 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.5 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent nor greater than 100 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch.
 - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch.
 - 2. Surface Course: 1/8 inch.
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.7 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.
- B. Allow paving to age for 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of **15 mils**.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every **1000 sq. yd.** or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.9 DISPOSAL

- A. Except for material indicated to be recycled, 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 02741

SECTION 02751 - CEMENT CONCRETE PAVEMENT

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. Driveways and roadways.
 - 2. Parking lots.
 - 3. Curbs and gutters.
 - 4. Walkways.
 - 5. Concrete Mow Strip
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for subgrade preparation, grading, and subbase course.
 - 2. Division 2 Section "Pavement Joint Sealants" for joint sealants within concrete pavement and at isolation joints of concrete pavement with adjacent construction.
 - 3. Division 3 Section "Cast-in-Place Concrete" for general building applications of concrete.

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. **Testing Agency Qualifications:** An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- D. **Source Limitations:** Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.
- E. **ACI Publications:** Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.
- F. **Concrete Testing Service:** Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.

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 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. Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.
- C. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.
- D. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed.
- E. Epoxy-Coated Reinforcement Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, deformed bars.
- F. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.
- G. Plain Steel Wire: ASTM A 82, as drawn.
- H. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A coated, plain steel.
- I. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- J. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.
- K. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- L. 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:
- M. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

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.
 - 2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Blended Hydraulic Cement: ASTM C 595M, Type IS, portland blast-furnace slag cement.
- D. Blended Hydraulic Cement: ASTM C 595M, Type IP portland pozzolan cement.
- E. Blended Hydraulic Cement: ASTM C 595M, Type I (PM) pozzolan-modified portland cement.

- F. Blended Hydraulic Cement: ASTM C 595M, Type I (SM) slag-modified portland cement.
- G. Aggregate: ASTM C 33, uniformly graded, from a single source, with coarse aggregate as follows:
 - 1. Class: 4S.
 - 2. Class: 4M.
 - 3. Class: 1N.
 - 4. Maximum Aggregate Size: 3/4 inch nominal.
 - 5. Do not use fine or coarse aggregates containing substances that cause spalling.
- H. 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.
- C. Water-Reducing Admixture: ASTM C 494, Type A.
- D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
- E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
- F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
- B. Pavement-Marking Paint: Latex, water-base emulsion; ready mixed; complying with FS TT-P-1952.
 - 1. Color: Blue for handicapped requirements, yellow for fire lanes, white elsewhere.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:

1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.

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.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches.
- D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.
- 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: 5.5 percent for 1-1/2-inch maximum aggregate.
 2. Air Content: 6.0 percent for 1-inch maximum aggregate.
 3. Air Content: 6.0 percent for 3/4-inch 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 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, unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler less than 1/2 inch or more than 1 inch 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. 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.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
- E. 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.

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. 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.
- F. 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.

- G. 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.
- H. 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.
- I. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- 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, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F 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. 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.
2. After final floating, apply a hand-trowel finish followed by a broom finish to concrete. Cure concrete with curing compound recommended by dry-shake material manufacturer. Apply curing compound immediately after final finishing.

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 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. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 3. 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.
 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 3. Surface: Gap below 10-foot-long, unlevelled straightedge not to exceed 1/4 inch.
 4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
 5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
 6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.

8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.9 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.
- B. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article.
- B. Testing Services: Testing shall be performed according to the following requirements:
 1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C 172, except modified for slump to comply with ASTM C 94.
 2. Slump: ASTM C 143; one test at point of placement for each compressive-strength test, but not less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
 3. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive-strength specimens.
 5. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd.. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.
 6. When frequency of testing will provide fewer than five compressive-strength tests for a given class of concrete, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
 8. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 psi.
- C. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project

- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as the sole basis for approval or rejection.
- E. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Engineer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.11 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 Engineer 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 02751

SECTION 02764 - PAVEMENT JOINT SEALANTS

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. Expansion and contraction joints within portland cement concrete pavement.
 - 2. Joints between portland cement concrete and asphalt pavement.
- B. Related Sections include the following:
 - 1. Division 2 Section "Hot-Mix Asphalt Paving" for constructing joints between concrete and asphalt pavement.
 - 2. Division 2 Section "Portland Cement Concrete Paving" for constructing joints in concrete paving.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.
- D. Product Test Reports: From a qualified testing agency indicating joint sealants comply with requirements, based on comprehensive testing of current product formulations.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- 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 manufacturer, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturer's standard test methods 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 nine pieces of each type of material, including joint substrates, joint-sealant backer materials, secondary seals, and miscellaneous material.
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 the use of specially formulated primers.
5. Testing will not be required if joint sealant manufacturer submits 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: 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.
 2. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than that allowed by joint sealant manufacturer for application indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint sealant manufacturer based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.
- B. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.
- C. Multicomponent Low-Modulus Sealant for Concrete and Asphalt: Proprietary formulation consisting of reactive petropolymer and activator components producing a pourable, self-leveling sealant.

2.3 HOT-APPLIED JOINT SEALANTS

- A. Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3406.
- B. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D 3405.

2.4 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rod for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.
- C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depths, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
- D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.

2.5 PRIMERS

- A. Primers: Product 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.

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.
- B. Joint Priming: Prime joint substrates where indicated or 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.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's written installation instructions applicable to products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials 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 backer materials.
 - 2. Do not stretch, twist, puncture, or tear backer materials.
 - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants by proven techniques to 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 provided for each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. 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 sealants from surfaces adjacent to joint.
 - 2. Use tooling agents that are approved in writing by joint sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint sealant manufacturer's written instructions, unless otherwise indicated.
- G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 02764

SECTION 02900 LANDSCAPING

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall perform all the landscaping and all appurtenant work, complete, in accordance with the requirements of the Contract Documents.
- B. Scope of Work: Landscaping as referred to herein shall include, but not be limited to the following work: soil preparation, installation of headers, weed control, finish grading, furnishing and installing plant materials, tree staking and tying, cleanup, maintenance, and guarantee.
- C. The Section cross references the following sections:
 - 1. Reference Standards 01095
 - 2. Contractor Submittals 01300
 - 3. Project Closeout 01700
 - 4. Landscape Irrigation System 02810

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes: All codes, as referenced herein, are specified in Section 01095 - Reference Standards.
- B. Federal Specifications:
 - FS O-F-241 D Fertilizer, Mixed, Commercial
- C. Commercial Standards
 - ANSI/ASTM D 422 Method for Particle-Size Analysis of Soils
 - ANSI Z601 Nursery Stock
 - American Association of Rules and Grading Provisions Nurserymen, Inc.
- D. Southern Utah University's standards shall be referenced and followed in addition to these plans and specifications.

1.3 Contractor SUBMITTALS

- A. General: The Contractor shall furnish a certificate with each delivery or bulk material delivery, stating source, quantity, and type of material. All materials shall conform to specification requirements. All certificates shall be delivered to the LANDSCAPE ARCHITECT (here in referred to as Engineer) at time of each delivery. All bulk delivered materials shall be delivered with level load volume plainly marked on the truck bed.
- B. Topsoil Report: Topsoil report as well as literature on fertilizers, mulch and seed mixes, shall be submitted as specified in Section 01300 - Contractor Submittals

1.4 QUALITY ASSURANCE

- A. General: All plants furnished by the Contractor shall be true to type or name as shown in the Contract Documents and shall be tagged in accordance with the standard practice recommended by the Agricultural Code of the State of Utah; however, determination of plant species or variety will be made by the Engineer..
- B. All plants shall comply with Federal and State laws requiring inspection for plant diseases and infestations. Inspection certificates required by law shall accompany each shipment of plants, and certificates shall be delivered to the Engineer
- C. All inspections herein specified will be made by the Engineer or its representative. The Contractor shall request inspection at least 24 hours in advance of the time inspection is required. Inspection will be required on the following stages of the WORK:
 - 1. During preliminary grading, soil preparation, and initial weeding.
 - 2. When trees are spotted for planting, but before planting holes have been excavated.
 - 3. When finish grading has been completed.
 - 4. When all specified work, except the maintenance period has been completed.
 - 5. Final inspection at the completion of the maintenance period.
- D. Plants shall be subject to inspection and approval or rejection by the Engineer at place of growth and upon delivery to the site at any time before or during progress of the WORK and according to:
 - 1. Quantity, quality, size, and variety;
 - 2. Ball and root condition; and
 - 3. Latent defects and injuries resulting from handling, disease, and insects.
- E. Plants approved at pre-planting inspection shall still be subject to rejection during planting if found to be below Specifications.
- F. Rejected plants shall be identified in an obvious manner, removed from the site and replaced with acceptable equals.
- G. Plants shall have been grown in nurseries which have been inspected by the governing authorities. Inspection of plant materials required by City, County, State, or Federal authorities shall be the responsibility of the Contractor, who shall have secured permits or certificates prior to delivery of plants to site.

1.5 CLEANUP

- A. Upon completion of all planting operations, the portion of the project site used for a work or storage area by the Contractor shall be cleaned of all debris, superfluous materials, and equipment. All such materials and equipment shall be entirely removed from the project site as specified in Section 01700 - Project Closeout.

- B. All walks or pavement shall be swept or washed clean upon completion of the WORK of this Section.
- C. During the entire Contract period, plant containers that have been cut or removed from plant materials shall be removed from the project site daily, in accordance with the provisions for maintenance and guarantee as specified in Section 01700 - Project Closeout.

1.6 MAINTENANCE OF LANDSCAPE PLANTING PRIOR TO ACCEPTANCE OF PROJECT

- A. General: The Contractor shall be responsible for protecting, watering, and maintaining all planting and irrigation systems until final acceptance of all work under the contract.
- B. Watering: Trees and shrubs shall be thoroughly soaked after planting and provided with additional water at intervals as necessary to provide for good health and growth of the planting.
- C. The new planting shall be kept watered by the sprinkling system existing on the site during dry weather or whenever necessary for proper establishment of the lawn. Care shall be taken to avoid excessive washing or puddling on the surface and any such damage caused thereby shall be repaired by the Contractor at its own expense.
- D. Protection: The Contractor shall provide adequate protection to all newly planted areas including the installation of approved temporary fences to prevent trespassing and damage, as well as erosion control, until acceptance.
- E. The Contractor shall replace any materials or equipment it has damaged or which has been damaged by its employees or subContractors.
- F. Partial utilization of the project shall not relieve the Contractor of any of the requirements contained in the Contract Documents.
- G. Plants shall be maintained in a vigorous, thriving condition by watering, cultivating, weeding, pruning, spraying, and other operations necessary. No trees or shrubs will be accepted unless they are healthy and show satisfactory foliage conditions.
- H. All planted areas shall be cultivated at least every 2 weeks and raked smooth, to present a neat appearance and additional mulch shall be added where necessary.
- I. Maintenance shall include, in addition to the foregoing, cleaning, edging, repairs to stakes, wire, and wrappings, the repair of erosion, and all other necessary work of maintenance. Sidewalks and other paved areas shall be kept clean while planting and maintenance are in progress.
- J. Any and all sprinkler lines broken or disrupted during this construction shall be replaced to proper working order prior to contract work and be acceptable to the OWNER.

1.7 SOUTHERN UTAH UNIVERSITY INSPECTION SCHEDULE, MAINTENANCE AND WARRANTY

- A. Inspections: All Contractors are required to follow an Inspection schedule as per Southern Utah University's Standards, Specifications, and Plans. Should any of the work

be covered or completed before inspections and test, the Contractor shall uncover the work at their own expense.

- B. Due to Utah having limited growing season, no inspections will be performed from October 31 through March 31, unless conditions permit and at the Owner's discretion.
- C. The Contractor shall set up an inspection schedule with the Owner. Prior to each inspection date, the Contractor shall give twenty-four (24) hours notice to the Owner. There shall be a minimum of five inspections. The Contractor may not proceed to the next phase of construction until the previous phase has been inspected and approved.

