



TRINITY METRO<sup>SM</sup>

**TRINITY RIVER EXPRESS (TRE)  
TRINITY LAKES PARKING LOT PROJECT**

**IFB SPECIFICATIONS**

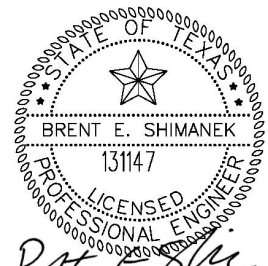
**MARCH 2023**

**PREPARED BY**



**EXPERIENCE |** Transportation

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*Brent E. Shimanek*

03/31/2023

TRINITY RAILWAY EXPRESS (TRE)  
TRINITY LAKES PARKING LOT PROJECT  
CONTRACT NO. 23-026

**SPECIFICATIONS**  
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THE FOLLOWING SPECIFICATIONS INVOKE, MODIFY, AND SUPPLEMENT THE DART “FACILITIES STANDARD SPECIFICATIONS”, DATED MAY 2016.

THE ORGANIZATION AND SEQUENCE OF ARTICLES AND PARAGRAPHS IN THESE SPECIFICATIONS SECTIONS ARE ALIGNED WITH LIKE IDENTIFIED ARTICLES AND PARAGRAPHS CONTAINED IN THE REFERENCED STANDARDS SPECIFICATIONS SECTIONS.

ACCORDINGLY, ARTICLES AND PARAGRAPHS IN THESE SPECIFICATIONS WHICH SPECIFY MODIFICATIONS SHALL BE UNDERSTOOD TO MEAN MODIFICATIONS TO THE PROVISIONS CONTAINED IN LIKE NUMBERED AND TITLED ARTICLES AND PARAGRAPHS IN THE REFERENCED STANDARDS SPECIFICATIONS SECTIONS.

REFERENCES TO DART, DALLAS AREA RAPID TRANSIT, OR VARIOUS DART PERSONNEL NOT ALREADY MODIFIED WITH A TRE TRINITY LAKES PARKING LOT SPECIAL SPECIFICATIONS ARE UNDERSTOOD TO REFER TO FWTA, TRE, FORT WORTH TRANSPIRATION AUTHORITY, TRINITY RAILWAY EXPRESS, OR FWTA/TRE PERSONNEL. THIS DOES NOT INCLUDE REFERENCES TO THE DART STANDARD OR SUPPLEMENTAL SPECIFICATIONS.

LEGEND

- FIRST COLUMN (STD SPECS): INDICATES STANDARD SPECIFICATION SECTION APPLIES TO THIS PROJECT.
- SECOND COLUMN (STD SUPP): INDICATES STANDARD SPECIFICATION SUPPLEMENT APPLIES TO THIS PROJECT.
- THIRD COLUMN: (TRE Trinity Lakes Parking Lot Project): INDICATES PROJECT SPECIFIC SPECIFICATIONS.
- FOURTH COLUMN: (Texas Department of Transportation (TxDOT)): INDICATES PROJECT SPECIFIC SPECIFICATIONS.

STD SPECS	STD SUPP	TRE TRINITY LAKES PARKING PROJECT	TXDOT SPECS	DIVISION 1 - GENERAL REQUIREMENTS	
				SECTION NUMBER	
●				01001	General Requirements
●	●			01010	Summary of the Work
●				01047	System Safety Program
●				01086	Color Codes and Color Standards
●				01220	Measurements and Payment
●				01312	Project Meetings
●	●			01320	Construction Schedule and Progress Reports
●				01321	Construction Schedule and Progress Reports for Small Projects
●	●			01330	Submittals
●				01340	Shop Drawings, Product Data and Samples
●				01345	Construction Photographs
●				01423	Reference Standards
●				01430	Contractor's Quality Assurance
●	●			01450	Quality Control
●				01454	Field Samples and Mock-Ups
●	●			01500	Temporary Facilities and Services
●				01505	Mobilization
●				01532	Tree and Shrub Protection and Care
●				01533	Temporary Decking
●	●			01560	Environmental Protection
●	●			01562	Soil Erosion and Sediment Control
●				01570	Maintenance and Control of Traffic
●	●			01580	Project Signs
●				01600	Product Requirements
●				01630	Product Substitution Procedures
●				01640	Authority Furnished Materials and Equipment
●				01715	Pre-Construction Inspection
●	●			01722	Field Engineering – Surveying
●				01731	Cutting and Patching
●				01740	Cleaning
●	●			01770	Contract Closeout
●	●			01785	Project Record Documents
●	●			01786	Operation and Maintenance Instructions
●				01790	Spare Parts and Maintenance Materials

STD SPECS	STD SUPP	TRE TRINITY LAKES PARKING PROJECT	TXDOT SPECS	DIVISION 2 – SITE CONSTRUCTION	
				SECTION NUMBER	
		●		02060	Soil Erosion and Sediment Control
		●		02072	Removal and Restoration of Miscellaneous Existing Facilities
		●		02100	Site Preparation
		●		02220	Grading, Excavation and Backfilling
		●		02221	Utility Excavation and Backfill
		●		02230	Base for Pavements
		●		02244	Soil Stabilization Lime Treatment
		●		02271	Ditch Lining and Slope Protection
		●		02525	Combined Curb and Gutter, Curb Ramps, and Walks
		●		02550	Concrete Pavement
		●		02560	Site Improvements
		●		02580	Pavement Markings and Delineators
		●		02600	Maintenance and Control of Traffic
		●		02700	Storm Sewer Systems
●				02780	Underground Electrical and Communication Distribution Systems
		●		02810	Planting Irrigation
		●		02831	Bollards
		●		02845	Aluminum Signs
		●		02850	Traffic Control
		●		02910	Topsoil and Finished Grading
		●		02920	Lawns and Grasses
		●		02930	Planting
		●		02931	Seeding and Sodding – Non-Irrigated Areas

STD SPECS	STD SUPP	TRE TRINITY LAKES PARKING PROJECT	TXDOT SPECS	DIVISION 3 – CONCRETE	
				SECTION NUMBER	
		●		03100	Concrete Formwork
		●		03200	Concrete Reinforcement
		●		03300	Cast-In-Place Concrete
		●		03305	Portland Cement Concrete
		●		03350	Concrete Finishing

STD SPECS	STD SUPP	TRE TRINITY LAKES PARKING PROJECT	TXDOT SPECS	DIVISION 16 - ELECTRICAL	
				SECTION NUMBER	
●				16110	Conduit and Raceways
●				16801	Basic Technical Requirements – Communication System
●				16837	Miscellaneous Components and Products – Communications System
●				16841	Communications Cable – Communications System
●				16845	Fiber Optic Cable Subsystem - Communications Systems
●				16850	Basic Electrical Materials and Methods - Communications Systems
●				16876	Grounding and Bonding - Communications Systems
●				16879	Power Supplies and Distribution - Communications Systems
		●		16880	Video Ip System - Communications System
●				16897	Manuals and Training - Communications Systems
●				16899	Technical Support and Spares - Communications Systems



TRINITY METRO<sup>SM</sup>

**TRINITY RIVER EXPRESS (TRE)  
TRINITY LAKES PARKING LOT PROJECT  
PROJECT SPECIFICATIONS IFB**

I hereby certify that the following Specification(s) that contained herein were prepared under my direct supervision.

**DIVISION 1 – GENERAL REQUIREMENTS**

- 01010 - SUMMARY OF THE WORK
- 01320 - CONSTRUCTION SCHEDULE AND PROGRESS REPORTS
- 01330 – SUBMITTALS
- 01450 – QUALITY CONTROL
- 01500 - TEMPORARY FACILITIES AND SERVICES
- 01560 - ENVIRONMENTAL PROTECTION
- 01562 - SOIL EROSION AND SEDIMENT CONTROL
- 01580 - PROJECT SIGNS
- 01722 - FIELD ENGINEERING – SURVEYING
- 01770 - CONTRACT CLOSEOUT
- 01785 - PROJECT RECORD DOCUMENTS
- 01786 - OPERATION AND MAINTENANCE INSTRUCTIONS



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CONTRACT NO.  
23-026

**IFB  
Submittal**

March  
2023

**SECTION 01001  
GENERAL REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 GENERAL**

- A. The General Requirements (Division 1 sections) of these specifications expand on the General and Special Provisions and cover administrative and procedural matters relating to work specified in all the technical sections.

**1.2 SPECIFICATIONS**

- A. Grammatical Mood: These Specifications are written in the imperative mood and abbreviated form. This imperative language of the technical sections is directed at the Contractor unless specifically noted otherwise. Complete incomplete sentences by inserting "shall", "the Contractor shall", and "shall be", and similar mandatory phrases by inference in the same manner as they are applied to notes on the Drawings. Supply the word "shall be" by inference where a colon (:) is used within sentences or phrases. Except as worded to the contrary, fulfill (perform) all indicated requirements whether stated imperatively or otherwise.
- B. Brevity: In the interest of brevity these Specifications frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.
- C. Definitions: For the purposes of this Contract, in addition to General Provisions Paragraphs "Definition" and "Specifications and Drawings", the following terms and their derivative forms shall be accorded the meanings assigned below:
1. Approved: Unless otherwise specified, as approved by the Contracting Officer.
  2. Construction Site (Project Site, Worksite, plant, or Site): The area delineated on the Contract plans for the Project and all the areas utilized by the Contractor for the storage and/or processing of materials to be incorporated into the Work that has been approved by the Contracting Officer.
  3. Contract Documents: Consist of the Invitation for Bid, the Bid Schedule, and all Exhibits identified on the Invitation for Bid.
  4. Construction Staging Area: Property available for use by the Contractor during the construction period for the purpose of storing products and construction

equipment and for the purpose of staging work.

5. Contractor: The individual, partnership, or corporation or a combination of any or all jointly undertaking the execution of the Work under terms of the Contract and acting directly or through agents or employees.
6. Defective: An adjective which when used to describe the contractual work effort that does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test, or approval referred to in the Contract Documents.
7. Drawings: Graphic and pictorial portions of the Contract Documents, showing the design, locations, and dimensions of the Work. Generally including plans, elevations, sections, details, schedules, and diagrams.
  - a. Synonym: Plans
8. Experienced: The term "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to the work within the Contract for which the experience is required.
9. Gauge: The term "gauge", when used in connection with the measurement of plates, will mean the U.S. Standard Gage; except that when reference is made to the measurement of galvanized or aluminum sheets used in the manufacture of corrugated metal pipe, metal plate culverts, arches, arched metal cribbing and corrugated aluminum pipe, then the term "gauge" will mean that specified in the applicable AASHTO or ASTM standard.
  - a. When the term "gauge" refers to the measurement of wire in regard to concrete reinforcement, it will mean the wire gauge specified in the applicable AASHTO or ASTM standard.

## GENERAL REQUIREMENTS

10. Including/Consisting of:
  - a. Including: Introduces a partial, representative listing of things, or actions.
  - b. Consisting of: Introduces a complete listing of things or actions which constitute the whole.
11. Installer: An Installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction operation, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
  - a. Trades: Using terms such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as carpenter. It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name
12. Jurisdictional Authorities: State, Federal, and local authorities or agency thereof having jurisdiction over work to which reference is made.
13. Milestone: A principal event specified in Contract Documents relating to an intermediate completion date, time period prior to completion of all work, or final completion of all work.
14. Mobilization: See Section 01505, "Mobilization".
15. Paragraph: An element of the specification section bearing its own alphanumeric designation.
  - a. Synonyms: Article, Clause, Provision.
16. Permanent Drainage Easement: A right to construct and maintain permanent drainage facilities for retention, release, and passage of surface water in a particular area.
17. Permanent Subsurface Easement: A right to construct and maintain permanent subsurface facilities in an underground space.
18. Permanent Utility Easement: A right to construct and maintain utility facilities in a particular area.
19. Review: A general overview, not an approval.
20. Right-of-Way: A term denoting land and property, and interests therein, acquired by the Authority.
21. Similar: Generally the same but not necessarily identical; details shall be worked out in relation to location and relation to other parts of work.
22. Shall/Will/May:
  - a. Shall: Indicates action which is mandatory on the part of the Contractor.
  - b. Will: Indicates probable action.
  - c. May: Indicates permissible action.
23. Specifications: That portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards and workmanship for the Work, and performance of related services.
24. Specified: Unless otherwise stated, as required by the General Provisions, the drawings, the Specifications, and the Special Provisions for the Project.
25. Supplier: A manufacturer, fabricator, supplier, distributor, material manufacturer, or vendor who contracts with the Contractor or any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or any Subcontractor.
26. Subcontractor: A person, persons, or entity who contracts with the Contractor or any Subcontractor to perform work, provide labor, or to render service on or about the Work.
27. Submit: Unless otherwise specified, transmit to the Contracting Officer for approval, or review and record. Refer to Section 01330, "Submittals", for general requirements for submittals.
28. Temporary Construction Easement Line: Boundary which describes the area not



## GENERAL REQUIREMENTS

owned by the Authority, but available for construction operations.

29. Transit System: The complete fixed guideway rail transportation system, including right-of-way, pavement, tracks, structures, equipment, appurtenances and other property of the Authority.
30. Underground Facilities: All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.
31. VOC: Volatile organic compound.
32. Work: Labor, supervision, services, materials, machinery, equipment, tools, supplies and facilities to accomplish the requirements of the Contract.

### 1.3 CONTRACTOR'S SUPERINTENDENT

- A. In furtherance of General Provisions, Paragraph, "SUPERINTENDENCE BY THE CONTRACTOR", the Contractor shall appoint immediately upon award of the Contract, a superintendent who is satisfactory to the Contracting Officer and has the authority to act for the Contractor.
- B. The appointment of the superintendent (by the Contractor) shall at all times be subject to the approval in writing of the Contracting Officer (which approval may at anytime be withdrawn). If the Contracting Officer withdraws such approval, the Contractor shall remove the superintendent from the Work and shall not employ him on the Work in any other capacity; and shall replace him by another superintendent as approved by the Contracting Officer.

### PART 2 - PRODUCTS

Not Used

### PART 3 - EXECUTION

Not Used

## PART 4 - MEASUREMENT AND PAYMENT

### 4.1 MEASUREMENT

- A. Unless specifically stated, no separate measurement will be made for the work specified in the various sections under Division 1, "General Requirements".

### 4.2 PAYMENT

- A. No separate payment will be made for the work specified in various sections under Division 1, "General Requirements" except for items specifically designated as separate pay items, but shall be included in the Contract Bid Schedule at the lump sum price for "General Requirements". This lump sum price will be full compensation for all materials, labor, tools, equipment, and incidentals necessary for the completion of the work; and for performance of all requirements as described in all sections under Division 1, "General Requirements" and relevant plans and Contract Documents. Payment will be made in the following manner:

1. Twenty-five percent of the lump sum price for General Requirements will be paid in three equal amounts, as part of each of the first three progress payments subject to timely and satisfactory compliance with the requirements of the General Requirements.
2. Seventy-five percent of the lump sum price for the General Requirements will be paid in equal amounts over the remaining duration of the Contract, beginning with the fourth progress payment, subject to compliance with the requirements of the General Requirements including Quality Control, Maintenance of As-Built Drawings, and Schedule Update.
3. The value allocated to General Requirements shall not exceed five percent of the total bid amount.

END OF SECTION 01001

**SECTION 01010  
SUMMARY OF THE WORK**

The provisions of the DART Standard Specification Section 01010, "Summary of the Work", shall apply to the Work as modified herein.

**PART 1 – GENERAL**

**1.3. GEOTECHNICAL:** Change Paragraph 1.3/A to read as follows:

A. The Contractor shall use the Geotechnical Report in the performance of the Work.

**1.4. WORKSITE:** Change Paragraph 1.4/A, 1.4/B/1, 1.4/B/3/f, 1.4/B/5 to read as follows:

A. Location of the Worksite: The Work is located in the TRE service area. Exact location of the Worksite, including the area available for Contractor's operations, and the right-of-way are shown in the contract drawings.

B. Access to the Worksite:

3. The contractor shall take into consideration the following guidelines for haul and delivery roads plan development:

f. Provide access by TRE maintenance Personnel and their vehicles to and on the Worksite.

g. The contractor shall maintain a clear turn around area, such as one of the options from Figure 503.2.5 of Part II: City Code Chapter 13 of the City of Fort Worth Texas Code of Ordinances.

5. The Contractor shall provide access to for other contractors, including contractor for utilities and parking lots during construction.

**1.8. WORK HOURS:** Change Paragraph 1.8/A to read as follows:

A. Construction will be limited to the daylight hours of 7:00 a.m. to 9:00 p.m. Monday through Sunday, or as approved by the jurisdictional authority.

**1.10. NOTIFICATIONS AND COMMUNITY RELATIONS:** Change Paragraph 1.10/B to read as follows:

B. The Contractor shall designate a contact person to be responsible for coordination and notifications. This contract person shall coordinate with the Owner's Representative and Authority's Community Relations Department prior to contact with property owners and businesses.

**END OF SECTION 01010**

**SECTION 01010  
SUMMARY OF THE WORK**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK**

- A. The Work under the Contract consists of construction as described in the Contract Documents. Extent and details of the construction site are shown on the Contract drawings. Unless otherwise provided, the Contractor shall furnish all materials, labor, tools, equipment, and incidentals necessary for the proper prosecution and completion of the Work.
  
- B. The Work By Others: In accordance with and in addition to the General Provisions, Paragraph, "OTHER CONTRACTS":
  - 1. The exercise of the right reserved by the Authority to permit other contractors and persons to do work in or about the Contract area during the performance period of this contract does not in any way or to any extent relieve the Contractor from liability for loss and damage to the Work due to or resulting from the Contractor's operations.
  - 2. These provisions apply to the relations between the Contractor and utility companies performing work in connection with Authority construction. Permit free and clear access to utility companies for their construction.
  - 3. Coordinate interface requirements with other Contractors; schedule and sequence the activities to meet the project schedule and milestones.

**1.2 CONTRACT MILESTONE AND PHASED CONSTRUCTION**

- A. Contract milestones and construction planning requirements, when applicable, are described in the Contract Documents. Schedules prepared under Section 01320 "Construction Schedules and Progress Reports" or Section 01321 "Construction Schedules and Progress Reports for Small Projects", shall be consistent with contract milestones and construction planning requirements. The work sequence shall be in accordance with the approved Construction Schedule.
  
- B. Suggested construction phasing, when applicable, is described in the Contract Documents.
  
- C. The Contractor shall develop for Authority review and approval a detailed and comprehensive cut-over work plan for the cutover, or connection of the new line section to the existing alignment and systems. The Contractor shall coordinate with the Authority and other contractors or consultants during the development and execution of the cut-over work plan. The cutover work plan shall be

submitted to the Authority a minimum of 90 days prior to the requested cutover date. The cutover work plan shall include:

- 1. Physical work to be implemented.
  - 2. Impacts to rail facilities, systems and operations.
  - 3. Integrated testing plans.
  - 4. Operations and maintenance requirements.
  - 5. Narrative and schedule information identifying work crew members and work shifts.
  - 6. Hourly schedule detailing all work elements and identification of key hold points to be adhered to during the cutover process.
  - 7. Identify contingency resources and the criteria for implementing the contingencies.
  - 8. Identify required outages and measures for the cutover.
- D. Perform work to accommodate vehicular and pedestrian traffic during construction as specified in Section 01570 "Maintenance and Control Of Traffic".
  
  - E. Contractor shall notify the Contracting Officer immediately of the Contractor's inability to meet any of the constraints or milestones described in the Contract.

**1.3 GEOTECHNICAL REPORT**

- A. The Contractor shall use the Geotechnical Report, Exhibit K, in the performance of the Work.

**1.4 WORKSITE**

- A. Location of the Worksite: The Work is located in the DART service area. Exact location of the Worksite, including the area available for Contractor's operations, access routes, and the right-of-way are shown in the Contract Drawings.
  
- B. Access to the Worksite
  - 1. Plan and execute safe access to the Worksite by construction equipment, vehicles, and personnel in accordance with the Contract.
  - 2. A plan for haul and delivery roads shall be developed by the Contractor and submitted in accordance with Section 01570 "Maintenance and Control of Traffic".

## SUMMARY OF THE WORK

3. The Contractor shall take into consideration the following guidelines for haul and delivery roads plan development:
  - a. Coordinate access and delivery roads with other contractors active in the area.
  - b. Minimize nighttime disturbance of hotel, apartment, single family and condominium residents in the area as required in accordance with the specifications for Section 01560 "Environmental Protection" and by the local rules and regulations of the jurisdictional agencies.
  - c. Minimize daytime disruption to retail and office operations.
  - d. Refer to Sections 01500 "Temporary Facilities and Services", 01560 "Environmental Protection", 01570 "Maintenance and Control of Traffic", and other applicable provisions of Contract Documents for related requirements.
  - e. Provide for access by utility companies and their vehicles to and on the Worksite.
  - f. Provide for access by DART maintenance Personnel and their vehicles to and on the Worksite.
4. The Contractor shall not restrict the portion of the public right-of-way except as noted in these Specifications.
5. The Contractor shall provide access for other contractors during construction.

### 1.5 CONTRACTOR'S STAGING AREA

- A. Refer to the Contract Drawings for specific areas available for Contractor staging areas. Access and egress from the staging area is subject to the approval of the Contracting Officer.
- B. Areas Provided by Contractor: Subject to the approval of the Contracting Officer, the Contractor shall provide, with no liability to the Authority, any additional areas and access thereto not shown or described that may be required for temporary construction facilities or storage of materials. Contractor shall construct and maintain all access roads, detour roads, or other temporary work as required by the Contractor's operation. Refer to Article entitled "Contractor's Use of Private Property" herein for additional requirements.
- C. The boundary of all staging areas shall be located 30 feet or more from the edge of lanes open to the public.