The inspections are as follows:

First inspection	Open main line & pressure test
Second inspection	Final irrigation system & coverage test
Third inspection	Plant material & location
Fourth inspection	Start of maintenance
Fifth inspection	Final release

- D. After installing the irrigation main line, the Contractor shall schedule the first inspection from the Owner.
- E. The developer/Contractor shall maintain the property until the second mowing of the grass. During this period the Contractor is responsible for all aspects of maintenance including but not limited to; mowing, fertilizing, irrigation scheduling and repair, and all safety inspections.
- F. At the second mowing, a fifth Inspection shall be scheduled by the Contractor. If at that point the project is still termed satisfactory, the Owner shall assume the maintenance of the property. The Contractor shall obtain written approval from the Owner that the City has officially assumed maintenance and that all work has been completed to Project Standards.
- G. As built: the Contractor shall furnish the Engineer with two (2) preliminary sets of blue line prints for review, showing all irrigation and landscape work required. After initial review by the Engineer, the Contractor shall make all noted corrections as required by the Engineer. The Contractor shall submit two (2) final sets of blue line prints to be signed and approved by the Engineer. Upon completion of the installation, the Contractor shall submit the as-built to the Engineer. The Engineer shall receive the corrected set of as-built plans prior to accepting the project for final release.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All landscaping materials for soil conditioning, weed abatement, or planting shall be first-grade, commercial quality and shall have certificates indicating the source of material, analysis, quantity, or weight attached to each sack or container or provided with each delivery. Delivery certificates shall be given to the Engineer as each shipment of material is delivered. A list of the materials used, together with typical certificates of each material, shall be submitted to the Engineer prior to the final acceptance of the job.

2.2 TERMINOLOGY AND QUALIFICATIONS

- A. Plants or plant material having characteristics not conforming to terms as defined will not be accepted. The terms "plant material" or "plants" refer to all vegetation, whether trees, shrubs, ground cover, or herbaceous vegetation.
- B. Quality refers to structure and form, as evidenced by density and number of canes and branches, compactness, symmetry, and general development without consideration of size or condition. Standard quality indicates the least acceptable quality. Plants shall be typical of the species and variety of good average uniform growth, shall be well formed and uniformly branched, and shall have the minimum number of canes specified, free from irregularities, or shall conform to minimum quality index. Where the number of canes is not specifically stated in describing this grade, the standards of the "Horticultural Standards" as adopted by the American Association of Nurserymen, shall apply. In this case, the number of canes and other factors for the appropriate classification under "quality definition" in the Horticultural Standards shall be the Quality index. Plant material below this standard will be considered "culls" and are not acceptable. Plants shall be nursery grown.
- C. Specimen means an exceptionally heavy, symmetrical, tightly-knit plant, so trained or favored in its development and appearance as to be outstanding, superior in form, number of branches, compactness, and symmetry.
- D. Size is the factor controlled by dimensions representing height or spread, or both, without consideration of quality or conditions. For standard quality, a dimension is given for height or container size, or a dimension is given for height as well as container size.
- E. Height is usually indicated with a tolerance. The smaller dimension is the minimum acceptable. The larger dimension represents the maximum permissible. The average dimension of all plants must equal the average of the tolerance figures shown on each item
- F. Condition is the factor controlled by vitality and ability to survive and thrive and be comparable with normal plants of the same species and variety in the vicinity, at the same season of the year. In addition, plants shall be free from physical damage or adverse conditions that would prevent thriving. Conditions also sometimes refer to state of growth, i.e., whether "dormant condition" or "growing condition" and this state shall be comparable to plants of similar species in the vicinity or leaves, formation of buds, and the like.
- G. Cane means a primary stem which starts from the ground, or close to the ground, at a point not higher than 1/4 the height of the plant.
- H. Caliber shall be taken 12 inches above the finish grade or ground, as a guide, or where a dimension in trunk appears to form the head of the tree.
- I. Foliage line is maximum dimension in case of specimen plants. It measures from ground to lowest part of body of plant.
- J. Collected plants shall not be used.

2.3 TOPSOIL

- A. Existing on site topsoil may be stripped and stockpiled on site for landscape use.
- B. Imported topsoil shall be obtained from naturally drained areas and shall be fertile, friable loam suitable for plant growth. Topsoil shall be subject to inspection and approval at the source of supply and upon delivery.
- C. The topsoil shall be of uniform quality, free from subsoil stiff or lumpy clay, hard clods, hardpan, rocks, disintegrated debris, plants, roots, seeds, and any other materials that would be toxic or harmful to plant growth. Topsoil shall contain no noxious weeds or noxious weed seeds.
- D. Imported topsoil shall contain at least 6 percent organic matter as determined by loss of weight after ignition of dried (moisture-free) samples in accordance with current methods of the Association of Official Agricultural Chemists.
- E. Imported acidity range of the topsoil shall be (pH 5.5 to pH 7.5). The salinity level shall be less than 3 millimhos/cm.
- F. Imported topsoil clay, as determined by the Bouyoucous hydrometer or by the Recantation method, shall not exceed 60 percent of the topsoil material.
- G. Mechanical analysis shall be performed and shall conform to ANSI/ASTM D 422.

QUALITY ASSURANCE

2.4 FERTILIZER AND ADDITIVES

- A. Fertilizer shall be furnished in bags or other standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon.
- B. Chemical fertilizers shall be a mixed commercial fertilizer "Gro-Power" conforming to FS O-F-241 D, Type I, with percentages of nitrogen, phosphoric acid, and potash at 5-3-1. The combined N-P-K content shall be following percentages of total weight: 5 percent nitrogen 3 percent phosphoric acid and 1 percent potash. Fertilizers shall be uniform in composition, dry, and free flowing.
- C. Tablets shall be 21 grams each 20-10-5 "Agriform," "Lesslie", or equal

2.5 PLANT MATERIALS

- A. Plants shall meet requirements of the Contract Documents and shall be in accordance with the botanical names and applicable standards of quality, size, condition, and type. They shall be true to name, genera, species, and variety in accordance with reference publications.
- B. Plant names are defined in "Standardized Plant Names" and "Bailey's Encyclopedia of Horticulture." When a name is not found in either reference, the accepted name used in the nursery trade shall apply.

- C. Plants shall be marked for identification. Each bundle of plants and at least 25 percent of each species and variety of separate plants in any one shipment shall have legible labels securely attached before delivery to the site.
- D. All trees and shrubs shall be measured while their branches are in their normal position. Height and spread dimensions specified refer to the main body of the plant and not from branch or root tip to tip. No trees will be accepted with their leaders cut, or so damaged that cutting is necessary.
- E. All plants shall be symmetrical and shall conform to the size, age, and condition as specified on the plant list shown in the Contract Documents. Exceptions are as follows:
 - 1. Plants larger than specified in the plant list may be used if approved by the Engineer, but use of such plants shall not increase the contract price. If the use of larger plants is approved, the spread of roots or ball earth shall be increased in proportion to the size of the plant. Bare root plants furnished in size greater than specified shall be balled and burlaped when required by the Engineer
 - 2. Where caliper or other dimensions of any plant materials are omitted from the Plant List, it shall be understood that such plant materials shall be normal stock for type
- F. Plants shall be of sound health, vigorous, and free from plant disease and shall be well-branched, shall have full foliage when in leaf, and shall have a healthy well-developed normal root system. Cold storage plants will not be accepted. Plants that are sensitive to shock from elevation change shall be grown at elevations close enough to site to alleviate any plant damage due to such change for at least 2 years.
- I. Roots or balls of all plants shall be adequately protected at all times from sun and drying winds.
- J. Plants (indicated to be in marked cans, pots, or other containers on the plant list) shall have been grown in the containers for a minimum of 6 months and a maximum of 2 years. Roots shall fill the containers but show no evidence of being or having been root bound.
- K. Trees shall have straight trunks and all old abrasions and cuts shall be completely callused over. In no case shall trees be topped before delivery.
- L. Plants shall have been transplanted or root-pruned at least once in the 2 years. Plants shall not be pruned prior to delivery except as authorized by the Engineer

2.6 STAKING MATERIALS

- A. Stakes for supporting trees to be metal "T" fence posts.
- B. Guying kits for trees will be "Cable Guy" (Alpine Nursery 1-800-356-6633) #CG-4000 and CG-6800-T. Add extra hose where guy cable comes in contact with tree.
- C. Hose for covering wire shall be new or used black or green 2-ply fiber-bearing garden hose, not less than ½-inch inside diameter.

- D. Wire for tree bracing and guying shall be double strand pliable No. 10-gage galvanized steel wire or vinyl-coated steel wire.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The landscape work shall not be performed at any time when it may be subject to damage by climatic conditions.
- B. The Contractor shall carefully scale or otherwise verify all dimensions in the Contract Documents. Dimensions and plant locations shown shall be coordinated with Engineer and final location shall be site-oriented by the planter and Engineer. Any discrepancies or inconsistencies discovered shall be brought to the attention of the Engineer
- C. In case of conflict between the plant list totals and total plant count of the Contract Documents, the Contractor shall provide the higher number of plants.
- D. Delivery of materials may begin only after samples and tests have been approved by the Engineer. All materials furnished for the work shall be not less than the approved sample.
- E. Substitutions for the indicated plant materials may be permitted pursuant to the Contract Documents.
- F. The Contractor shall provide temporary fencing, barricades, covering, or other protections to preserve existing landscaping items indicated to remain and to protect the adjacent properties and other structures when they may be damaged by the landscape work.
- G. Waste materials shall be removed and disposed of off the Owner's property, unless otherwise indicated.
- H. It shall be the responsibility of the Contractor to avail itself of any information regarding utilities which are in the area of work and to prevent damage to the same. The Contractor shall provide protection to the utilities as necessary.
- I. Burning of combustible materials on the site shall not be permitted.
- J. The Contractor shall provide protection to structures, sidewalks, pavements, and other facilities in areas of work which are subject to damage during landscape work. Open excavations shall be provide with barricades and warning lights which conform to the requirements of governing authorities and the State's OSHA safety requirements from dusk to dawn each day and when needed for safety.
- K. Planting areas include all areas to be landscaped unless, specified or shown, otherwise.

3.2 SOIL PREPARATION

- A. The landscape work shall not begin until all other trades have repaired all areas of settlement, erosion, rutting, etc., and the soils have been re-established, recompactd, and refinished to finish grades. The Engineer shall be notified of all areas which prevent the landscape work from being executed.

- B. Areas requiring grading by the landscaper including adjacent transition areas shall be uniformly level or sloping between finish elevations to within 0.10-ft above or below required finish elevations.
- C. The landscape work shall not proceed until after walks, curbs, paving, edging, and irrigation systems are in place. The contract operations shall be completed to a point where the landscape areas will not be disturbed. The sub grade shall be cleaned free of waste materials of all kinds.
- D. During grading waste materials in the planting areas such as weeds, rocks (1 inches and larger) building materials, rubble, wires, cans, glass, lumber, sticks, etc., shall be removed from the site. Weeds shall be dug out by the roots.
- E. Fertilizers, additives, seed, peat, etc. subject to moisture damage shall be kept in a weatherproof storage place in such a manner that they will be kept dry.
- F. After removal of waste materials the planting areas sub grade shall be scarified and pulverized to a depth of not less than 6 inches and all surface irregularities below the cover of topsoil removed.
- G. Finish sub grade and topsoil placement and grading shall consist of:
 - 1. Prepare sub grade by rough grading and removing all irregularities and debris, then till and scarify subsoil to a depth of 6 inches before placing topsoil. Dig sub grade down as required in shrub beds for the placement of topsoil. Provide laser leveling on large flat areas to create a uniform level sub grade.
 - 2. Place 3 inches of topsoil over all lawn and irrigated grass seeding areas. Place 6 inches of topsoil in shrub beds unless shown or specified otherwise on plans. Sub grade soil shall be in a loosened and rough surface finish before topsoil is placed over sub grade. (Sub-grade surface shall not be smooth, but a rough surface shall exist for a transition zone of topsoil to subsoil.) If areas of sub grade become compacted before topsoil is placed, sub grade shall be tilled again before topsoil placement.
 - 3. Placing all soil additives and fertilizers for the areas as noted on the plan.
 - 4. Tilling planting area sub soils and top soils that are compacted.
 - 5. After tilling, bring areas to uniform grades by floating and/or hand raking. In large open level areas, perform laser leveling to create uniform level areas.
 - 6. Make minor adjustment of finish grades as directed by the landscape architect or owner.
 - 7. Remove waste materials over 1" in size such as stones, roots, or other undesirable foreign materials and finish raking, dishing, dragging, and smoothing soil ready for planting.
 - 8. No grading or soil placement shall be undertaken when soils are wet or frozen.
 - 9. Provide dust control measures at all times by wetting down the soil surface as required to prevent blowing dust.