- D. The Contractor's material and equipment shall be stored at the approved Contractor's staging area or at locations approved by the Contracting Officer. The Contractor shall confine equipment, storage of materials, and operation of workers to those areas approved with no liability to the Authority.
- E. When required in the interest of the Work, the Contractor shall arrange offsite parking with a third party at the Contractor's sole responsibility and risk.
- F. Contractor shall provide a security fence for all staging areas used by the Contractor to prevent intrusion into the areas by unauthorized personnel.
- G. The Contractor shall be responsible for the staging areas and offsite parking including the security, maintenance, compliance with the applicable Contract provisions, cleaning, and restoration to their original condition.
- H. The Contractor's facility and the Contracting Officer's facility may be located in one of the staging areas subject to the approval of the Contracting Officer and in accordance with Section 01500, "Temporary Facilities and Services", of the Specifications.

### 1.6 WORKSITE AND STAGING AREA

- A. The Contractor's work activities shall be confined within the Right-of-Way, Easements, and Staging areas as depicted on the drawings, unless approved otherwise.

### 1.7 CONTRACTOR'S USE OF PRIVATE PROPERTY

- A. Use by the Contractor of private property including use for storage, staging, parking, or travel across property shall be with no liability to the Authority and shall be subject to the following provisions.
- B. The Contractor shall identify its need (including the need of its subcontractors of all tiers) for use of private property and obtain written authorization from property owners. Contractor shall also obtain written authorization from occupants, if appropriate.
- C. Contractor shall submit such written authorization for approval by the Contracting Officer. Written authorization shall be in a form acceptable to the Contracting Officer. Refer to Form 01010-A "Temporary Use Agreement", at the end of this Section as an example of an acceptable form.
- D. Such authorization shall typically be submitted a minimum of 21 days prior to Contractor's use of the property. In all cases, such authorization shall be submitted prior to Contractor's use of the property.

**1.8 WORK HOURS**

- A. Construction will be limited to the daylight hours of 7:00 a.m. to 9:00 p.m., Monday through Friday, or as approved by the jurisdictional authority.

**1.9 PERMITS AND LICENSES**

- A. Refer to General Provisions, Paragraph "PERMITS AND RESPONSIBILITIES".
- B. Submit copies of permits and licenses prior to proceeding with work.

**1.10 NOTIFICATIONS AND COMMUNITY RELATIONS**

- A. Contractor shall be responsible for coordination with and notifications to adjacent property owners and businesses regarding disruptions due to the Work scheduled in those areas.
- B. The Contractor shall designate a contact person to be responsible for coordination and notifications. This contact person shall coordinate with the Authority's Community Relations Department prior to contact with property owners and businesses.
- C. Refer to Section 01570 "Maintenance and Control of Traffic", for community notification requirements in regard to disruption of normal vehicular and pedestrian traffic flow patterns.
- D. Prior to commencement of any part of the Work, give any notices required to be given to adjoining landowners or other parties.

**PART 2 - PRODUCTS**

Not used

**PART 3 - EXECUTION**

Not used

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements".

END OF SECTION 01010

SUMMARY OF THE WORK

**ATTACHMENT 01010 - A**

STATE OF TEXAS  
COUNTY OF \_\_\_\_\_

TEMPORARY USE AGREEMENT

As property owner of the property located at \_\_\_\_\_  
Address

I do hereby grant \_\_\_\_\_  
Contractor's Name and Address

(Contractor) the right to use my property for the purpose of \_\_\_\_\_  
Specific Use

In connection with the construction of the Dallas Area Rapid Transit's project: \_\_\_\_\_  
Specific Name of DART Project

The temporary use of my property shall be for a term of \_\_\_\_ months beginning \_\_\_\_\_ and ending \_\_\_\_\_.  
Start Date End Date

Contractor agrees that at the end of the term as specified above, all surplus excavation, debris, trash, and litter resulting from said use of my property shall be cleaned up and hauled off the premises and my property shall be restored as nearly as reasonable to its original condition. This agreement does not waive any damages to my remaining property, which were the result of the Contractor's activities upon this specified property.

Executed this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.  
\_\_\_\_\_  
Property Owner's Signature

THE STATE OF TEXAS  
COUNTY OF \_\_\_\_\_

The foregoing instrument was acknowledged before me on the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_  
by \_\_\_\_\_ and acknowledge to me that he-she executed this agreement for the purposes and consideration  
Name  
herein expressed.

Given under my hand and seal of office on this the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.  
\_\_\_\_\_  
Notary Public, State of Texas

END OF ATTACHMENT

**SECTION 01047  
SYSTEM SAFETY PROGRAM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The Work to be done under this Section consists of establishing and maintaining a Contractor System Safety Program (CSSP). This safety program shall be developed by the designer and integrated into all Work phases relating to Communications, Traction Electrification, i.e., Overhead Contact System and Traction Power Substations, Signals, and Fare Collection, and these Contract Work elements shall be known collectively as "Systems." The CSSP requirements shall be applied to subcontractors, suppliers, and vendors.
- B. The CSSP shall prescribe a formal approach to hazard control through engineering, design, education, management policy, and supervisory control of conditions and practices. The procurements and guidelines established in MIL-STD-882D, Standard Practice For System Safety, shall be applied to the CSSP.
- C. The CSSP shall supplement the fail-safe and fault tolerant design requirements of these Specifications, but shall not, in any way, relieve the Contractor of design responsibility.

**1.2 REFERENCED STANDARDS**

- A. Military Standards
  - 1. MIL-STD-882D – Standard Practice For System Safety
- B. Dallas Area Rapid Transit (DART/Authority)
  - 1. DART Light Rail Transit, Systems Safety and Security Program Plan, January 2006, Revision 8 (SSPP)

**1.3 OBJECTIVES**

- A. Contractor's objectives shall be in compliance with Authority's System Safety and Security Program Plan (SSPP).
- B. The primary objective of the CSSP shall be to eliminate hazards from the "Systems" equipment and facilities provided under this Contract. These are hazards which could result in personal injury, damage, or loss of a portion of the subject facilities, see Article 1.6, "Hazard Risk Assessment and Resolution" of this Section. Hazard risk assessment applies both directly and indirectly, (i.e., whether the injury, damage, or loss, were to be caused directly by a subject facility malfunction or indirectly by the resultant unsafe operation of one or more trains.)

- C. The secondary objective of the CSSP shall be to minimize the extent and seriousness of injury to personnel and damage to equipment and property due to any malfunction of the facilities provided under this Contract.

**1.4 SUBMITTALS**

- A. System Safety Program Plan
  - 1. Contractor shall submit for Authority approval, a Contract System Safety Program Plan (CSSP) within 60 days after Contract NTP in accordance with the requirements of these Specifications. The CSSP shall include all of the requirements of this Section and the intent of the Authority SSPP.
    - a. It shall describe how the CSSP is to be implemented, managed, and documented to achieve the objectives of the CSSP.
    - b. The functions, responsibilities, and authority of all personnel associated with the implementation, management, and operation of the CSSP shall be clearly identified in the Contractor's CSSP. The relationship between line, staff, project, and management shall be shown. The process by which the Contractor shall monitor and supervise subcontractors, suppliers and vendors, to assure their conformance to the applicable requirements of the CSSP shall also be discussed.
    - c. Contractor proposed Preliminary Hazards Analysis (PHA) format shall be shown and described in the CSSP. Contractor's PHA format shall be submitted for Authority approval as part of the CSSP.
  - 2. Contractor may submit a CSSP for Authority approval that has been successfully implemented on a similar rail transit project. In this case, the CSSP shall include:
    - a. A reference contact for the other project including name, title, address and telephone number.
    - b. Definition of equipment and processes that are new or different between the Authority Project and the other project.

## SYSTEM SAFETY PROGRAM

- c. Approach for evaluating the system safety impacts of these new and different elements.
  3. The Authority approved CSSP shall be maintained throughout the life of the Contract.
- B. Monthly Progress Reports: Contractor shall submit to the Authority a Monthly System Safety Reports, commencing no later than 60 days after Contract NTP, as a part of the Monthly Progress Report. The Monthly System Safety Reports shall include the following:
  1. A list of in-progress System safety tasks and the status of each.
  2. Evaluation of design changes on the System safety.
  3. A list of open items relevant to System safety.
  4. A list of System safety tasks to be accomplished in the next reporting period.
  5. An updated schedule showing the significant milestones of the CSSP, with expected dates of completion.
- C. Preliminary Hazard Analysis (PHA): Contractor shall submit the PHA in quarterly increments beginning no later than 6 months after Contract NTP. Each submittal shall include the following information:
  1. The PHA, in the current state of completion.
  2. Perform the PHA and ensure compliance with the relevant portions of the Authority's SSPP Chapter 5 and the CSSP and these Specifications.
  3. Identification of changes, additions, or closed items since the previous submittal.
  4. Status of all known system hazards.
- D. Operating Hazard Analysis (OHA): Contractor shall submit the OHA in quarterly increments, beginning no later than 6 months after Contract NTP. Each submittal shall include the following information:
  1. The OHA, in the current state of completion.
  2. Perform the OHA and ensure compliance with the relevant portions of the Authority's SSPP Chapter 5, the CSSP and these Specifications.
3. Identification of changes, additions, or deletions since the previous submittal.
  4. Status of all known operating hazards.
- E. Failure Mode Effects Analysis (FMEA): Contractor shall submit the FMEA in quarterly increments, beginning no later than 6 months after Contract NTP. Each submittal shall include the following information:
  1. The FMEA, in the current state of completion.
  2. Perform the FMEA and ensure compliance with the relevant portions of the Authority's SSPP Chapter 5, the CSSP and these Specifications.
  3. Identification of changes, additions, or deletions since the previous submittal.
  4. Status of all known operating hazards.
- F. Fault Tree Analysis (FTA): Contractor shall submit the FTA in quarterly increments, beginning no later than 6 months after Contract NTP. Each submittal shall include the following information:
  1. The FTA, in the current state of completion.
  2. Perform the FTA and ensure compliance with the relevant portions of the Authority's SSPP Chapter 5, the CSSP and these Specifications.
  3. Identification of changes, additions, or deletions since the previous submittal.
  4. Status of all known operating hazards.

### 1.5 REQUIREMENTS

- A. Management: Contractor shall be responsible for the CSSP management and operation. The responsibilities and functions of those directly associated with System Safety policies and implementation of the program shall be clearly defined. The authority delegated to this organization and the relationship between line, staff, interdepartmental, project, functional and general management organizations shall be identified. It is not the intent of this Section to prescribe or imply organizational structure, management methodology, implementation procedures, or internal documentation. Pertinent aspects of the CSSP Management shall be reported in the monthly reports.



- B. Contractor shall designate an employee as "System Safety Supervisor or Manager" to manage all aspects of the Contractor's and subcontractors' CSSP. The requirements for the System Safety Supervisor or Manager shall be:
1. Minimum of three years experience in performing operating hazard analyses and preliminary hazard analyses.
  2. Knowledge in "Systems" technology.
  3. Knowledge of Light Rail or Transit control system software safety characteristics.
  4. Contractor shall submit the designated Safety Manager/Supervisor employee and resume and credentials for Authority approval.
- C. Preliminary Hazard Analysis: Contractor shall conduct a complete and comprehensive PHA to identify, classify, evaluate and resolve hazards in the System. The PHA shall include consideration of all "Systems" subsystems, assemblies and components. The PHA shall include the following information:
1. Hazard Index Number
  2. Description of the hazard.
  3. Effects of the hazard.
  4. Initial hazard risk.
  5. Controls for the hazard.
  6. Final hazard risk.
  7. Status of the hazard.
- D. Operating Hazard Analysis: Contractor shall conduct a complete and comprehensive OHA.
- E. Interface With the Authority System Safety Activities.
1. The Authority will perform System Safety Activities as defined in Authority's SSPP. Included in these activities are PHA and OHA. Contractor shall support these activities by providing:
    - a. Technical data related to the Contract requested by the Authority.
    - b. Response to System Safety questions for equipment, procedures or other material related to the Contract.
    - c. Contractor shall disclose, analyze, explain, and discuss designs with the Authority that impact or potentially impact the safety, operation, or reliability where the Contractor's designs deviate from the Authority's current configuration and equipment complement and potentially compel the Authority to review the system safety impact.
- F. Interface With the Authority Operations: Contractor employees that are required to work in and around the Authority revenue operations shall attend an Authority sponsored safety class prior to commencing any Work.
- 1.6 HAZARD RISK ASSESSMENT AND RESOLUTION**
- A. Hazard Risk is comprised of two elements: severity and frequency. Severity is a qualitative measure of the injury and damage resulting from a mishap. Frequency is a qualitative measure of how often a mishap occurs.
  - B. Hazard severity shall be classified and assigned a relative quantitative severity in accordance with the Authority's SSPP Paragraph 5.2.1.
  - C. Hazard frequency shall be assigned a relative frequency of occurrence in accordance with the Authority's SSPP Paragraph 5.2.2.
  - D. Contractor shall take immediate action to control hazards in accordance with the requirements of Authority's SSPP Paragraph 5.4.
- 1.7 TASKS AND PROCEDURES**
- A. The CSSP shall specifically describe the procedures that the Contractor shall follow in order to accomplish CSSP tasks. These tasks shall include the following:
    1. Adequately control entire system hazards in the design phase as early as possible.
    2. Eliminate from the System any identified false Signal proceed aspects or the evoking of any false proceed aspects.
    3. Identify any single failure in the Communication and Control System, Signal System, and Overhead Contact System, Traction Power Substation, Fare Collection or their interfaces that may cause an unsafe condition.
    4. Minimize the number of false signal stop aspects and other false communications control indications due to equipment design, installation, or operating procedure.

5. Evaluate design changes and the impact these changes will have on the safety of the complete System.
6. Establish and maintain the required backup data, information and material to assure and support System Safety Certification of the Communications and Control, OCS, and Signals Systems.

## **PART 2 - PRODUCTS**

### **2.1 CONTRACTOR FURNISHED MATERIALS**

- A. Contractor shall provide all the materials, tools, equipment, computer time, reference literature and any such required items that are essential to meet the CSSP requirements.

## **PART 3 - EXECUTION**

### **3.1 PERFORMANCE**

- A. The System Safety Supervisor / Manager, identified in this Section shall have the following responsibilities:
  1. Direct the activities of the CSSP and assigned personnel to complete all required CSSP tasks in accordance with the Contract Documents, while maintaining and staying within schedule and budget.
  2. Supervise the Contractor's "PHA" of the Communications, OCS, Traction Power Substation, Fare Collection, and Signal Systems and its individual subsystems and interface areas.
  3. Maintain records of all changes to the CSSP. These records shall be available to the Authority upon 48 hours notice.
  4. Determine potential changes that could be made in the systems, operating rules, training procedures, equipment, maintenance procedures, physical structure, or other systems outside this Contract to eliminate critical and marginal hazard conditions or to reduce their effect to a negligible status and recommend these changes to the Authority.
  5. Implement those safety changes approved or required by the Authority, which fall within these Specifications.
  6. Prepare and submit the Monthly System Safety Reports to the Authority as required in Paragraph 1.4.B of this Section.

## **PART 4 - MEASUREMENT AND PAYMENT**

### **4.1 GENERAL**

- A. Work specified in this Section will not be measured separately for payment.

### **4.2 PAYMENT**

- A. In accordance with Section 01001, "General Requirements."

END OF SECTION 01047

**SECTION 01086  
COLOR CODES AND COLOR STANDARDS**

**PART 1 - GENERAL**

**1.1 PURPOSE**

- A. The purpose of this standard is to establish, by means of color-coding, a method for identification of the contents of pipelines; in addition, a uniform color system is given for the painting of safe and hazardous areas of equipment and in buildings.
- B. In all cases where identification is essential to safe operation, use English legend and provide framed/mounted color code guides.

**1.2 REFERENCE STANDARDS**

- A. National Electrical Manufacturers Association (NEMA):
  - 1. NEMA Z535.1 - Safety Color Code

**1.3 CONTENTS**

- A. This standard covers the following color codes, standards, and systems:
  - 1. Safety Color Code.
  - 2. Pipeline Identification Color Code.

**1.4 CODE SYSTEMS USED**

- A. The color codes and standards presented herein are based on historical practice and accepted codes of the American National Standards Institute (ANSI), the National Safety Council and the Occupational Safety and Health Administration (OSHA).

**1.5 GROUP IDENTIFICATION**

- A. Because there is a limited number of colors which are readily distinguishable under all conditions of lighting and aging, materials having some property in common are grouped together under one base or ground color. Within each color group, individual designations are indicated by a secondary color applied as a stripe, or used for the color of letters in stencil.

**1.6 BASE COLORS**

- A. The base or ground colors and the groups of materials they represent are presented in Table 01086 - 1.

**PART 2 - PRODUCTS**

**2.1 SAFETY COLOR CODE**

- A. General Hazard Indication: This Safety Color Code for the use of colors to call attention to physical hazards, the location of safety equipment, and the identification of fire and other protective equipment, is based on NEMA Z535.1.
- B. Code Colors:
  - 1. Red - Fire Protection and Emergency: Use for hydrants and associated piping, firefighting equipment and facilities, also for emergency shut-down controls.
  - 2. Green - Safety: Use for first aid and personal protective equipment and facilities and for sealing devices on valves.
  - 3. Yellow - Caution: Use to designate locations of physical hazards which might cause striking against, stumbling, falling, tripping, "caught in between", as well as for traffic marks.
  - 4. Yellow & Black Stripes - Danger: Use to attract special attention to locations of the physical hazards discussed above.
  - 5. Orange - Alert: Use to designate dangerous parts of machines or energized equipment which may cut, crush, shock, or otherwise injure, and to emphasize such hazards when enclosure doors or other guards around moving equipment are opened or removed.
  - 6. Blue - Precaution (electrical): Use as a precautionary color on electrical controls.
- C. Examples of some applications of the Safety Color Code:
  - 1. Red - Fire Protection and Emergency:
    - a. Fire alarm boxes.
    - b. Fire hydrants.
    - c. Fire buckets or pails.
    - d. Fire extinguishers and areas on walls or supports on which they are mounted.
    - e. Fire exit signs.

## COLOR CODES AND COLOR STANDARDS

- f. Fire hose drum shelters.
  - g. Fire hose cabinets.
  - h. Fire Doors.
  - i. Water lines used primarily for fire fighting purposes.
2. Green - Safety:
- a. Gas mask boxes.
  - b. First aid kits.
  - c. Stretchers.
  - d. Safety deluge showers (white and green stripes).
3. Yellow - Caution:
- a. Corner markers for piles of stored materials.
  - b. Traffic aisles in shops.
  - c. Caution traffic signs in shop and warehouse aisles.
  - d. Coverings or guards for guy wires.
  - e. Crane hooks.
  - f. Suspended fixtures which extend into normal operating areas.
  - g. Projecting fixtures such as doorways, traveling conveyer, low beams, and pipes.
4. Black & Yellow Stripes - Danger:
- a. Dangerous curbs.
  - b. Bottom risers and top landings of industrial and public stairways.
  - c. Exposed and unguarded edges of platforms, pits, and walls.
  - d. Lower pulley blocks of cranes.
  - e. Car bumpers of fork-lift trucks and cranes.
  - f. Pillars, posts, and columns, in areas hazardous to personnel (paint to 5 feet above floor).
- g. Dead ends of passageways and roads.
5. Orange - Alert:
- a. Inside of removable guards for pulleys, shafts, chains.
  - b. Inside of enclosed doors for electrical equipment.
  - c. Any valves which for safety reasons are required to be locked open.
6. Blue - Precaution: Electrical control units.

### PART 3 - EXECUTION

#### 3.1 PIPELINE IDENTIFICATION COLOR CODE

- A. Usage:
- 1. This Pipeline Identification Color Code is for use on all piping systems.
  - 2. Label identifications and the use of English legend are mandatory for the content.
- B. Non-Descriptive Color:
- 1. Aluminum: The only non-descriptive color used or permitted throughout the Contract.
  - 2. When shown on the Drawings, or when approved by the Contracting Officer, paint the entire length of pipe with aluminum color.
  - 3. When aluminum color is used as a non-descriptive color, indicate the base color or band color as specified herein.
- C. Base or Ground Colors Only: When it is necessary to indicate only the broad group of materials handled, without designating the specific material by a stripe, apply only the base or ground color.
- D. Secondary Colors:
- 1. Apply the narrow stripe presenting the secondary color which identifies the specific material by painting, or preferably by use of adhesive plastic tapes or snap-on plastic sleeves of the correct color. Tapes or snap-on plastic sleeves manufactured for this purpose are available from many vendors, with colors matching ANSI colors.
  - 2. In addition, further identify by arrows and legend in English the direction of flow and contents of the pipeline.

**COLOR CODES AND COLOR STANDARDS**

E. Color Bands: The location and size of stripes and bands applied to the pipes are recommended as follows:

1. One each side of and adjacent to valves and tees, and other major fittings.
2. Where the pipe enters and emerges from walls, and road and walkway overpasses; on 20 foot centers in equipment rooms.
3. At uniform intervals (20 foot centers) along long sections of the pipe.
4. Adjacent to tanks, vessels, and pumps. When bands are employed in place of painting the entire line, provide these bands 1 foot long. Paint stripes 2 inches wide centered on the band, and space 1 inch apart when two stripes are applied.

F. Examples of Application of the Pipeline Identification:

1. Color Code: Table 01086-2 presents the comprehensive Identification Color Code, listing both band and stripe colors:

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

A. Separate measurement or payment will not be made for work required under this Section. All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

**TABLE 01086-1  
BASE COLORS**

<u>Color</u>	<u>Class of Material</u>
White	Steam (all pressures)
Yellow	Chemicals (most of these being dangerous, including inhibitors)
Gray	Crude oil
Orange	Petroleum gases, naphthas, gasolines, solvents, jet fuels including mineral spirits and lighter fluid
Oxide Red	Kerosene, diesel oils, waxy distillages, and heavier non-volatile petroleum products.
Black	Fuel oils, asphalt, slop oils, residual oils, still bottoms.
Blue	Water (designated types and temperatures).
Green	Air, nitrogen, oxygen, Freon
Red	Fire protection materials and equipment.