- H. Any unusual subsoil condition that will require special treatment shall be reported to the Engineer
- I. Topsoil shall be uniformly distributed over all areas where required. Sub grade and topsoil shall be damp and free from frost.
- J. Surface drainage shall be provided as shown by molding the surfaces to facilitate the natural run-off of water. Low spots and pockets shall be filled with topsoil and graded to drain properly.
- K. Finish grade of all planting areas shall be 2 inches below finish grades of adjacent pavement of any kind.

3.3 DELIVERY, STORAGE, AND HANDLING OF PLANT MATERIALS

- A. No plants other than the required samples shall be dug or delivered to the site until the required inspections have been made and the plant samples are approved
- B. Plants shall not be pruned prior to delivery except upon approval by the Engineer
- C. Plant material shall be planted on the day of delivery if possible. The Contractor shall protect the stock in a temporary nursery at the project site where it shall be protected from sun and drying winds and shall be shaded, kept moist, and protected with damp soil, moss, or other acceptable material. Plants shall be planted within 2 days after delivery.
- D. All balled and burlapped plants which cannot be planted immediately in delivery shall be set on the ground and shall be well protected with soil, wet moss, or other acceptable material. Bare rooted plants, which cannot be planted immediately, shall be planted on heeled-in trenches immediately upon delivery. No material heeled-in more than one week may be used. Bundles of plants shall be opened and the plants separated before the roots are covered. Care shall be taken to prevent air pockets among the roots.
- E. During planting operations, bare roots shall be covered with canvas, wet straw, or other suitable materials. No plants shall be bound with wire or rope at any time so as to damage the bark or break branches.
- F. Plants shall not be picked up or moved by stem or branches, but shall be lifted the ball or container.
- F. Plants shall be lifted and handled from the bottom of the ball or container. Plants with balls cracked or broken before or during planting operations will not be accepted and shall be immediately removed from the site.

3.4 GENERAL SEEDING

- A. Weather Conditions: Fertilizing, seeding, or mulching operations will not be permitted when wind velocities exceed 5 miles per hour or when the ground is frozen, unduly wet, or otherwise not in a tillable conditions. Seeding shall not be conducted when temperatures exceed 80°F.
- B. Topsoil: Three inches of approved, imported, amended topsoil shall be placed in all areas delineated to be seeded with grass. Imported, amended topsoil shall be placed and raked smooth prior to seeding.

- C. Soil Preparation: The ground to be seeded shall be graded in conformance with the Drawings and shall be loose and reasonably free of large rocks, roots, and other material which will interfere with the work.
- D. Grass seed mix for lawn areas shall be similar to that used by Demille Turf Farm, which is located in Cedar City, Utah.

3.2 DRILL SEEDING, NON IRRIGATED SEEDING

- A. Drill seeding of the grass mixture shall occur from March 15 – May 15. The actual seeding period must be approved by the Engineer because weather conditions vary from year to year. No seed shall be conducted until approved.
- B. Only those areas that are too steep to drill may be broadcast or hydro-seeded.
- C. Seeding: Seed shall be uniformly drilled to an average depth of 1/4 to 1/2 inch at the rate specified using equipment having drills not more than 6-1/2 inches apart. Row markers shall be used with the drill seeder. Drill seeding shall take place 3 days after application of herbicide.
- D. Rolling: Immediately after seeding, the entire area shall be firmed with a roller not exceeding 90 pounds for each foot of roller width. Areas seeded with drills equipped with rollers shall not be rolled.
- E. Hydro mulch: Apply hydro mulch over the entire seeded area at a rate of 2000 pounds per acre as noted in the hydro seeding section.

3.3 HYDRO SEEDING

- A. Hydro seeding shall only be used in areas that are too steep for drill seeding.
- B. Hydro seeding shall occur before October 31 or after March 31. . The actual seeding period must be approved by the Engineer because weather conditions vary from year to year. No seeding shall be conducted until approved.
- C. Hydro mulch or slurry shall conform to the following:
 1. Apply specified seed at twice the listed rate with one half the seed to be applied to the prepared ground surface by broad casting. The remaining seed shall be mixed with the slurry mix.
 2. Echofiber or Conwed or approved equal wood fiber mulch, applied at a rate of 2000 pounds per acre.
 3. M-binder or Plantego tackifier, applied at a rate of 150 pounds per acre.
 4. 16-16-8 slow release fertilizer, applied at a rate of 150 pounds per acre
 5. Water at a rate of 4000 gallons per acre.
- D. Hydro mulch shall be applied using a hydro seeding equipment manufactured by Finn or Bowie or approved equal. Machines shall be equipped with heavy duty cast iron pumps and agitators capable of thoroughly mixing the slurry.
- E. Spray of hydro mulch shall begin immediately after the tank is full and the slurry components are mixed.

- F. Apply hydro mulch in a downward drilling motion using a fan stream nozzle. It is important to ensure that all of the components enter and mix with the topsoil.
- G. Only qualified and trained personnel shall perform hydroseeding to insure the uniformity of the hydro seeding application.
- H. Hydro mulch slurry less fertilizer and seed shall also be applied to areas that may be susceptible to erosion that were drill seeded.

3.4 TREE AND PLANT LOCATIONS

- A. The Contractor shall locate and stake all tree and shrub locations and have the locations approved by the Engineer before starting excavation for same. The plant locations shall be observed, and their locations shall be adjusted as directed by Engineer before final approval.
- B. No trees shall be located closer than 72 inches to structures unless otherwise shown. Ground covers and shrubs may be planted up to structures or curbs.

3.5 PLANT PITS

- A. Plant pits, centered on location stakes, shall be excavated circular pits with vertical sides and flat or saucer shape bottom in accordance with the following sizes unless shown
 - 1. Tree pits shall be at least 3 feet greater in diameter than the specific diameter of ball or spread of roots, and at depth of ball or roots.
 - 2. Shrubs shall be planted in pits or holes of soil the depth of ball below finished grade, or as much deeper as necessary to properly set the plant at finished grade. Shrubs with balls shall be planted in pits that are at least 12 inches greater in diameter than the bottom of ball.

3.6 PREPARED BACKFILL

- A. Tree and shrub pit backfilling soil shall consist of ½ existing soil from plant pit and ½ topsoil mixed.
- B. Tree and shrub pits shall be provided with fertilizer tablets as follows:
 - 1 per one-gallon can plant
 - 2 per 5-gallon can plant
 - 3 per 1.5" cal. tree

3.7 ROCKS OR UNDERGROUND OBSTRUCTIONS

- A. In the event that rock or underground obstructions are encountered in the excavation of plant pits, alternative locations shall be selected by the Engineer. Moving of trees to alternative locations shall not entail additional costs to the OWNER.

3.8 SETTING PLANT MATERIALS

- A. The soil shall not be worked when the moisture content is so great that excessive compaction will occur, nor when it is so dry that a dust will form in the air or that clods will

not break readily. Water shall be applied if necessary to provide ideal moisture for filling and for planting as herein specified.

- B. Plants shall be set in center of pits as shown in the Contract Documents. They shall be set plumb and straight, and at such a level that after settlement that the crown of the plant will be 2 inches above the finished grade.
- C. Balled and burlapped trees shall have planting soil placed and compacted around base of ball to fill all voids. All burlap ropes or wires shall be removed from the sides and tops of balls.
- D. All ground cover plants shall be evenly spaced, staggered in rows, and set at intervals specified, so as to produce a uniform effect. Plants shall be watered immediately after Planting operations have been completed.
- E. All shrubs and vines shall be pruned to remove damaged branches. All bare root shrubs shall be pruned and shaped to compensate for transplant root loss.
- F. Planting soil around roots or balls shall be thoroughly compacted and watered. After planting, the soil in the shrub beds shall be cultivated between shrubs, raked smooth, and neatly outlined. Muddy soil shall not be used for backfilling. All broken or frayed roots shall be properly cut off.
- G. Trees and shrubs on slopes steeper than 6 to 1 shall be provided with watering dams or berms at least 6 inches high and 8 inches wider than planting pit (hole) unless specified or shown otherwise.

3.11 MISCELLANEOUS ITEMS

- A. Concrete curbing shall be placed so that the top finish of curbing matches adjoining concrete curbs and walks. Curbing shall be straight and uniform both horizontal and vertically.
- B. Gravel mulch shall be placed in the landscape areas as noted on plans, spread carefully and evenly to a minimum depth as noted on plans. Gravel mulch to match existing gravel mulch used along park strip at Fall Oak Drive. Contractor to submit a sample of the gravel to Engineer for approval prior to installation.

3.12 6" MOW CURB

- A. Contractor to install in areas as shown on plans, separating gravel, asphalt and landscape area from turf/seed area.
- B. Contractor install as shown per manufacturers recommendations and specifications.
- C. Compact subgrade and soil under concrete curb to a minimum of 95%.
- D. Provide control joint at 10' O.C. and expansion joint at 30' O.C.
- E. Provide 1" radius per details. Concrete finish to be medium broom finish.

END OF SECTION

DIVISION 16

ELECTRICAL

C. Commercial Standards

ANSI C80.1	Zinc Coated, Rigid Steel Conduit, Specification for
ANSI C80.4	Fittings for Rigid Metal Conduit and Electrical Metallic Tubing, Specifications for
ANSI/UL 467	Grounding and Bonding Equipment, Safety Standard for
ASTM B 3	Soft or Annealed Copper Wire
ASTM B 8	Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, and Soft
ASTM B 33	Specification for Timed Soft or Annealed Cooper Wire for Electrical Purposes
ICEA S-61-402	Thermoplastic - Insulated Wire and Cable
ICEA S-68-516, NEMA WC8	Ethylene Propylene Rubber Insulated Wire and Cable
NEMA 250	Enclosures for Electrical Equipment (1,000 volts maximum)
NEMA PB-1	Panelboards
UL 6	Rigid Metal Electrical Conduit
UL 514	Electrical Outlet Boxes and Fittings

D. All equipment furnished by the CONTRACTOR shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated, (UL) or an independent testing laboratory acceptable to the local Code-enforcement agency having jurisdiction.

E. The construction and installation of all electrical equipment and materials shall comply with all applicable provisions of the OSHA Safety and Health Standards (29CFR1910 and 29CFR1926, as applicable), State Building Standards, and applicable local codes and regulations.

1.3 PERMITS AND INSPECTION

Permits shall be obtained and inspection fees shall be paid for as indicated in in Article 6.06 of the General Conditions.

1.4 CONTRACTOR SUBMITTALS

A. Shop Drawings and Catalog Data: Submit shop drawings and catalog data submittals in accordance with Section 01300 - Contractor Submittals.