**TABLE 01086-2  
PIPELINE COLOR CODES**

<u>Pipeline</u>	<u>Identification Base or Ground Color Band</u>	<u>Color Code Secondary Color or Stripe</u>
<b><u>Steam</u></b>		
400 psi and over	White	1-yellow
150 psi to 400 psi	White	1-red
Below 150 psi	White	1-green

COLOR CODES AND COLOR STANDARDS

**Hot Water (150° F and over)**

Raw	Blue	2-black
Condensate	Blue	2-white
Treated (any process)	Blue	2-oxide red

**Water (below 150°F)**

Raw	Blue	1-black
Chilled	Blue	1-gray
Condensate	Blue	1-white
Treated (any process)	Blue	1-oxide red
Sewage	Blue	1-purple

**Fire Protection**

Water, Foam or Other Fire-extinguishing Material	Red	
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**Fuels**

Gasoline (regular)	Orange	1-black
(premium)	Orange	1-blue
Gasoline (white)	Orange	1-white
LP Gas	Orange	1-oxide red
LP Gas (refrigerated)	Orange	1-yellow
Diesel Oil (white)	Oxide Red	1-white
Diesel Oil (black)	Oxide Red	1-black
Fuel Oils Black	1-yellow	
Asphalt Black	1-white	
Slop and Waste Oils	Black	1-orange

**Lube and Crude Oils**

Lube Oils	Gray	1-green
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**Chemicals**

Acids	Yellow	1-red
Ammonia	Yellow	1-blue
Caustics	Yellow	1-black
Chlorine	Yellow	1-oxide red
Inhibitors	Yellow	1-aluminum
Hydrogen	Orange	1-aluminum
Gas (fuel and sour)	Orange	1-gray
Gas (sweet)	Orange	1-aluminum
Air (industrial)	Green	1-gray
Air (instrument)	Green	1-black
Nitrogen	Green	1-orange
Oxygen	Green	1-white
Carbon Dioxide	Green	1-red
Freon	Green	1-yellow

END OF SECTION 01086

**SECTION 01220  
MEASUREMENT AND PAYMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. In addition to the General Provisions Paragraphs, "MEASUREMENT AND PAYMENT OF SCHEDULED ITEMS" and "PAYMENTS", this Section includes specifications for measurement and payment as they apply to the Work, and includes provisions applicable to lump sum prices, unit prices, and allowances, as indicated.
- B. Measurement methods specified in the individual Sections of these Specifications shall govern if they differ from methods specified in this Section.

**1.2 LUMP-SUM MEASUREMENT**

- A. The term "lump sum." when used as an item of payment, will mean complete and fixed price for the work prescribed for that portion of the contract work under the item described in the contract.
- B. The quantities may be shown on the Contract Drawings for items for which lump sum is the method of measurement. If shown, the quantities are shown for the convenience of the Contractor. Contractor shall verify quantities for purposes of bidding and construction. The Contractor will not be entitled to additional compensation if the quantities shown vary from those actually required.
- C. Breakdown of costs of lump sum items:
  - 1. If the Contractor requests progress payments for lump-sum items or amounts in the Bid Schedule, such progress payments will be made in accordance with a well-balanced, detailed breakdown of costs of lump sum items for payment purposes, prepared by the Contractor and submitted to the Contracting Officer for approval.
  - 2. Such breakdown for each applicable lump-sum item shall show fixed definable and measurable quantities where possible and unit prices therefor as developed and assigned by the Contractor to the different features of the work and major subdivisions thereof. The summation of extensions of quantities and unit prices and related costs shall equal the amount of the lump-sum Contract Price or lump sum bid item indicated in the Bid Schedule.
  - 3. Following the Contracting Officer's approval, progress payments will be made in accordance with the Contractor's breakdown and from the approved progress schedule, reflecting the progress which occurred during the payment period as approved by the Contracting Officer.

**1.3 MEASUREMENT OF QUANTITIES FOR UNIT PRICES**

- A. Measurement will be in accordance with the General Provisions Paragraph, "MEASUREMENT AND PAYMENT OF SCHEDULED ITEMS".
- B. Measurement Standards: Work paid for at a unit price per unit measurement will be measured in accordance with United States Standard Measures except as otherwise specified.
  - 1. The term "pound" when used in the measurement or payment of any material or work, will mean 16 ounces avoirdupois, based on computed or scale weight.
  - 2. The term "ton" when used in the measurement or payment of any material or work, will mean the short ton consisting of 2000 pounds avoirdupois. When applicable, materials measured in pounds will be converted to tons.
- C. Measurement, General: Unless otherwise specified, the following shall apply:
  - 1. Structures will be measured according to neat lines shown on the Contract Drawings or as ordered in writing, unless otherwise specified. Concrete and masonry will be measured and accurately computed by dividing the work into simple geometrical figures and adding their volumes or areas.
  - 2. Allowance will not be made for surface laid over a greater area than shown on the Contract Drawings, or for any material moved from outside the area of the cross section and lines shown on the Contract Drawings except when specifically authorized by the Contracting Officer.
- D. Measurement by Area: Unless otherwise specified, the following shall apply: Longitudinal measurements for area computations will be made horizontally. Transverse measurements will be the neat dimensions shown on the Contract Drawings or ordered in writing by the Contracting Officer.
- E. Measurement by Volume: Unless otherwise specified, the following shall apply: In computing volumes of excavation, embankment or borrow, methods utilizing electronic computation, planimeters, or other accepted engineering procedure having general acceptance in the engineering profession will be used. When the measurement is based on the cross sectional area, the average end area method will be used.

## MEASUREMENT AND PAYMENT

- F. Linear Measurement: Unless otherwise specified, the following shall apply: Items which are measured by the linear foot, such as guardrail, underdrains, etc., will be measured parallel to the base or foundation upon which such structures are placed, unless otherwise shown on the Contract Drawings. Unless otherwise specified, items measured on a linear basis will be measured at the centerline of item in place.
- G. Measurement per Each: The term "each" when used as an item of payment such as project markers and Right-of-Way monuments will mean complete payment for the work prescribed for that item.
- H. Measurement by Weight: Unless otherwise specified, the following shall apply:
1. Materials specified for measurement by weight shall be weighed on standard scales furnished by and at the expense of the Contractor. Such scales shall be sealed at the expense of the Contractor as often as is necessary to ensure their accuracy. A sworn weigher, to be compensated by the Contractor, shall weigh all materials required to be weighed as provided above. The Contracting Officer may witness the weighing of such materials. If materials are shipped by rail or trucks, the car weights or quarry weights may be accepted, but scales shall be used as above and weight slip shall be signed by the sworn weigher. Obtain countersignature by the Contracting Officer of the weight slips on delivery. Weight slips which have not been countersigned will not be included for payment under the Contract.
- I. Bituminous Materials: Bituminous materials, where specified to be paid for separately, will be measured for payment by the ton, unless specified or directed otherwise. Bituminous materials delivered in tank trucks or tank feeders shall be weighed on scales, as approved by the Authority.
- a. Bituminous materials delivered in tank cars, when not actually weighed, shall be measured by volume at the loading temperature, subject to the approval of the Contracting Officer, and this quantity converted to the volume at the applying temperature. The coefficient of expansion or contraction per degree Fahrenheit shall be 0.00035 for asphalt, 0.00025 for asphalt emulsions, 0.0004 for cutback asphalt, and 0.0003 for tar.
- J. Portland Cement: Where specified to be paid for separately, Portland cement will be measured by the bag or barrel as indicated. A bag of cement shall contain 94 pounds net and shall be considered equal to 1 cubic foot. A barrel of cement shall weigh 376 pounds net.
- K. Timber: Where specified to be paid for separately by the thousand board foot, timber will be measured by the thousand feet board measure (M.F.B.M.) actually incorporated in the structure. Measurement will be based on nominal widths, and the thickness and the extreme length of each piece.
- L. Timber: Where specified to be paid for separately by the board foot, timber will be measured by the board foot actually incorporated in the structure. Measurement will be based on nominal widths, and the thickness and the extreme length of each piece.

### 1.4 VALUES OF UNIT PRICES

- A. The number of units and quantities contained in the Bid Schedule as estimated quantities are approximate only, and final payment will be made for the actual number of units and quantities, which are incorporated in the Work and required by the Contract, as, measured by the Contracting Officer.
- B. In the event that work or materials or equipment are required to be furnished to a greater or lesser extent than is indicated in the Contract Documents, such work or materials or equipment shall be furnished in greater or lesser quantities in accordance with General Provisions Paragraph, "VARIATION IN ESTIMATED QUANTITY".

### 1.5 ALLOWANCES

- A. Description: Allowances specified in the Contract Documents and indicated in the Bid Schedule shall cause the work so covered to be furnished, performed, and completed for such sums as are acceptable to the Contracting Officer and shall include the cost to the Contractor of all materials and equipment to be delivered and installed under the specified allowances.
- B. Specific Allowances: Specific allowances, if any, included in the Contract are indicated in the Bid Schedule.
- C. Administration:
1. The allowances specified in the Contract Specifications and indicated in the Bid Schedule are exclusive of any work indicated in the Contract Documents for which payment is included under other specifically designated items in the Bid Schedule.
  2. Contractor Accountability of Allowance Work Performed: Contractor shall maintain a separate account of all incurred, segregable, direct costs for the work allocable to the item requirements. Only allowable and allocable direct costs will be reimbursed; there shall be no compensation for any other related costs including but not limited to overhead indirect costs, commission or profit. These amounts shall not subject to retainage.



**1.6 CONTRACT PAYMENTS**

- A. Payments will be in accordance with the General Provisions Paragraph, "PAYMENTS".
- B. Full Compensation:
  - 1. The Contract lump sum and unit prices paid for the various items and classifications of work shall include full compensation for furnishing labor, supervision, materials, tools, equipment, transportation, services, and incidentals, and for performing work necessary for completing the construction or installation of the item or work classification, complete in place, unless stated otherwise. Prices paid shall include all miscellaneous components, accessories, and appurtenances; shop drawings, working drawings, and other submittals; and testing and inspection, unless stated otherwise.
    - a. The term "complete in place", when used in regard to measurement and payment, means the completion of the contract item, including the furnishing of materials, equipment, tools, labor, supervision and work incidental thereto, unless otherwise specified.
  - 2. Refer to with the General Provisions Paragraph, "MEASUREMENT AND PAYMENT OF SCHEDULED ITEMS" for payment for cost of work not specifically provided for by a pay item in the Bid Schedule.
- C. Refer to the breakdown of costs of the lump sum price for General Requirements required under this Section: If in any month, the Contractor fails to comply with any portion of the General Requirements that has value to the Authority which will not be fulfilled by the untimely performance of that aspect of the work, the entire monthly payment for General Requirements will be deducted from the Contract Amount. If such work is completed or submitted late within a particular month, the payment will be prorated at the option of the Contracting Officer and a percent of the payment (in accordance with the proration) will be deducted from the Contract Amount. Examples of aspects of the work which have value to the Authority only or primarily in their timely execution for each month are submittal of properly prepared Schedule Update, proper execution of Contractor's Quality Control Plan, and maintenance of complete and correct Working (As-Built) Drawings and Specifications.

**1.7 REJECTED, EXCESS, OR WASTED MATERIALS**

- A. Quantities of material wasted or disposed of in a manner not called for under the Contract; rejected loads of material, including material rejected after it has been placed by reasons of the failure of the Contractor to conform to the provisions of the Contract; material not unloaded from the transporting vehicle; material placed outside the lines indicated on the Contract Drawings or established by the Contracting Officer; or material remaining on hand after completion of the Work, will not be paid for, and such quantities shall not be included in the final total quantities. No additional compensation will be permitted for loading, hauling, and disposing of rejected material.

**1.8 CERTIFICATION OF AS-BUILTS**

- A. The Contractor shall submit with each pay request, a certification that all Request for Information (RFI's), Change Orders or Supplemental Agreements, clarifications, revisions and field surveyed data have been documented on the Working (As-Built) Drawings and Specifications sets in accordance with the contract requirements. Working (As-Built) Drawings and Specifications shall be certified correct and complete by the Contractor's Quality Control Representative at the time invoices are submitted for progress payments.

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements"

END OF SECTION 01220

**SECTION 01312  
PROJECT MEETINGS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the general requirements and procedures regarding the project meetings.

**1.2 TYPES OF MEETINGS**

- A. Pre-Construction Conference: Prior to the start of construction.
- B. Initial Coordination Meeting: Prior to the start of construction
- C. Initial Coordination Utility and Jurisdictional Agency Meetings: As needed.
- D. Contractor Coordination Meeting (Weekly Progress Meeting): Held weekly.
- E. Monthly Progress Status Meeting: Held monthly.
- F. Mutual Understanding Meeting: Held after the Contractor's Quality Control Plan is approved, refer to Section 01450, Quality Control.
- G. Contractor's Quality Control (CQC) Meetings: Held weekly.
- H. Ad-Hoc Meetings: As required throughout prosecution of the Work. To address immediately any matter or situation that has a bearing on the quality or completion of the Contract Work.

**1.3 PRE-CONSTRUCTION CONFERENCE**

- A. The Contracting Officer will arrange a Pre-Construction Conference to orient the Contractor. The date of the conference will be as soon as practical after Notice of Award.
- B. Attendees: Contracting Officer, other Authority representatives, and representatives of the Authority's designers, utilities, and other jurisdictional authorities. Contractor's Attendees: A responsible officer of the Contractor, the Project Manager, proposed Contractor's Quality Control Representative (CQCR), Superintendent, Safety Supervisor, and other personnel as necessary.
- C. Agenda:
  - 1. Project Organization and Discussion of Responsibilities.
  - 2. Design Overview
  - 3. Contract Documents
  - 4. Insurance and Bonds

- 5. Quality Control
- 6. Safety
- 7. Environmental Protection
- 8. DBE/MDE/WBE Requirements
- 9. Operations Coordination
- 10. Maintenance Coordination
- 11. Utility Coordination
- 12. Community Relations
- 13. Neighborhood Job Opportunity Program

**1.4 INITIAL COORDINATION MEETING**

- A. The Contracting Officer will arrange and conduct the Initial Coordination Meeting with the Contractor. The agenda will be forwarded to the Contractor soon after Notice to Proceed.
- B. Contractor's attendees shall include the Project Manager, CQCR, Superintendent, Safety Supervisor, and other personnel as necessary.
- C. Agenda:
  - 1. Authority's Project Organization
  - 2. Contractor's Project Organization
  - 3. Partnering
  - 4. Quality Control
  - 5. Proposed Construction Methods
  - 6. Scheduling
  - 7. Communications Procedures
  - 8. Meetings
  - 9. Submittals
  - 10. Project Cost Control
  - 11. Differing Site Conditions
  - 12. Design Changes
  - 13. Claims
  - 14. Project Completion
  - 15. Labor Provisions

16. Payment Procedures

**1.5 INITIAL COORDINATION UTILITY AND JURISDICTIONAL AGENCY MEETINGS**

- A. The Contracting Officer will arrange and conduct meetings with the Contractor and affected entities. The purpose of these meetings will be to establish an early working relationship between the Contractor and affected utilities and jurisdictional agencies and establish coordinated activities during the construction phase.
- B. Agenda:
  - 1. Review the Agreements with each party.
  - 2. Representative contact and their authority for each party present.
  - 3. Permit, insurance, safety requirements.
  - 4. Scheduling of work.
  - 5. Inspection and acceptance of work.
  - 6. Release and Final Acceptance.

**1.6 MONTHLY PROGRESS STATUS UPDATE MEETING**

- A. This meeting shall be held prior to the formal submittal to verify progress and review the approved schedule against actual progress and to establish a basis for the monthly payment estimate.
- B. Agenda Topics
  - 1. Agreement on Update Information: The Contracting Officer will review the Contractor submitted logic sort of last month's printout as a draft. Either prior to or during the meeting, the update information listed below shall be agreed upon. This agreed-upon update information shall then be entered into the CPM Schedule.
    - a. Actual start dates on activities started this period.
    - b. Actual completion dates on activities finished this period.
    - c. Remaining duration's for activities which have started but are not completed.
  - 2. Status of Project Milestones: Review project milestones with gains or slippages noted.
  - 3. Schedule Slippages: Review any slippages in critical activities or on project milestones.

- 4. CPM Changes for Next Update: List and categorize any agreed changes to the schedule as shown below:
  - a. Minor logic changes.
  - b. Changes in the duration of any activity.
  - c. Incorporation of any Change Orders and/or Contract Modifications into the schedule and their impact upon project milestones.
  - d. Personnel loading changes.

- 5. Potential Delays: Review the planned activities (starting, in-progress, and completing) for the next period, highlighting any foreseeable delaying factors. Resolve problems that may or have already affected the schedule, with the specific action to be taken by each party.

**1.7 CONTRACTOR COORDINATION MEETING**

- A. This meeting shall serve as a forum to establish and maintain close coordination of work activities through an overview of the next month's activities, provide details regarding the upcoming work week; and discussing the activities of the following work weeks in more general terms. The agenda shall include the following, as appropriate:
  - 1. Review and approval of minutes of previous meeting.
  - 2. Project safety issues.
  - 3. Environmental protection and hazard related issues.
  - 4. Weather-related issues.
  - 5. Community relations.
  - 6. Review of work progress since previous meeting.
  - 7. Activities in progress or scheduled for upcoming week including subcontracted work.
  - 8. Manpower, material, and equipment restrictions.
  - 9. Access and availability of work sites.
  - 10. Potential slippage in progress schedule.
  - 11. Corrective measures to regain project schedule.

- 12. Status of shop drawings, working drawings, and other submittals.
- 13. Review of offsite fabrication, inspection, and delivery schedules.
- 14. Delivery of materials.
- 15. Interfaces and dependencies with preceding, concurrent, and follow-on contractors.
- 16. Quality assurance and quality control issues.

**PART 4 - METHOD OF MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements".

END OF SECTION 01312

**1.8 CONTRACTOR'S QUALITY CONTROL MEETING**

- A. This meeting shall be held to review Contractor's and Authority's quality control and quality assurance activities and results, review discrepant items, review deficiencies and non-conformances, discuss prevention and correction, identify work which requires as-built drawings, to agree on weather days, and discuss any other concerns which may be related to quality control. DART Quality has the option to attend these meetings.

**1.9 MEETING ADMINISTRATION PROCEDURES**

- A. Unless advised otherwise, meetings will be held in the office of the Contracting Officer.
- B. Except for ad-hoc meetings, the day and time for regularly scheduled meetings will be established at the Pre-construction Conference. Requests for changes in date and time of meeting by either party will require a minimum of 24 hours advance notice.
- C. Except as otherwise specified, the Contracting Officer will prepare the meeting minutes and distribute them to attendees within five working days following the date of the meeting and within three working days following the date of the Monthly Progress Status Update Meeting.
- D. Contractor shall submit any exceptions to the meeting minutes within 48 hours of receipt.
- E. Contractor's Quality Control Representative (CQCR) shall document CQC meetings and provide copies of the minutes to the Contracting Officer within two days after the meeting.

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.

**SECTION 01320  
CONSTRUCTION SCHEDULE AND PROGRESS REPORTS**

The provisions of the DART Standard Specification Supplement Section 01320, "Construction Schedule and Progress Reports", shall apply to the Work as modified herein.

**PART 1 – GENERAL**

**1.4 IN-HOUSE CAPABILITY:** Change Paragraphs 1.4/C/1 to read as follows:

- C. Contractor shall maintain on the project site. It is the contractor's responsibility to provide an accurate, detailed, and timely schedule in compliance with specifications. The contractor shall have a scheduler whose is qualified in CPM scheduling techniques and familiar with Authority's CPM scheduling software. The scheduler shall have responsibility for monitoring status, updating progress and revising the Contract Schedule tor reflect current contract status.

**APPENDIX C**

**TO SECTION 01320**

**SCHEDULE OF VALUES**

**I. WORK STRUCTURE:** Change Items I/A/1-5 as follows:

- A. In order to achieve a standardized coding structure, the following activity code definitions are required as a minimum:
  - 1. TRE Project Code
  - 2. TRE Function Code
  - 3. TRE Contract Number.
  - 4. Pay Item Number
  - 5. Area of Work
  - 6. Sub-Area of Work

**II. ACTIVITY CODES DICTIONARY:** Change Items as follows:

<u>Name</u>	<u>Length</u>	<u>Description</u>
PROJ	9	TRE Project Code
FUNC	4	TRE Function Code
CONT	10	TRE Contract Number
PAY	6	Pay Item Number
AREA	6	Area of Work
SUBA	4	Sub-Area of Work

Note: Procurement should be and "AREA" and Submittal, Submittal Review by Contractor, TRE Approval and Delivery should all be "SUB AREAS" of work.

**III. ACTIVITY CODES DEFINITIONS:** Change Items III/1-6 as follows:

- 1. TRE Project Codes (PROJ): As Assigned by the Authority.
- 2. TRE Function Codes (FUNC): As Assigned by the Authority.
- 3. TRE Contract Number (CONT): As Assigned by TRE Contract Department.
- 4. Pay Item Number (PAY): As per the associated Item number in the Bid schedule.
- 5. Area of Work (AREA): As assigned by Contractor.
- 6. Sub-Area of Work (SUBA): As assigned by Contractor.

**END OF SECTION 01320**

**SECTION 01320  
CONSTRUCTION SCHEDULE AND PROGRESS REPORTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. This section together with Appendices A, B, and C specifies requirements and procedures for the Contractor to prepare Construction Schedule, Schedules of Values, Schedule Reports, Schedule Data Files, and related reports. The purpose of the schedules and reports shall be to:

1. Ensure adequate planning and timely execution of the work by the Contractor.
2. Establish a model to be used as a basis for determining satisfactory progress and completion of the Project.
3. Facilitate coordination and interfacing of the Contractor's work with others as needed.
4. Assist the Contracting Officer in monitoring progress.
5. Verify the approximate amount of the monthly progress payment to be made to the Contractor.
6. Evaluate proposed changes to the Contract and subsequent impacts to the schedule.