B. Submit complete material lists for the Work of this Section. Such lists shall state manufacturer and brand name of each item or class of material. Submit shop drawings for all grounding work not specifically indicated.

- C. Shop drawings are required for materials and equipment listed in other sections. Shop drawings shall provide sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications. The following shall be included:
1. Front, side, rear elevations and top views with dimensional data.
 2. Location of conduit entrances and access plates.
 3. Component data.
 4. Connection diagrams, terminal numbers, wire numbers, internal wiring diagrams, conductor size, and cable numbers.
 5. Method of anchoring, seismic requirement; weight.
 6. Types of materials and finish.
 7. Nameplates.
 8. Temperature limitations, as applicable.
 9. Voltage requirement, as applicable.
 10. Front and rear access requirements.
- D. Catalog data shall be submitted to supplement all shop drawings. Catalog cuts, bulletins, brochures, or the like or photocopies of applicable pages thereof shall be submitted for mass produced, noncustom manufactured material. These catalog data sheets shall be stamped to indicate the project name, applicable Specification section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the stamp.
- E. Materials and Equipment Schedules: Furnish within 30 days, a complete list of all materials, equipment, apparatus, and fixtures proposed for use. The list shall include type, sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.
- F. O&M Manuals: Furnish manuals as part of the shop drawing submittals under "Operation and Maintenance Manuals" in Section 01300 - Contractor Submittals.
- G. Record Drawings: In addition to the record drawings as a part of the record drawing requirements specified in Section 01300 – Contractor Submittals, show depths and routing of all duct bank concealed below grade electrical installations. Said set of record drawings shall be available to the ENGINEER during construction. After final inspection, transfer all record drawing information using a red pen to a set of **reproducible tracings** which shall then be delivered to the ENGINEER. In addition, the record drawings shall show all variations between the Work as actually constructed and as originally shown on the Drawings, based upon information supplied by the CONTRACTOR.

1.5 QUALITY ASSURANCE

- A. Field Control of Location and Arrangement: The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. Determine exact locations in the field based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Locations shown on the Drawings, however, shall be adhered to as closely as possible.
- B. All conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms, as shown. Where the Drawings do not indicate exact locations, such locations shall be obtained from the ENGINEER. Where equipment is installed without instruction and must be moved, it shall be moved without additional cost to the OWNER.

- C. Workmanship: All materials and equipment shall be installed in accordance with printed recommendations of the manufacturer which have been reviewed by the ENGINEER. The installation shall be accomplished by workmen skilled in this type of work and installation shall be coordinated in the field with other trades so that interferences are avoided.
- D. All Work, including installation, connection, calibration, testing, adjustment, and paint touchup, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The completed installation shall display competent work, reflecting adherence to prevailing industrial standards and methods.
- E. Protection of Equipment and Materials: Furnish adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the Work and until acceptable by the ENGINEER.
- F. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry.
- G. Replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of panels and switchboard sections, at no expense to the OWNER.
- H. Tests: Perform all tests required by the ENGINEER or other authorities having jurisdictions. All such tests shall be performed in the presence of the ENGINEER. Furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation. The following testing shall be accomplished:
 - 1. Insulation resistance tests under "Wire and Cable," below.
 - 2. Operational testing of all equipment furnished and/or connected in other Sections of Division 16, including furnishing of support labor for testing.
- I. Standard test reports for mass-produced equipment shall be submitted along with the shop drawing for such equipment. Test reports on testing specifically required for individual pieces of equipment shall be submitted for review prior to final acceptance of the project.
- J. Any test failure shall be corrected in accordance with the industry practices and in a manner satisfactory to the ENGINEER.

1.6 AREA DESIGNATIONS

- A. General: For purposes of delineating electrical enclosure and electrical installation requirements of this project, certain areas have been classified in the Contract Documents as defined below. Electrical installations within these areas shall conform to the referenced code requirements for the area involved.
- B. General Purpose Indoor Locations: Electrical work installed in areas which are not otherwise specifically classified shall be "General Purpose." Workmanship and enclosures shall comply with the general requirements of these Specifications. Electrical enclosures shall be NEMA Type 12.
- C. Outdoor and Damp Locations: In outdoor locations, raceway shall be rigid galvanized steel (GRS) conduit; entrances shall be threaded; and fittings shall have gasketed covers. Provisions shall be made to drain the fitting or conduit system. Threaded fastening hardware shall be

stainless steel. Raceway supports such as hanger rods, clamps, and brackets shall be galvanized. Attachments or welded assemblies shall be galvanized after fabrication. Instruments and control cabinets, and panel enclosures shall be NEMA Type 4X. Switchboard and motor control centers shall be weatherproof NEMA Type 3R. Enclosures shall be mounted 1 inch from walls to provide an air space. Locations which are indoors and 2 feet below grade elevation or which are classified as damp locations on the Drawings shall have electrical installations which conform to the requirements for outdoor locations. "Damp locations" shall include pipe galleries, tunnels, vaults, and basements. All rooms housing liquid handling equipment are also classified as damp locations regardless of grade elevation.

- D. Vaults with forced air ventilation are not considered "damp locations". NEMA Type 12 panels will be required in these areas
- E. Splash Locations: Areas shown as splashproof shall have electrical installations as described for
- F. "outdoor locations."

1.7 CLEANUP

- A. In addition to the requirements of "Cleanup" in Section 01700 - Project Closeout, all parts of the materials and equipment shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. All oil and grease spots shall be removed with a nonflammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Paint touchup shall be applied to all scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum cleaned before final acceptance.
- B. During the progress of the Work, clean the premises and leave the premises and all portions of the site free of debris.

1.8 DEMOLITION AND RELATED WORK

- A. The CONTRACTOR shall perform all electrical demolition work as indicated.
 - 1. Electrical equipment and components, terminal and relay cabinets, MCCs, shall be returned to the OWNER in an orderly fashion to a designated location on the site.
 - 2. Wire, conduit, junction boxes, fittings, supports and miscellaneous hardware removed a part of the demolition work shall not be reused and shall be returned to the OWNER for their salvage use.
 - 3. Wires and/or conduits which need to be extended shall be terminated in a new terminal box with terminal strips. Terminal box shall be properly sized by the CONTRACTOR unless specified on drawings. Wires and terminals shall be properly identified before disconnection and after reconnection.
 - 4. Wiring in conduits located in or under slabs shall be removed. The conduit shall be plugged level with the floor where practical. In other cases, the conduit shall be cut three inches below the finished floor and the area shall be resurfaced.
 - 5. Openings in walls and platforms created by the removal of conduit or electrical equipment shall be patched with materials similar to those in surrounding work areas or as required to provide proper sealed conditions as reviewed and accepted by the ENGINEER.
 - 6. Electrical demolition works shall be as shown on the Drawings or as required by the Specifications.
 - 7. Exercise due care in the removal of the equipment made surplus by this project so as not to impair its resale value or reuse. The OWNER has the right to salvage any wire or other electrical equipment removed from the project.

8. Contractor shall be responsible for properly disposing of all electrical demolition materials, except those items to be salvaged to the OWNER as directed by the ENGINEER.

B. Installation of New Equipment in Existing Structures

1. Certain new equipment and devices' installation are required in existing structures. Under this phase of the Work the CONTRACTOR shall be required to remove existing equipment or devices, install new equipment as indicated, remove existing conductors from existing raceway, and pull new conductors in existing raceway, reconnect existing conductors or furnish and install new conduit and wires.
2. Visit the site before bidding and carefully examine existing installation so that its proposal will reflect all the Work necessary to provide a complete installation so that the resulting installation will function as required. Include in the bid price all costs of labor and materials necessary to complete installations.

C. Installation of Temporary Equipment

1. To facilitate continuous operation of existing equipment, provide temporary equipment indicated. Submit installation and connection details for review and acceptance. All costs associated with these temporary installations shall be part of the original Bid Documents, and without additional cost to the OWNER.
2. All cables, conduits, and fittings used in temporary connections shall not be reused to install permanent connections. Return the salvage items to the OWNER.

D. Plant Monitoring Power and Control Shutdowns

1. Continuance of plant operation during this demolition and expansion process is important. Therefore, carefully examine all Work to be done in, on, or adjacent to existing equipment. Work shall be scheduled, subject to OWNER'S approval, to minimize required plant shutdown time. Submit a written request, including sequence and duration of activities to be performed during plant shutdown.
2. Perform all switching and safety tagging required for plant shutdown or to isolate existing equipment. In no case shall the CONTRACTOR begin any Work in, on, or adjacent to existing equipment without written authorization.

E. Modifications to Existing Electrical Facilities

1. Provide all modifications or alterations to existing electrical facilities required to successfully install and integrate the new electrical equipment. All modifications to existing equipment, panels, or cabinets shall be made in a professional manner with all coatings repaired to match existing. The total costs for all modifications to existing electrical facilities required for a complete and operating system shall be included in the original bid amount and no additional payment for this Work shall be authorized. Extreme caution shall be exercised in digging trenches in order not to damage existing underground utilities. Cost of repairs of damages caused during construction shall be the CONTRACTOR's responsibility.
2. The CONTRACTOR shall be responsible for verifying all available existing circuit breakers in lighting panels for their intended use as required by the Drawings. It shall also be responsible for verifying the available space in substation switchboards to integrate new power circuit breakers. Expenses in time for all of this Work shall be included in the original bid amount.

PART 2 – PRODUCTS

2.1 GENERAL

- A. All equipment and materials shall be new, shall be listed by UL, and shall bear the UL label, where UL requirements apply. All equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the project shall be products of the same manufacturer. All equipment and materials shall be of industrial grade and standard of construction; shall be of sturdy design and manufacture; and shall be capable of reliable, trouble-free service.

2.2 GROUNDING

- A. General: All components of the grounding electrode system shall be manufactured in accordance with UL 467 and shall conform to the applicable requirements of National Electrical Code Article 250.
- B. Grounding cable shall be copper. Bare copper wire shall be annealed, No. 8 AWG minimum, if not called out in the Drawings.
- C. Ground rods shall conform to ANSI/UL 467 and shall be ¾-inch diameter copper-clad steel, sectional type, joined by threaded copper alloy couplings.
 - 1. Grounding connectors shall be high-strength copper alloy suitable for direct burial.
 - 2. Wire connections shall be exothermic weld by Cadweld of Erico Products.
 - 3. Manufacturers of grounding materials shall be Copperweld, Blackburn, Burndy, or equal.

2.3 UNDERGROUND DUCTS AND MANHOLES

- A. General: Where an underground distribution system is required, it shall be comprised of multiple runs of single bore nonmetallic ducts, with underground manholes and pullboxes. When nonmetallic ducts are required, they shall be rigid Schedule 40 PVC for concrete encasement.
 - 1. Manholes and pullboxes shall be of precast concrete. Concrete construction shall be designed for traffic loading.
- B. Covers shall be traffic type, except as shown otherwise. Manholes and pullbox covers designated as "HV" covers shall be identified as "High Voltage Electric," "P" shall be identified as "Secondary Electric," "C" as "Control" and "S" as "Signal." All covers shall be watertight after installation.
- C. Manholes and pullboxes shall be equipped with pulling-in irons opposite and below each ductway entrance.
- D. Manholes shall have concrete covers with 30--inch diameters lids. All covers and lids shall be bolted to cast-in-place steel frames with corrosion resistant hardware. Frames shall be factory-primed; covers shall be cast-iron and shall have pick holes or lifting handles.
 - 1. Manholes and pullboxes shall have cable supports so that each cable is supported at 3-foot intervals within the manhole or pullbox. Cable supports and racks shall be fastened with galvanized bolts and shall be fabricated of fiberglass or galvanized steel. Porcelain insulators for cable racks shall be provided.
 - 2. Manholes and pullboxes shall be Brooks, Quikset, U.S. Precast, or equal.

- E. The concrete envelope shall have a compression strength of 4,000 psi in accordance with the Specifications.

2.4 RACEWAYS

- A. General: Raceway shall be manufactured in accordance with UL and ANSI standards and shall bear UL label as applicable.
- B. Galvanized Rigid Steel (GRS) Conduit
 - 1. Rigid steel conduits and fittings shall be full weight, mild steel, hot-dip galvanized and zinc bichromate coated inside and outside after galvanizing.
 - 2. Rigid steel conduit shall be manufactured in accordance with UL Standard No. 6 and ANSI 80-1.
 - 3. Rigid steel conduit shall be manufactured by Triangle PWC, Republic Steel, or equal.
- C. Rigid nonmetallic conduit shall be Schedule 40 PVC.
 - 1. Nonmetallic conduits and fittings shall be UL listed, sunlight-resistant, and rated for use with 90 degrees C conductors.
 - 2. Nonmetallic conduits and fittings shall be manufactured by Carlon, Condux, or equal.
- D. Flexible metallic conduit shall be fabricated from galvanized interlocked steel strip. Liquid-tight flexible metallic conduit shall have an extruded PVC covering over the flexible steel conduit. For conduit sizes 3/4 inch through 1-1/4 inches, flexible conduits shall have continuous built in copper ground conductor. Flexible conduit shall be American Brass, Anaconda, Electroflex, or equal.
- E. PVC-coated raceway system shall conform to Federal Specification WW-C-581E, ANSI C80.1, and to Underwriter's Laboratories specifications.
 - 1. The zinc surfaces of the conduits and fittings shall remain intact and undisturbed on both the inside and the outside of the conduit through the preparation and application processing.
 - 2. A PVC coating shall be bonded to the galvanized outer surface of the conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic.
 - 3. The thickness of the PVC coating shall be a minimum of 40 mils.
 - 4. A PVC jacketed coupling shall be furnished with each length of conduit. A PVC sleeve equal to the OD of the conduit shall extend 1-1/2 inches from each end of coupling.
 - 5. PVC-coated conduits shall be as manufactured by Robroy, Occidental (OCCAL), or equal.

2.5 WIRE AND CABLE

- A. General: All conductors, including ground conductors, shall be copper. Insulation shall bear UL label and the manufacturer's trademark, type, voltage and temperature rating, and conductor size. Wire and cable shall be products of American, BICC/General, Rome Cable, Okonite, or equal.
- B. Control Cables: All control cables shall be rated for 600 volts and shall meet the following requirements:
 - 1. Control wires shall consist of No. 14 gage stranded copper conductors and shall be XHHW rated for 90 degrees C at dry locations and 75 degrees C at wet locations.
 - 2. Control wires at panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations.

- C. Instrumentation Cables: Shielded instrumentation cables shall be rated at 600 volts and shall comply with the following requirements:
1. Individual shielded cable shall consist of twisted 2 or 3 No. 16 gage, stranded, color coded, tinned-coated copper in accordance with ASTM B 33 - Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes and B 8 - Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, and Soft. Color coding shall be black-clear, or black-red-clear.
 2. Insulation thickness shall be 32 mils of polyethylene, insulated with 2.3 mils 100 percent aluminum foil/polyester shield and No. 18 stranded tinned copper drain wire, all under a 32 mil PVC jacket. The shield shall be continuous and shall be grounded only at the receiving end, or as indicated.
 3. Multi-individual shielded pair or triad instrumentation cable shall consist of individual shielded and twisted pair copper conductors with an ethylene-propylene insulation, and No. 18 AWG tinned stranded copper drain wire, an overall aluminum mylar shield and an overall chloro-sulfonated polyethylene compound jacket. The cables shall be suitable for cable tray installation and shall be flame retardant.
- D. Building Wire and Cable: Building wires and cables shall be rated at 600 volts and shall meet the following requirements:
1. Building wire shall be single conductor copper cable listed by UL as Type THHWN rated for wet locations.
 2. Building wire; **all conductors** shall be stranded.
 3. No wire smaller than No. 12 AWG shall be used unless specifically indicated.
- E. Cable Terminations: Cable terminations shall be in accordance with the following:
1. Compression connectors shall be Burndy "Hi Lug", Thomas & Betts "Shure Stake", or equal. Threaded connectors shall be split bolt type of high strength copper alloy.
 2. Spring connectors (wire nuts) shall be 3M "Scotch Lok," "Ideal Wing Nuts", or equal.
 3. Preinsulated fork tongue lugs shall be "Thomas & Betts" RC Series, Burndy, or equal.
 4. General purpose insulating tape shall be Scotch No. 33, Plymouth "Slip-knot", or equal. High temperature tape shall be polyvinyl by Plymouth, 3M, or equal.
 5. Epoxy resin splicing kits shall be 3M Scotchcoat 82 Series, Burndy Hy Seal, or equal.
 6. Stress cone material for makeup of medium voltage shielded cable shall be by 3M- No substitutions.
 7. Motor load termination kits shall be 3M.

2.6 PULL AND JUNCTION BOXES

- A. Outlet, switch, pull and junction boxes for flush-mounting in general purpose locations shall be one-piece, galvanized, pressed steel. Ceiling boxes for flush-mounting in concrete shall be galvanized, pressed steel.
- B. Outlet, switch, pull and junction boxes where surface mounted in exposed locations shall be cast ferrous boxes with mounting lugs, zinc or cadmium plating, and enamel finish. Surface mounted boxes in concealed locations may be pressed steel.
- C. Control station, pull and junction boxes, including covers, for installation in corrosive locations shall meet the NEMA 4X requirements and shall be stainless steel or fiber glass-reinforced polyester and shall be furnished with mounting lugs.

- D. All cast boxes and pressed steel boxes for flush mounting in concrete shall be fitted with cast, malleable box covers and gaskets. Covers for pressed steel boxes shall be one-piece pressed steel, cadmium plated, except that boxes for installation in plastered areas and finished rooms shall be stainless steel over plaster rings. Stainless steel plates shall be Sierra S-line, Hubbell, or equal. Cast boxes shall be as manufactured by Crouse-Hinds, Appleton, or equal.

2.7 CONDUIT FITTINGS

- A. General: Fittings shall comply with the same requirements as the raceway with which they will be used. Fittings having a volume less than 100 cubic inches for use with rigid steel conduit, shall be cast or malleable nonferrous metal. Such fittings larger than one inch shall be "mogul size." Fittings shall be of the gland ring compression type. Covers of fittings, unless in "dry" locations, shall be closed with gaskets. Surface-mounted cast fittings, housing wiring devices in outdoor and damp locations, shall have mounting lugs.
- B. Insulated bushings shall be molded plastic or malleable iron with insulating ring, similar to O-Z Type A and B, equivalent types by Thomas & Betts, Steel City, Appleton, O-Z/Gedney, or equal.
- C. Insulated grounding bushings shall be malleable iron with insulating ring and with ground lug, - by T & B, - no substitutions.
- D. Crouse Hinds UNF or UNY unions shall be used at all points of union between ends of rigid steel conduits which cannot be coupled. Running threads and threadless couplings shall not be used.
- E. Liquid-tight fittings shall be - manufactured by T & B, no substitutions.
- F. Hubs for threaded attachment of steel conduit to sheet metal enclosures shall be similar to Appleton Type HUB, equivalent types such as manufactured by T & B, Myers Scrutite, or equal.
- G. Transition fittings to mate steel to PVC conduit, and PVC access fitting, shall be as furnished or recommended by the manufacturer of the PVC conduit.
- H. Conduit sealant shall be Chico, or equal.
- I. Expansion fittings shall be installed wherever a raceway crosses a structural expansion joint. Such fittings shall be expansion and deflection type and shall accommodate lateral and transverse movement. Fittings shall be O-Z/Gedney Type "DX," Crouse Hinds "XD," or equal. These fittings are required in metallic and nonmetallic raceway installations. When the installation is in a nonmetallic run, a 3-foot length of rigid conduit shall be used to connect the nonmetallic conduit to the fitting.

2.8 WIRING DEVICES

- A. All wiring devices shall be a product of a single manufacturer and shall conform to applicable NEMA Standards for UO series. Devices shall be as manufactured by Hubbell, Sierra, Pass & Seymour, or equal. General purpose duplex receptacles and toggle switch handles shall be brown everywhere except in finished rooms, where they shall be ivory. Special purpose receptacles shall have a body color as shown. Receptacles and switches shall conform to Federal Specifications W-C-596E and W-S-896E, respectively.
 - 1. Receptacles
General purpose duplex receptacles shall be grounding type, 125-volt, ac, 20-amperes, **backwired** NEMA Configuration 5-20R, such as Hubbell **5362**, or equal.

- a. Convenience receptacles for installation in outdoor and corrosive areas shall be NEMA 5-20R configured and shall have stainless steel or nickel plated parts and plastic parts of Melanine.
 - 1) Receptacles at outdoor locations shall be UL-approved for weatherproof locations with plug inserted. These shall be Crouse-Hinds, Hubbell, Pin and Sleeve Series, or equal.
 - 2) Receptacles at damp or dry locations shall be Crouse-Hinds DS 23G, Pyle National N-1, or equal.
 - 3) Receptacles at corrosive locations shall be Hubbell 52CM62 15 ampere, 53CM62 20 ampere, or equal.
 - b. Ground fault interrupter (GFI) receptacles shall be NEMA 5-20R configured and shall mount in a standard outlet box. Units shall trip at 5 milliamperes of ground current and shall comply with NEMA WD-1-1.10 and UL 943. GFI receptacles shall be capable of individual as well as "downstream" operation. GFI receptacles shall be Hubbell GF 5252, or equal.
2. Switches
- a. Switches at outdoor locations shall be Crouse-Hinds DS 128, Mackworth Rees Style 3845, Joy Flexitite, or equal.
 - b. Switches at damp locations shall be Mackworth Rees Style 3496, Joy Flexitite, or equal.
 - c. Switches at dry locations shall be Crouse-Hinds DS 32G, Pyle National SCT-10k, or equal.
 - d. Toggle switches shall be **suitable for backwiring** and shall conform to the following table, or equal:

	Hubbell No.	Bryant No.	Hubbell No.	Bryant No.
Single Pole	1221 (ivory)	4901 (ivory)	1221I (ivory)	4901I (ivory)
Three Way	1223	4903	1223I	4903I
Momentary	1556	4821	1556I	4821I
Four Way	1224		1224I	

2.9 CABINETS AND ENCLOSURES

- A. General: All electrical cabinets and enclosures housing control relays and terminal blocks shall be manufactured in accordance with NEMA Publications 250, UL Standards 50 and 508.
 - 1. Relay or control, and terminal cabinets shall be NEMA 4 enclosures. Sizes shown on the Drawings are minimum. Provide sufficient terminal blocks to terminate 25 percent more conductors than are shown. Interiors of cabinets shall be finished white including internal back mounting plate.
 - 2. Floor standing NEMA 12 construction shall have three-point latching mechanism operated by oiltight key-locking handle, and shall have gasketed overlapping doors. Steel construction shall be 12-gauge; construction for wall-mounted type shall be 14-gauge steel. Exterior finish shall be ANSI 61 light gray, or equal.
- B. Wiring of terminal cabinets, control or relay cabinets shall be accomplished with stranded copper conductor rated for 600-volts and UL listed as Type MTW. Wires for annunciator and indication circuits shall be No. 16 AWG. All others shall be No. 14 AWG. Color coding shall be as specified elsewhere in this Section. Incoming wires to terminal or relay cabinets shall be terminated on a master set of terminal blocks. All wiring from the master terminals to internal components shall be factory-installed and shall be contained in [2] [4]-inch wide by [2] [4]-inch high plastic wireways having removable covers. Wiring to door-mounted devices shall be extra flexible and anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals.