B. Contractor shall be required to provide and maintain at a minimum the following:

1. Monthly Requirements:
  - a. Construction Schedule.
  - b. Schedule of Values.
2. Weekly Requirements: Provide for Contractor Coordination (Weekly Progress) Meetings:
  - a. Narrative Summary.
  - b. Three Week Look Ahead (using the P6 Baseline Schedule) with updated data disk.

**1.2 REFERENCED STANDARDS**

A. The following publications are cited as references for the CPM scheduling technique described in this Contract:

1. O'Brien, J., CPM in Construction Management, 4th Edition, McGraw-Hill.
2. Construction Planning and Scheduling Manual, Associated General Contractors of America, latest Edition.

**1.3 CONSTRUCTION SCHEDULING PROCEDURE**

- A. Scheduling technique known as the Critical Path Method (CPM) will be used by the Contractor in complying with these Specifications. The Precedence Diagramming Method (PDM) shall be used in preparing the CPM diagrams and calculations.
- B. Contractor shall prepare the Construction Schedule, Schedule Reports, and Schedule Data Files using products of Primavera Systems, Inc., specifically: Primavera Project Planner for Windows (latest version). Any versions of the specified scheduling software used by the Contractor shall be compatible with the versions employed by the Contracting Officer.
- C. Construction Schedule, Schedule of Values, Review Bar Chart, and Schedule Data Files shall be produced in the formats described in Part 2 "PRODUCTS".

**1.4 IN-HOUSE CAPABILITY**

- A. Within 14 calendar days after Notice of Award, submit a statement of network analysis capability to the Contracting Officer verifying that either the Contractor's organization has "in-house" capability qualified to satisfy the requirements of this specification or that the Contractor employs a consultant or firm which is so qualified. Contractor shall verify capability by providing a description of construction projects to which the Contractor or his consultant has successfully applied CPM network analysis. Include a minimum of two projects, with references, valued at least half of the value of this contract and which were controlled throughout the duration of the project by means of periodic systematic review, update and revision of a CPM network schedule.
- B. The use of an outside consultant is at the Contractor's expense and does not relieve the Contractor of responsibility for complying with this section.
- C. Contractor shall maintain on the project site, a full time dedicated scheduler whose sole responsibility is scheduling and who is qualified in CPM scheduling techniques and familiar with the Authority's CPM scheduling software. The dedicated scheduler shall have the primary responsibility for monitoring status, updating progress and revising the Contract Schedule to reflect current contract status.

**1.5 SUBMITTALS**

- A. Construction Schedule:
  1. Preliminary Construction Schedule:
    - a. Contractor shall prepare a Preliminary Construction Schedule, which shall show in detail the Work activities for the first 3 months of the Work and a summary by

## CONSTRUCTION SCHEDULE AND PROGRESS REPORTS

- area/subarea of all remaining activities for the entire Contract.
  - b. Preliminary Construction Schedule shall consist of no less than 200 activities (refer to Appendix A) and shall be presented in the form of a Bar Chart.
  - c. Each activity, which is not a milestone, submittal, or information, on the Preliminary Construction Schedule shall be allocated a dollar value that coincides with the Schedule of Pay Items, the summation of which shall equal the Grand Total shown on the Schedule of Pay Items.
  - d. Preliminary Construction Schedule shall be submitted within 14 calendar days after the effective Notice to Proceed.
- 2. Secondary Construction Schedule:
  - a. Contractor shall expand the Preliminary Construction Schedule to create a Secondary Construction Schedule that will show in detail all work activities and corresponding costs and resource requirements including labor by type, major equipment, as required per activity for the entirety of the Contract.
  - b. Secondary Construction Schedule shall be divided into activities which are reasonable, realistic and feasible; and shall be representative of the separable portions of the work and shall comply with the policies of Activity Definition and Duration as outlined in Appendix A to this section.
  - c. Graphic representations and tabular reports shall be generated using the formats and quantities stipulated in PART 2 "PRODUCTS" using the software specified in Paragraph 1.3.B
  - d. Secondary Construction Schedule is to be submitted within 25 calendar days after the effective Notice to Proceed.
- 3. Review Conference
  - a. In preparation for a Baseline Construction Schedule, and as part of the submittal process, the Contractor and Contracting Officer shall jointly review the Secondary Construction Schedule within 7 days after submittal to insure Contract compliance.
  - b. Revisions requested by the Contracting Officer with respect to schedule presentation shall be implemented and resubmitted for approval within 7 days after the Review Conference.
- c. Contractor shall furnish within 7 days after the Review Conference a written narrative defining the Contractor's determination of durations. The narrative shall describe the number of laborers, weather incorporation, the number of work days per week, and major construction equipment.
- 4. Baseline Construction Schedule:
  - a. A Secondary Construction Schedule incorporating any revisions as requested by the Contracting Officer as a result of the Review Conference shall be submitted 45 calendar days after Notice to Proceed for approval by the Contracting Officer.
  - b. Upon approval by the Contracting Officer, the Secondary Construction Schedule, as defined in Paragraph 1.5.A.2.a, shall constitute the Baseline Construction Schedule. Approval by the Contracting Officer is for conformance to the requirements of the contract documents only. Approval does not relieve the Contractor of any of its responsibility for the accuracy or feasibility of the Baseline Construction Schedule, or the Contractor's ability to meet milestone dates and the contract completion date.
  - c. Baseline Construction Schedule and subsequent updates shall be generated using the formats and quantities stipulated in PART 2 "PRODUCTS" using the software specified in Paragraph 1.3.B .
  - d. Contractor shall discuss in detail the Baseline Construction Schedule with all subcontractors and major suppliers as it relates to their respective work.
  - e. Baseline Construction Schedule will be used as a basis for verifying future progress payments and to measure the Contractor's overall performance on a monthly basis.
- 5. Update of Baseline Construction Schedule:
  - a. Baseline Construction Schedule, hereinafter referred to as the "Construction Schedule," shall be updated on a monthly basis until Contract completion except with respect to contract modifications or approved revisions to the Construction Schedule which will require interim submittals of the Construction Schedule as deemed necessary by the Contracting Officer.

CONSTRUCTION SCHEDULE AND PROGRESS REPORTS

- b. Updated Construction Schedule shall be calculated using "retained logic" and shall depict progress of work and payments corresponding to the established "status" date as mutually agreed upon by the Contractor and Contracting Officer. Construction Schedule. 12 digit cost accounts by pay item number with Categories shall be assigned as indicated in Appendix B. The sum of the dollar amounts assigned to each activity shall equal the Grand Total shown on the Schedule of Pay Items.
  - c. Actual progress shall be reflected in the following terms and subject to approval by the Contracting Officer:
    - 1) Activities started and/or completed.
    - 2) Percentage of resources expended..
    - 3) Estimated remaining duration for each activity in progress.
    - 4) Budgeted dollar amount and actual dollar amount per activity based on percent complete per resource.
  - d. Contractor shall certify in writing that the updated Construction Schedule has been discussed in detail with all subcontractors and major suppliers as it relates to their respective work and a copy submitted to the Contracting Officer.
  - e. Updates to the Construction Schedule, as agreed upon by the Contracting Officer shall be submitted with requests for progress payment, commencing with the third payment request. Failure to meet the requirements of this paragraph shall result in the withholding of payments for the General Requirements.
  - f. Monthly reports shall be provided to the Contracting Officer with the request for progress payment by the 15th day of each month or by a date mutually agreed to by the Contractor and the Contracting Officer (See b above) and shall contain the latest updated progress information from the previous update.
  - g. Request for progress payment, narrative report, and the construction schedule shall cover a 1-month period from the end of the last period day 25 of the current month or as mutually agreed.
- b. Preliminary Schedule of Values shall outline at a minimum:
    - 1) The "Title" of each activity as defined in the Construction Schedule.
    - 2) The Pay Items used to determine the total dollar amount of each activity.
    - 3) The total dollar value of each activity.
  - c. Preliminary Schedule of Values is to be submitted with the Preliminary Construction Schedule ten days after Notice to Proceed.
2. Secondary Schedule of Values:
- a. Contractor shall update the Preliminary Schedule of Values to create a Secondary Schedule of Values that will allocate a dollar value (cost) for each activity of the CPM Schedule. Each activity cost allocation shall include a labor, equipment, and material cost and a prorata contribution to overhead and profit. The sum of activity costs shall be equal to the total Contract Sum.
  - b. Secondary Schedule of Values is to be submitted in the format and quantities stipulated in PART 2, "PRODUCTS".
  - c. Secondary Schedule of Values is to be submitted with the Secondary Construction Schedule, 25 days after Notice to Proceed.
3. Review Conference:
- a. In conjunction with the Review Conference for the Secondary Construction Schedule, the Contracting Officer shall also review for approval the items delineated on the Secondary Schedule of Values.

B. Schedule of Values:

1. Preliminary Schedule of Values:

- a. Contractor shall prepare a Preliminary Schedule of Values to show the allocation of Pay Items to individual activities defined in the Preliminary

- b. If, in the opinion of the Contracting Officer, the Secondary Schedule of Values lacks sufficient detail to support an activity's value, the Contractor will be required to submit documentation substantiating the value of those activities in question.



CONSTRUCTION SCHEDULE AND PROGRESS REPORTS

- 1) Documentation shall be in the format defined in Appendix B to this section. This documentation shall be submitted within 3 working days after the Review Conference.
  - 2) Based on the documentation provided for in the preceding paragraph, dollar amount allocations will be considered unbalanced if an activity on the Construction Schedule has been assigned a disproportionate share of the dollar amounts.
  - c. Any adjustment to the dollar amounts of activities as deemed necessary by the Contracting Officer shall be implemented and resubmitted for approval within 7 days after the Review Conference.
4. Baseline Schedule of Values:
- a. Secondary Schedule of Values incorporating any dollar amount adjustments as requested by the Contracting Officer as a result of the Review Conference, and subsequent review of any additional dollar amount documentation as described under Sub-section 1.5.B.3 shall be submitted with the Secondary Construction Schedule, 45 days after the effective Notice to Proceed for approval by the Contracting Officer.
  - b. Upon approval, the Secondary Schedule of Values as defined in Paragraph 1.5B.4.a. shall constitute the Baseline Schedule of Values.
5. Update of the Baseline Schedule of Values:
- a. Contractor shall update the Baseline Schedule of Values to reflect approved contract modifications and/or revisions affecting activity dollar amounts.
  - b. Submit Updates to the Baseline Schedule of Values to the Contracting Officer for approval.
  - c. Updates to the Baseline Schedule of Values, as approved by the Contracting Officer, shall be submitted with the corresponding updates to the Construction Schedule.
- C. Weekly Narrative Summary:
1. Contractor shall prepare a Weekly Narrative Summary which briefly addresses the following:
    - a. Status of submittals and RFI's.
    - b. Subcontractors' work.
    - c. Anticipated change orders.
    - d. Project issues and concerns.
    - e. Deficiencies and Non-conformances.
    - f. Questions and answers.
  2. Weekly Narrative Summary shall discuss in greater detail the physical progress during the preceding week; plans for the current week and succeeding 2 weeks; problem areas, current and anticipated; delaying factors and their impact; and an explanation of corrective actions taken or proposed.
  3. Weekly Narrative Summary shall specifically address the status of incomplete activities which have less than 5 work days of float and which are either in progress or schedule to be started within the next 2 weeks.
  4. Weekly Narrative Summary shall include a list of the anticipated delivery status of material and equipment, including current estimates of submission and review status of submittals and product data.
  5. Weekly reports shall be provided to the Contracting Officer no later than 24 hours prior to the Contractor Coordination Meeting and shall contain the latest updated progress information from the previous week (Saturday through Friday).
- D. Three-Week Look Ahead:
1. Contractor shall prepare a Three-Week Look Ahead on a weekly basis.
  2. Three-Week Look Ahead shall be submitted to the Contracting Officer for review no later than 24 hours prior to the Contractor Coordination Meeting.
  3. Three-Week Look Ahead shall be created in P6 format or other acceptable formats approved by DART from the latest accepted Construction Schedule.
    - a. Additional detail shall be added to the Construction schedule if the Three-Week Look Ahead requires additional detail.
    - b. No activity ID number or Description shall be changed.
    - c. Additional detail shall be added by changing the activity type to hammock and creating the detail within the hammock.