- C. All terminal block requirements shall be as manufactured by WAGO with cage clamp, Phoenix, or equal.
- D. Engraving shall be as shown or as directed by the ENGINEER. Characters shall be uniform block style not smaller than 1/8-inch. Nameplates shall be secured using cadmium plated steel or other corrosion resistant screws. Adhesive alone is not acceptable.
- E. Each relay or control and terminal cabinets shall be completed, assembled, wired, and tested at the factory. Test shall be in accordance with the latest UL and NEMA Standards. All cabinets shall bear UL label, as applicable.

2.10 DISCONNECT SWITCHES

- A. Unfused and fused disconnect switches shall be externally operated with quick-make/quick-break mechanisms. The handle shall be interlocked with the switch cover by means of a defeatable interlock device. The switch shall be padlockable in the "off" position. Switches shall have nameplates stating manufacturer, rating, and catalog number. Heavy-duty switches shall have arc suppressors, pin hinges, and shall be horsepower rated at 600-volts. All switches rated at 100 amperes or larger shall have auxiliary contact for remote status indication. Heavy-duty switches shall be provided for all motor circuits above 3 horsepower. In smaller motor circuits switches shall be general duty.
- B. Switch rating shall match the horsepower requirements of the load at the particular voltage if not otherwise shown.
- C. Switch enclosure shall be NEMA 1 and shall be as manufactured by Square D, Cutler-Hammer, or equal.

2.11 ELECTRICAL IDENTIFICATION

- A. Nameplates: Nameplates shall be fabricated from white-letter, black-face laminated plastic engraving stock, Formica type ES-1, or equal. Each shall be fastened securely, using fasteners of brass, cadmium plated steel, or stainless steel, screwed into inserts or tapped holes, as required. Engraved characters shall be block style of adequate size to be read easily at a distance of 6 feet with no characters smaller than 1/8-inch high.
- B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices such as manufactured by Brady, Thomas & Betts, or equal, or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place, or equal.
- C. Identification Tape: Identification tape for protection of buried electrical installation shall be a 6-inch wide red polyethylene tape imprinted "CAUTION – ELECTRIC UTILITIES BELOW."

2.12 LIGHTING AND POWER PANELBOARDS

- A. General: Panelboards shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1 as well as the provisions of UL 50 and 67. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for 120/208-volt 3-phase operation or 120/240-volt for single phase operation as shown. Power panelboards shall be rated for 600 volts, 3-phase operation.

1. Interiors shall have solderless, anti-turn connectors and shall be constructed so that branch circuit breaker can be replaced without disturbing adjacent units or resorting to field drilling and tapping. Bus bars and connecting drops shall be copper. Neutral bar shall be full-sized and shall have one terminal screw for each branch circuit; main bus bar shall be full-sized for entire length. Spaces shown shall have cross connections for the maximum sized device that can be fitted.
2. Panelboard box shall be galvanized code grade steel with knockouts, and shall have removable end walls. All boxes or panelboard enclosures shall have gray baked enamel finish.
3. All circuit breakers shall be bolt-in type.

B. Lighting Panelboards

1. Cabinets for building panels shall be 20-inch wide minimum, with 4-inch minimum side gutters and 5-inch minimum top and bottom gutters. Panelboard trim shall be the same size as cabinet on surface-mounted panels and 3/4-inch larger all around than cabinet of flush-mounted panels. Doors in trim shall have typed circuit directory and pocket with protective clear plastic sheet. All trim and cabinets of surface-mounted panels in general purpose areas shall be phosphate treated, primed and finished with baked enamel, panels of flush mounted panels shall be finished to match surrounding wall color.
2. The number of circuit breakers and the ampere ratings shall be in accordance with panel schedules. Main circuit breaker or main lugs only shall be provided as indicated. The panelboard circuit breakers shall be group mounted and shall be molded case with 3- or 2-pole main breakers as required and branch circuit breakers with 10,000 AIC.
3. Surface mounted cabinets and trim in wet and damp areas shall be galvanized. Provide control enclosures under common panel trim. All panelboard doors shall be keyed alike.

2.13 PROCESS CONTROL DEVICES

- A. Liquid Level Control: Liquid level controls shall be as indicated. Level settings shall be determined by Design ENGINEER and received from the ENGINEER.
1. High level flood switches shall be as shown on the drawings.

2.14 CONTROL STATIONS

- A. Control stations shall comply with NEMA Standards ICS2-216. All control stations shall be industrial type, heavy duty, oil-tight, with legend plates.
- B. Control stations shall be as follows:
1. Pushbutton Switch: Pushbutton switches shall be momentary type with round or square button plate. All emergency-stop pushbuttons shall have red button plates. Lock-out stop shall be momentary pushbutton with locking mechanism.
 2. Selector Switches: Selector switches shall be rated 10 amperes at 600 volts and shall be rotary type with number of position and poles as indicated.
 3. Indicating Lights: Pilot lights shall be full-voltage, push to test type and with plastic color caps: red color for running, green for ready, white for power status, and amber for failure status.
 4. Control station enclosures shall be stainless steel, NEMA 4X in corrosive, outdoor, below grade, or wet areas.
- C. Manufacturers shall be Square D with Class 9001, or equal.

PART 3 – EXECUTION

3.1 GROUNDING

- A. General: Grounding cable shall be sized in accordance with code requirements when sizes are not indicated on the Drawings.
- B. Equipment Ground: Ground continuity throughout the facility shall be maintained by installing a grounding conductor in all raceways.
 - 1. Metallic raceway shall be installed with double lock nuts or hubs at enclosures. Nonmetallic raceway containing dc conductors operating at more than 50 volts to ground, or any ac conductors, shall contain a copper-grounding conductor either bare, or green if insulated. Such conductor shall be bonded to terminal and intermediate metallic enclosures.
 - 2. Metal equipment platforms which support any electrical equipment shall be bonded to the nearest ground bus or to the nearest switchgear ground bus. This grounding requirement is in addition to the raceway grounding required in the preceding paragraph herein.
- C. Grounding Electrode System: Install the grounding electrode system with all required components in accordance with National Electrical Code Article 250.
 - 1. Connection to ground electrodes and ground conductors shall be exothermic welded where concealed and shall be bolted pressure type where exposed. Bolted connectors shall be assembled wrench-tight.
 - 2. Insulated grounding bushings shall be employed for all grounding connections to steel conduits in switchboards, in motor control centers, in pullboxes, and elsewhere where conduits do not terminate at a hub or a sheet metal enclosure. Where insulated bushings are required, they shall be installed in addition to double lock-nuts.
 - 3. Copper bonding jumpers shall be used to obtain a continuous metallic ground.
- D. Shield Grounding
 - 1. Shielded power cable shall have its shield grounded at each termination in a manner recommended by the cable manufacturer.
 - 2. Shielded instrumentation cable shall be grounded at one end only; this shall be at the RTU or otherwise at the "receiving" end of the signal carried by the cable, unless shop drawings indicate that the shield shall be grounded at both ends.
 - 3. Termination of each shield drain wire shall be on its own terminal screw. All of these terminal screws in one rack shall be jumpered with No. 16 solid tinned bare copper wire; connection to ground shall be accomplished with a No. 12 green insulated conductor to the main ground bus.

3.2 UNDERGROUND DUCTS AND MANHOLES

- A. The underground duct bank shall be installed in accordance with the criteria below:
 - 1. Duct shall be assembled using high impact nonmetallic spacers and saddles to provide conduits with vertical and horizontal separation. Plastic spacers shall be set every 5 feet.
 - 2. The duct shall be laid on a grade line of at least 4 inches per 100 feet, sloping towards pullboxes or manholes. Duct shall be installed and pullbox and manhole depths adjusted so that the top of the duct is a minimum of 24 inches below grade.
 - 3. Changes in direction of the duct envelope by more than 10 degrees horizontally or vertically shall be accomplished using bends with a minimum radius 24 times the duct diameter.

4. Couplings shall be staggered at least 6 inches vertically. Bottom of trench shall be of select backfill or sand. The duct array shall be anchored every 4 feet to prevent movement during placement of backfill.
 5. Each bore of the completed duct bank shall be cleaned by drawing through it a standard flexible mandrel one foot long and 1/4-inch smaller than the nominal size of the duct through which the mandrel will be drawn. After passing of the mandrel, draw a wire brush and swab through.
 6. A raceway, in the duct envelope, which does not require conductors, shall have a 1/8-inch polypropylene pull cord installed throughout the entire length of the raceway.
- B. Duct entrances shall be grouted smooth; duct for primary and secondary cables shall be terminated with flush end bells. Sections of pre-fabricated manholes and pullboxes shall be assembled with waterproof mastic and shall be set on a 6-inch bed of gravel as recommended by the manufacturer or as required by field conditions.
 - C. Duct bank markers shall be installed every 200 feet along run of duct bank, at changes in horizontal direction of duct bank, and at ends of duct bank. Concrete markers, 6 by 6 inches square and one-foot long, shall be set 2 inches above finish grade. The letter "D" and arrow set in the concrete shall be facing in the direction of the duct alignment.
 - D. Each duct bank shall contain a No. 4/0 bare stranded copper ground wire, continuous throughout the entire duct bank. End of ground wires shall be terminated at switchgear or MCC ground bus, or transformer ground lugs.
 - E. Duct bank penetration through walls of manholes or pullboxes, and on building walls below grade shall be watertight.
 - F. Trenches containing duct banks shall be filled with select backfill with no large rocks which could damage the duct.
 - G. Concrete encased duct bank shall terminate at building foundations. When duct enters the building on a concrete slab on grade, duct shall not be encased, but shall transition to rigid steel PVC-coated conduits on all stub-ups.

3.3 RACEWAYS

- A. General: Raceways shall be installed as indicated, however, conduit routings shown are diagrammatic. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, and shall be accomplished with tools designed for the purpose intended. Factory elbows shall be used for all 3/4-inch conduit. Bends in larger sizes of metallic conduit shall be accomplished by field bending or by the use of factory elbows. All installations shall be in accordance with the latest edition of the National Electrical Code.
- B. Raceways shall be installed in accordance with the following schedule:
 1. Low Voltage Raceway (control and power):
 - a. Rigid Schedule 40 PVC shall be used for concrete encased duct on earth.
 - b. Galvanized rigid steel (GRS) shall be used on exposed installations in general purpose areas.
 - c. Galvanized rigid steel shall be used for conduits embedded in concrete slab on grade and above grade.
 - d. Schedule 40 PVC shall be used for fiber optic data hi-way system concrete encased on grade.
 - e. Galvanized rigid steel shall be used in exposed installations in outdoor areas.

2. Analog Signal Raceways
 - a. Galvanized rigid steel conduits shall be used for concrete encased duct on earth.
 - b. Galvanized rigid steel conduits shall be used on exposed installations in general purpose areas.
 - c. Galvanized rigid steel shall be used on exposed installations in outdoor areas.
3. Exposed Raceways
 - a. Conduits shall be rigidly supported with clamps, hangers, and Unistrut channels.
 - b. Intervals between supports shall be in accordance with the National Electric Code.
4. All underground elbows shall be GRS (coated or wrapped).

C. Conduit Terminations

1. Empty conduit terminations not in manholes or pullboxes shall be plugged. Exposed raceway shall be installed perpendicular or parallel to buildings except where otherwise indicated. Conduit shall be terminated with flush couplings at exposed concrete surfaces. Conduit stubbed up for floor-standing equipment shall be placed in accordance with approved shop drawings. Metallic raceways installed below-grade or in outdoor locations and in concrete shall be made up with a conductive waterproof compound applied to threaded joints. Compound shall be Zinc Clads Primer Coatings No B69A45, HTL-4 by Crouse-Hinds, Kopr Shield by Thomas & Betts, or equal.
2. Both rigid and flexible conduit shall be sealed against water at each entrance to enclosures. Unless indicated otherwise, rigid and flexible conduit shall enter panels through the top, shall continue down from the top to the bottom, and shall turn upward at the bottom.

D. Conduit Installations

1. Conduit may be cast integral with horizontal and vertical concrete slabs, providing one-inch clearance is maintained between conduit surface and concrete surface. If said clearance cannot be maintained, the conduit shall be installed exposed below elevated slabs; provided, that in the case of slabs on grade, conduit shall be installed below the slab and shall be encased with a minimum cover of 3 inches of concrete. Maximum size of conduit that can be cast in slab above grade shall be 3 inches, in slab on grade shall be 1-1/2 inches.
2. Nonmetallic conduit may be cast integral with horizontal slabs with placement criteria stated above. Non-metallic conduit may be run beneath structures or slabs on grade, without concrete encasement. In these instances conduit shall be placed at least 12 inches below the bottom of the structure or slab. Nonmetallic conduit may be buried 24 inches minimum below grade, with a 3-inch concrete cover, in open areas or where otherwise not protected by concrete slab or structures. Top of concrete cover shall be colored red. Nonmetallic conduit shall be permitted only as required by the Specifications and in concealed locations as described above.
3. Where a run of concealed PVC conduit becomes exposed, a transition to rigid steel conduit is required. Such transition shall be accomplished by means of a factory elbow or a minimum 3-foot length of rigid steel conduit, either terminating at the exposed concrete surface with a flush coupling. Piercing of concrete walls by nonmetallic runs shall be accomplished by means of a short steel nipple terminating with flush couplings.
4. Flexible conduit shall be used at dry locations for the connection of equipment such as motors, transformers, instruments, valves, or pressure switches subject to vibration or movement during normal operation or servicing. Flexible conduit may be used in lengths required for the connection of recessed lighting fixtures; otherwise the maximum length of flexible conduit shall be 18 inches.
5. In other than dry locations, connections shall be made using flexible liquid-tight conduit. Equipment subject to vibration or movement which is normally provided with wiring leads, such as solenoid valves, shall be installed with a cast junction box for the make-up of connections. Flexible conduits shall be as manufactured by American Brass, Cablec, Electroflex, or equal.

6. Conduit penetrations on walls, concrete structures, pull boxes, and equipment cabinets shall be performed in accordance with the following:
 - a. Seal all raceways entering structures at the first box or outlet with conduit sealant to prevent the entrance into the structure of gases, liquids, or rodents.
 - b. Dry pack with nonshrink grout around raceways that penetrate concrete walls, floors, or ceilings aboveground, or use one of the methods indicated for underground penetrations.
 - c. Where an underground conduit enters a structure through a concrete roof or a membrane waterproofed wall or floor, provide an acceptable, malleable iron, watertight, entrance sealing device. When there is no raceway concrete encasement, provide such device having a gland type sealing assembly at each end with pressure bushings which may be tightened at any time. When there is raceway concrete encasement indicated, provide such a device with a gland type sealing assembly on the accessible side. Securely anchor all such devices into the masonry construction with one or more integral flanges. Secure membrane waterproofing to such devices in a permanently watertight manner.
 - d. Where an underground raceway without concrete encasement enters a structure through a nonwaterproofed wall or floor, install a sleeve made of Schedule 40 galvanized pipe. Fill the space between the conduit and sleeve with a suitable plastic expandable compound, or an oakum and lead joint, on each side of the wall or floor in such a manner as to prevent entrance of moisture. A watertight entrance sealing device may be used in lieu of the sleeve.
7. All underground GRS conduit shall be PVC coated or taped.

3.4 WIRES AND CABLES

- A. General: Conductors shall not be pulled into raceway until:
 1. Raceway system has been inspected and accepted by the ENGINEER.
 2. Plastering and concrete have been completed in affected areas.
 3. Raceway system has been freed of moisture and debris.
- B. Wire and Cables
 1. Conductors of No. 1 size and smaller shall be hand pulled. Larger conductors may be installed using power winches. Pulling tensions on the cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.
 2. Wire in panels, cabinets, and gutters shall be neatly grouped using nylon tie straps, and shall be fanned out to terminals.
- C. Splices and Terminations
 1. The CONTRACTOR shall provide, install, and terminate the conductors required for power and controls to electrical equipment instrumentation terminal cabinets, control and instrumentation equipment except where indicated elsewhere. There shall be no cable splices in underground manhole or pullboxes. If splices are necessary, the cables shall be brought aboveground and terminated in a NEMA 4X, stainless steel terminal or splice cabinet on a concrete pad.
 2. Two- and three-conductor shielded cables installed in conduit runs which exceed 2,000 feet may be spliced in pullboxes. These cable runs shall have only one splice per conductor.
 3. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment. For the purposes of the various Sections of Division 16 of the Specifications, "control conductors" are defined as

- conductors operating at 120 volts or less in circuits that indicate equipment status or that control the electric energy delivered to a power consuming device.
4. All 120/208-volt and 480-volt branch circuit conductors may be spliced in suitable fittings at locations determined by the CONTRACTOR.
 5. Stranded conductors shall be terminated directly on equipment box lugs making sure that all conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.
 6. Splices in 600-volt wire which are not pre-insulated shall be insulated with three layers of tape each half lapped except that splices in below grade pull boxes or in any box subject to flooding shall be made watertight using an epoxy resin splicing kit.
 7. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of 2 layers of varnished cambric tape overtaped with a minimum of 2 layers of high temperature tape. Provide 3M motor load termination kits.
 8. Shielded power cable shall be terminated with pre-assembled stress cones in a manner approved by the cable manufacturer. Submit the proposed termination procedure as described for shop drawings.
 9. Control devices, such as solenoid operated valves, that are normally supplied with conductor pigtails, shall be terminated as described for control conductors.
- D. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements ICEA Publication No. S-68-516 and other relevant ICEA publications. Factory test results shall be submitted in accordance with Section 01300 - Contractor Submittals, prior to shipment of cable. The following tests shall be the minimum requirements:
1. Insulation resistance shall be obtained and shall not be less than the value recommended by ICEA.
 2. All cables rated at 600 volts shall be tested for insulation resistance between phases and from each Phase to a ground using a megohmmeter.
 3. All field testing mentioned above shall be done after cables are installed in the raceways.
 4. Field tests shall be performed by certified test organization acceptable to the ENGINEER. Test results shall be submitted for review and acceptance.
 5. Cables failing in the said tests shall be replaced with a new cable or repaired. Such kind of repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.
- E. Continuity Test: All control and instrumentation cables shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed prior to placing all cables in service.

3.5 PULL AND JUNCTION BOXES

- A. Pull and junction boxes shall be sized in accordance with the requirements of the National Electrical Code or as shown on drawings.
- B. Outlet boxes shall be used as junction boxes wherever possible. Where separate pullboxes are required, they shall have screw covers.
- C. Pullboxes shall be installed when conduit run contains more than three 90-degree bends and runs exceed 200 feet.

3.6 CABINETS AND ENCLOSURES

- A. Cabinets shall be set plumb at an elevation that will cause the maximum circuit breaker height to be less than 5 ft 6 inches. Top edge of trim of adjacent panels shall be at the same height. Panels which are indicated as flush mounted shall be set so cabinet is flushed and serves as a "ground" for plaster application.
- B. All factory wire connections shall be made at shipping splits, and all field wiring and grounding connections shall be made after the assemblies are anchored.

3.7 CONCRETE HOUSEKEEPING

- A. Concrete housekeeping pads shall be provided for all floor standing electrical equipment. Housekeeping pads for all equipment, including future units, shall be 2 inches above surrounding finished floor or grade and 2 inches larger in both dimensions than the supported equipment, unless otherwise indicated.
- B. Concrete housekeeping curb shall be provided for all conduit stub-up in indoor and outdoor locations, not concealed by equipment enclosures. Such curb shall be 3 inches above finished floor or grade.

3.8 EQUIPMENT ANCHORING

- A. Freestanding or wall-hung equipment shall be anchored in place by methods that will meet seismic requirement in the area where project is located. Wall-mounted panels that weigh more than 500 pounds or which are within 18 inches of the floor shall be provided with fabricated steel support pedestal(s). Pedestals shall be of welded steel angle sections. If the supported equipment is a panel or cabinet and enclosed with removable side plates, it shall match supported equipment in physical appearance and dimensions. Transformers hung from 4-inch stud walls and weighing more than 300 pounds, shall have auxiliary floor supports.
- B. Leveling channels anchored to the concrete pad shall be provided for all switchgear and pad-mounted transformer installations. Area between the channels shall be grouted perfectly flat.
- C. Anchoring methods and leveling criteria specified in the printed recommendations of the equipment manufacturers are a part of the Work of this Contract. Such recommendations shall be submitted as required for shop drawings in Section 01300 - Contractor Submittals.

3.9 CABLE AND EQUIPMENT IDENTIFICATION

- A. General: The completed electrical installation shall be provided with adequate identification to facilitate proper control of circuits and equipment and to reduce maintenance effort.
- B. Cable: Assign each control and instrumentation wire and cable a unique identification number. Said numbers shall be assigned to all conductors having common terminals and shall be shown on all shop drawings. Identification numbers shall appear within 3 inches of conductor terminals. "Control" shall be defined as any conductor used for alarm, annunciator, or signal purposes:
 - 1. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number shall form a part of the individual wire number. All individual control conductors and instrumentation cable shall be identified at pull points as described

above. The instrumentation cable numbers shall incorporate the loop numbers indicated on the Drawings.

2. All 120/208-volt system feeder cables and branch circuit conductors shall be color coded as follows: Phase 1-black, Phase 2-red, Phase 3-blue, and Neutral-white. The 480/277-volt system conductors shall be color coded as follows: Phase A-brown, Phase B-orange, Phase C-yellow, and Neutral-gray. Color-coding tape shall be used where colored insulation is not available. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase 1-2-3, top to bottom, or left to right, facing the front of the equipment.
3. General purpose ac control cables shall be pink. General purpose dc control cables shall be blue.
4. All spare cables shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.
5. Terminal strips shall be identified by imprinted, varnished, marker strips attached under the terminal strip.

C. Equipment: Equipment and devices shall be identified as follows:

1. Nameplates shall be provided for all panelboards, panels, starters, switches, and pushbutton stations. In addition to the name plates shown, control devices shall be equipped with standard collar-type legend plates.
2. Control devices within enclosures shall be identified similar to the paragraph above.
3. Three-phase receptacles shall be consistent with respect to phase connection of receptacle terminals. Errors in phasing shall be corrected at the bus, not at the receptacle.
4. Toggle switches which control loads out of sight of switch, and all multiswitch locations of more than 2 switches, shall have suitable inscribed finish plates.
5. Empty conduits shall be tagged at both ends to indicate the destination at the far end. Where it is not possible to tag the conduit, destination shall be identified by marking an adjacent surface.
6. Provide typewritten circuit directories for panelboards; circuit directory shall accurately reflect the outlets connected to each circuit.
7. Install identification tape directly above buried unprotected raceway; install tape 8 inches belowgrade and parallel with raceway to be protected. Identification tape is required for all buried raceway not under buildings or equipment pads except identification tape is not required for protection of street lighting raceway.

END OF SECTION

SECTION 16526 – SPORTS FIELD LIGHTING

PART 1 – GENERAL

1.1 SUMMARY

- A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.
- B. The purpose of these specifications is to define the performance and design standards for Southern Utah University Intramural Soccer Field, Cedar City, UT. The Manufacturer / Contractor shall supply lighting equipment to meet or exceed the standards set forth by the criteria set forth in these specifications.
- C. Base Bid includes the cost for providing and installing two 2" conduits from existing panel "MDP" in P.E. building to the two electrical pull boxes shown on the plans. Additional cost to provide and install lighting system as specified below shall be included in Additive Alternate #1.
- D. The sports lighting will be for the following fields:
 - 1. Intramural Sports Field
- E. The primary goals of this sports lighting project are:
 - 1. Guaranteed Light Levels: Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore the lighting system shall be designed such that the light levels are guaranteed for a period of 25 years. Environmental Light Control: It is the primary goal of this project to minimize spill light and glare.
 - 3. Life Cycle Cost: In order to reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be eliminated, and the field(s) should be proactively monitored to detect fixture outages over a 25 year life cycle. To allow for optimized use of labor resources and avoid unneeded operation of the facility, customer requires a remote on/off control system for the lighting system.

1.2 LIGHTING PERFORMANCE

- A. Performance Requirements: Playing surfaces shall be lit to an average constant light level and uniformity as specified in the chart below. Light levels shall be held constant for 25 years. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified below. Measured average illumination level shall be +/- 10% of predicted mean in accordance with IESNA RP-6-01, and measured at the first 100 hours of operation.

Area of Lighting	Average Constant Light Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Intramural Field	20 footcandles	2.0:1.0	96	30' x 30'

- B. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, the pole mounting heights from the playing field surface shall be 70'.

1.3 ENVIRONMENTAL LIGHT CONTROL

- A. Spill Light Control: Maximum vertical footcandles taken with the meter aimed at the brightest light bank at a distance of 100 feet from the field perimeter shall not exceed .86. Maximum horizontal footcandles at a distance of 100 feet from the perimeter of the field shall not exceed .38. Footcandle readings shall be taken at 30' intervals along the specified line. Measured average illumination level shall allow a 10% variance of predicted mean in accordance with IESNA RP-6-01, and be measured at the first 100 hours of operation.

1.4 LIFE CYCLE COSTS

- A. Energy Consumption: The average kWh consumption for the field lighting system shall be minimized.
- B. Complete Lamp Replacement: Manufacturer shall include all group lamp replacements required to provide 25 years of operation based upon 200 usage hours per year.
- C. Preventative and Spot Maintenance: Manufacturer shall provide all preventative and spot maintenance, including parts and labor for 25 years from the date of equipment shipment. Individual lamp outages shall be repaired when the usage of any field is materially impacted. Owner agrees to check fuses in the event of a luminaire outage.
- D. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The manufacturer shall notify the Owner of outages within 24 hours, or the next business day. The controller shall determine switch position (Manual or Auto) and contactor status (open or closed).
- E. Remote Lighting Control System: System shall allow Owner and users with a security code to schedule on/off system operation via a web site, phone, fax or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

The Owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities, to only having permission to execute "early off" commands by phone.

Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

- F. Management Tools: Manufacturer shall provide a web-based database of actual field usage and provide reports by facility and user group.
- G. Communication Costs: Manufacturer shall include communication costs for operating the controls and monitoring system for a period of 25 years.

- H. 25-Year Life Cycle Cost: Manufacturer shall submit 25-year life cycle cost calculations as follows. Equipment price and total life cycle cost shall be entered separately on bid form.

a.	Luminaire energy consumption # luminaires x __kW demand per luminaire x .07 kWh rate x 200 annual usage hours x 25 years		
b.	Cost for spot re-lamping and maintenance over 25 years Assume 7.5 repairs at \$ \$500 each if not included with the bid	+	
c.	Cost to re-lamp all luminaires during 25 years 200 annual usage hours x 25 years / lamp replacement hours x \$125 lamp & labor x # fixtures if not included with the bid	+	
d.	Extra energy used without base bid automated control system \$ Energy consumption in item a. x 10% if control system not included with the bid	+	
TOTAL 25-Year Life Cycle Operating Cost		=	

1.5 WARRANTY AND GUARANTEE

- A. 25-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 25 years. Warranty shall guarantee light levels; lamp replacements; system energy consumption; monitoring, maintenance and control services, spill light control, and structural integrity. Manufacturer shall maintain specifically-funded financial reserves to assure fulfillment of the warranty for the full term. Warranty may exclude fuses, storm damage, vandalism, abuse and unauthorized repairs or alterations.

1.6 DELIVERY TIMING

- A. Equipment On-Site: The equipment must be on-site four to six weeks from receipt of approved submittals and receipt of complete order information.

1.7 PRE-BID SUBMITTAL REQUIREMENTS

- A. Approved Product: Musco's Light-Structure Green™ System is the approved product. All substitutions must provide a complete submittal package for approval as outlined in Submittal Information at the end of this section at least 10 days prior to bid. Special manufacturing to meet the standards of this specification may be required. An addendum will be issued prior to bid listing any other approved lighting manufacturers and designs.
- B. Design Approval: The Owner or Engineer will review pre-bid shop drawings from the manufacturers to ensure compliance to the specification. If the design meets the design requirements of the specifications, a letter will be issued to the manufacturer indicating approval for the specific design submitted.

1.8 ALTERNATE SYSTEM REQUIREMENTS

- A. Compliance to Specifications: Acceptance of a bid alternate does not negate the Contractor and lighting manufacturer's responsibility to comply fully with the requirements of these specifications. Any exceptions to the specifications must be clearly stated in the prior approval submittal documents.

- B. Light Level Requirements: Manufacturer shall provide computer models guaranteeing light levels on the field over 25 years. If a constant light level cannot be provided, a maximum Recoverable Light Loss Factor of 0.70 shall be applied to the initial light level design to achieve the following Initial and target/maintained light levels. For alternate systems, scans for both initial and maintained light levels shall be submitted.

Area of Lighting	Average Initial Light Levels	Average Target/Maintained Light Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Soccer	28 footcandles	20 footcandles	2.0:1.0	96	30' x 30'

- C. All costs associated with revising the electrical distribution plans to include changes to service entrance, panel, and wire sizing, as well as installation of all such equipment shall be at the Contractor's expense.

PART 2 – PRODUCT

2.1 LIGHTING SYSTEM CONSTRUCTION

- A. System Description: Lighting system shall consist of the following:
1. Galvanized steel poles and crossarm assembly
 2. Pre-stressed concrete base embedded in concrete backfill allowed to cure for 12-24 hours before pole stress is applied. Alternate may be an anchor bolt foundation designed such that the steel pole and any exposed steel portion of the foundation is located a minimum of 18 inches above final grade. The concrete for anchor bolt foundations shall be allowed to cure for a minimum of 28 days before the pole stress is applied.
 3. All luminaires shall be constructed with a die-cast aluminum housing or external hail shroud to protect the luminaire reflector system.
 4. Manufacturer will remote all ballasts and supporting electrical equipment in aluminum enclosures mounted approximately 10' above grade. The enclosures shall include ballast, capacitor and fusing for each luminaire. Safety disconnect per circuit for each pole structure will be located in the enclosure.
 5. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
 6. Controls and Monitoring Cabinet to provide on-off control and monitoring of the lighting system, constructed of NEMA Type 4 aluminum. Communication method shall be provided by manufacturer. Cabinet shall contain custom configured contactor modules for 30, 60, and 100 amps, labeled to match field diagrams and electrical design. Manual Off-On-Auto selector switches shall be provided.
- B. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, ballast and other enclosures shall be factory assembled, aimed, wired and tested.
- C. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel of 18-8 grade or better, passivated and coated for protection against corrosion and stress corrosion cracking. All wiring shall be enclosed within the crossarms, pole, or electrical components enclosure.

- D. Lightning Protection: All structures shall be equipped with lightning protection meeting NFPA 780 standards. Contractor shall supply and install a ground rod of not less than 5/8" in diameter and 8' in length, with a minimum of 10' embedment. Ground rod should be connected to the structure by a copper main down conductor with a minimum size of #2 for poles with less than 75' mounting height and 2/0 for poles with more than 75' mounting height.
- E. Safety: All system components shall be UL Listed for the appropriate application.
- F. Electric Power Requirements for the Sports Lighting Equipment:
 - 1. Electric power: 480 Volt, 3 Phase
 - 2. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

2.2 STRUCTURAL PARAMETERS

- A. Support Structure Wind Load Strength: Poles and other support structures, brackets, arms, bases, anchorages and foundations shall be designed at the Contractor's expense by a registered engineer in the State of Utah. Design shall be based on the 2006 edition of the International Building Code, wind speed of 90, exposure category C. Luminaire, visor, and crossarm shall withstand 150 mph winds and maintain luminaire aiming alignment.
- B. Soil Conditions: The design criteria for these specifications are based on soil design parameters as outlined in the geotechnical report. If a geotechnical report is not provided by the Owner, the foundation design shall be based on soils that meet or exceed those of a Class 5 material as defined by 2006 IBC, Table 1804.2 (used if wind criteria is 2006 IBC)
- C. It shall be the Contractor's responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. No additional payment will be made to Contractor for additional costs associated with:
 - 1. Providing engineered foundation embedment design by a registered engineer in the State of Utah.
 - 2. Additional materials required to achieve alternate foundation.
 - 3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.
- D. Foundation Drawings: Project specific foundation drawings stamped by a registered engineer in the state where the project is located are required. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole.

PART 3 – EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA RP-6-01, Appendix B.

- B. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles, uniformity ratios, and maximum kilowatt consumptions are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be liable to any or all of the following:
1. Manufacturer shall at his expense provide and install any necessary additional fixtures to meet the minimum lighting standards. The Manufacturer shall also either replace the existing poles to meet the new wind load (EPA) requirements or verify by certification by a licensed structural engineer that the existing poles will withstand the additional wind load.
 2. Manufacturer shall minimize the Owner's additional long term fixture maintenance and energy consumption costs created by the additional fixtures by reimbursing the Owner the amount of \$1,000.00 (one thousand dollars) for each additional fixture required.
 3. Manufacturer shall remove the entire unacceptable lighting system and install a new lighting system to meet the specifications.

SUBMITTAL CHECKLIST

**All items listed below are mandatory, shall comply with the specification and be submitted
7 Days Prior to bid.**

Tab	Item	Description
	Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included.
B	Equipment Layout	Drawing(s) showing field layouts with pole locations.
C	On Field Lighting Design	Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by, and other pertinent data b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y). Illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, as well as luminaire information including wattage, lumens and optics d. Height of light level test meter above field surface e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance and uniformity gradient; number of luminaires, total kilowatts, average tilt factor; light loss factor. f. Alternate manufacturers shall provide both initial and maintained light scans using a maximum 0.70 Light Loss Factor to calculate maintained values.
D	Off Field Lighting Design	Lighting design drawing showing initial vertical spill light levels along the boundary line (defined on bid drawings) in footcandles. Vertical levels shall be at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank lights.
E	Life Cycle Cost Calculation	Document life cycle cost calculations as defined in the specification. Identify energy costs for operating the luminaires, maintenance cost for the system including spot lamp replacement, and group re-lamping costs. All costs should be based on 25 years.
F	Structural Information (if required)	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of Utah. (May be supplied upon award.)
G	Control & Monitoring System	Manufacturer shall provide written definition and schematics for lighting contactor cabinet(s).OR automated control system to include monitoring. They will also provide examples of system reporting and access for numbers for personal contact to operate the system.
H	Electrical Distribution Plans	If bidding an alternate system, manufacturer must include a revised electrical distribution plan including changes to service entrance, panels and wire sizing, signed by a licensed electrical engineer in the state of Utah.
I	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the Owner. Light levels must be guaranteed per specification for 25 years.
J	Warranty	Provide written warranty information including all terms and conditions.
K	Project References	Manufacturer to provide a list of project references of similar projects completed within the past three years.
L	Product Information	Complete set of product brochures for all components, including a complete parts list, UL Listings, and Manufacturers Certificate of Corrosion Protection.
M	Delivery	Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.
N	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.

DRAWINGS