- E. Qualifications of Scheduler: Refer to Article entitled “In-House Capabilities” herein for submittal requirements.

- b. Codes.
- c. Early Dates.
- d. Actual Dates.
- e. Calendar.
- f. Original Duration.
- g. Resources.

**PART 2 - PRODUCTS**

**2.1 FORMATS**

- A. This section defines the acceptable formats for which the Construction Schedule, Schedule Data Files, Schedule of Values, Weekly Narrative Summary, and Review Bar Chart shall be submitted:

**2.2 CONSTRUCTION SCHEDULE**

- A. Bar -Chart:
  - 1. Bar-Charts shall be produced in 8-1/2 inch by 11 inch format with sufficient clarity and readability so the Contracting Officer can readily monitor and follow progress for all portions of the Contract.
  - 2. Bar-Charts shall contain the following information for each activity in the activity column:
    - a. Identification Number.
    - b. Activity Description (“Title”).
    - c. Original Duration.
    - d. Remaining Duration.
    - e. Percent Complete.
    - f. Total Float.
    - g. Calendar.
    - h. Early Start and Early Finish Date (“Bars”).
    - i. Free Float.
  - 3. Bar-Charts are to be sorted according to the area/sub-area and Early Start/Early Finish.
  - 4. Critical path shall be clearly shown on the Bar-charts. Critical activities shall be defined as activities with “total float” of less than one day and being the longest path associated to physical work.
  - 5. One Bar-Chart shall be submitted in accordance with Paragraph 1.5.A, “Construction Schedule”

B. Schedule Narrative Reports:

- 1. Schedule Narrative Reports shall comment on the following updated information for each changed activity:
  - a. Logic.

- 1) Labor Resources.
- 2) Equipment Resources.
- 3) Whether work will be performed on a single, double or triple shift, and whether it is to be done on a 5, 6 or 7 day work week basis.
- h. Budgeted Dollar amount per activity.
- 2. Narrative Report shall be sorted Area/Sub-Area activity ID.
- 3. One copy of the Schedule Narrative Report shall be submitted in accordance with Paragraph 1.5.A

**2.3 SCHEDULE DATA FILES**

- A. A copy of data files in PRX back-up format for the Construction Schedule and subsequent approved updates of the Construction Schedule shall be submitted on a CD-ROM or DVD. Each submitted schedule shall have a unique P6 “project name”. These data files are hereinafter referred to as the Schedule Data Files.
- B. Schedule Data Files shall be submitted with the corresponding hard copy of the Construction Schedule and subsequent approved updates to the Construction Schedule.
- C. Schedule Data Files shall be considered the property of the Authority upon receipt.

**2.4 SCHEDULE OF VALUES**

- A. Schedule of Values shall be presented using the outline in Table 01320 – 1
- B. Schedule of Values shall be arranged and subtotaled to match the format followed by the bid “Schedule”.
- C. Include manload for Baseline and Update Baseline Construction Schedules.
- D. One copy of the Schedule of Values shall be submitted in accordance with Paragraph 1.5.B

**2.5 WEEKLY NARRATIVE SUMMARY**

- A. Weekly Narrative Summary shall be generated and one copy provided to the Contracting Officer in accordance to Paragraph 1.5.B in this section.
- B. Weekly Narrative Summary shall be typed and on 8-1/2 inch by 11 inch paper.

**2.6 THREE-WEEK LOOK AHEAD**

- A. Information on the Three-Week Look Ahead shall relate to physical progress during the preceding week, plans for the current week and for succeeding 2 weeks. The Three-Week Look Ahead shall depict the time frame corresponding to the weekly progress meetings and shall be accompanied by a data disk with the updated monthly Construction Schedule. The most updated construction schedule can be provided, even if same as before.
- B. Three-Week Look Ahead shall depict the following information in the column field
  - 1. Identification Number.
  - 2. Activity Description.
  - 3. Original Duration,
  - 4. Remaining Duration.
  - 5. Percent Complete.
  - 6. Total Float.
  - 7. Calendar.
  - 8. Early Start and Early Finish Date. (bars).
- C. Area, Sub-Area and Early Start Dates shall sort the activities.
- D. One copy of the Three-Week Look Ahead shall be generated in accordance with Paragraph 1.5.D.

**PART 3 - EXECUTION**

**3.1 PERFORMANCE CONDITIONS**

- A. Baseline Construction Schedule does not relieve the Contractor of responsibility for the accuracy and feasibility of the Construction Schedule. However, to the extent the Baseline Construction Schedule is reasonable, it shall become a part of the Contract and defines the obligations of the Contractor to achieve a timely Contract completion.
- B. Failure by either the Contractor or Contracting Officer to include any element of work required for performance of the Contract in the Construction Schedule shall not excuse the Contractor from its obligation under the Contract to complete all work with the Contract completion time.

- C. Contractor shall be responsible in accordance with the General Provisions Paragraph, "PERMITS AND RESPONSIBILITIES" for obtaining all necessary permits and licenses unless otherwise indicated. Should the Contractor's work be delayed because a necessary permit was not obtained, the Contractor shall reschedule work and/or employ additional labor and equipment as is necessary to complete the work by the date required at no additional cost to the Authority.
- D. Contractor shall furnish sufficient forces, plant and equipment, and shall work such hours, including overtime operations, as necessary and approved by the Contracting Officer, to ensure the execution of work in accordance with the current monthly update of the Construction Schedule.
  - 1. If, in the opinion of the Contracting Officer, the Contractor is failing to achieve the Contractual Milestone Dates, as required in the current monthly update, the Contractor shall submit a recovery plan, in the form of a Three Week Look Ahead, PRX back-up file and narrative, for the Contracting Officer's approval within 3 days of notification.
  - 2. The recovery plan is dependent on the cause for loss of time and may require the Contractor to increase the number of shifts; days of work; institute or increase overtime operations; and/or increase the amount of construction plant and equipment without additional cost to the Authority.
- E. It shall be the responsibility of the Contractor to maintain progress so as not to delay the work of other Authority Contractors participating in the Project.
- F. If the Contractor delays the work of other Authority Contractors, the Contractor shall, with the approval of the Contracting Officer, increase the number of shifts; days of work; institute or increase overtime operations; and/or increase the amount of construction plant and equipment without additional cost to the Contract so as not to impede the work of others.
- G. Float time is not for the exclusive use of, or benefit of, either the Authority or the Contractor.

**3.2 UPDATES, REVISIONS, AND CHANGES**

- A. In the event actual progress on critical activities (activities with total float less than one day and on the longest path); or on activities with less than 15 percent total float (refer to Appendix D for mathematical computation) is observed to deviate from the Baseline Construction Schedule by 1 week behind (5 working days), the Contractor shall provide, within 3 working days after notification by the Contracting Officer, a recovery plan for completing the work in accordance with Paragraph 3.1.D.
- B. Updates to the Construction Schedule to reflect progress to date shall not be considered a revision to the Baseline Construction Schedule. However, the Contractor shall submit to the Contracting Officer for

approval a revised Construction Schedule in the formats and quantities stipulated in PART 2, "PRODUCTS", if one or more of the following conditions occur:

1. Changes which reflect adjustments to activities and related dollar amounts.
2. Contractor elects to change any sequence of activities from the previously approved update to the Construction Schedule. Contractor shall notify the Contracting Officer in writing, stating the necessity for proposed revisions and receive the Contracting Officer's approval prior to making any such revisions.
3. When, in the opinion of the Contracting Officer, the status of work is such the Baseline Construction Schedule is no longer representative for planning and evaluation of the Contractor's work.

**3.3 TIME EXTENSIONS**

- A. Requests, if any, for extensions of time resulting from Excusable or Compensable changes issued by the Contracting Officer shall be accompanied by a full schedule analysis. The analysis shall include an updated Baseline Construction Schedule reflecting proposed changes; a narrative explaining the impacts and any dollar amounts associated with the extension. The requests shall be submitted in accordance with the General Provisions, Paragraph, "CHANGES".
- B. Construction Schedules revised as a result of the foregoing conditions are to be submitted in the formats and quantities stipulated in PART 2, "PRODUCTS".

**3.4 EARLY COMPLETION**

- A. An early completion schedule is one which anticipates completion of all or specified parts of the work ahead of

the corresponding Contract Time. Since Contract float belongs to the project, the Contractor shall not be entitled to any extension in Contract Time, or recovery for any delay incurred because of extensions in an early completion date, until all contract float is used or consumed and performance or completion of the work extends beyond the corresponding Contract Time. Contractor shall adjust or remove any float suppression techniques, e.g. preferential sequencing (crew movements, equipment use, form reuse, etc.), extended durations, imposed dates, scheduling of Work not required for a Contract Time as required Work, and others, as a prerequisite to a request for an increase in Contract Price or Contract Time. Use of restraint dates should be minimized and require approval by the Contracting Officer.

**3.5 NON-COMPLIANCE**

- A. Failure of the Contractor to comply with the requirements of this section may result in withholding of progress payments or in termination of the Contractor's right to proceed with the Work, or any separate part thereof, in accordance with the Contract.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements".

**TABLE 01320 – 1**

<b>ITEM NO. (FROM BID PER ACTIVITY SCHEDULE)</b>	<b>PAY ACTIVITY ITEM ID</b>	<b>ACTIVITY TITLE</b>	<b>ESTIMATED QUANTITY</b>	<b>TOTAL DOLLAR AMOUNT</b>
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**APPENDIX A  
TO  
SECTION 01320**

**ACTIVITY DEFINITION AND DURATION POLICY**

**I. ACTIVITY DEFINITIONS**

- A. Construction activities shall be defined as work activities that require time and resources (manpower, equipment, and/or material) to complete. The description shall be a concise representation in sufficient detail to identify the work to be performed. The use of "start," "continue," "complete," or similar words is not acceptable.
- B. The Construction Schedule shall contain sufficient detail of activities to include the following:
  - 1. Procurement, fabrication, delivery, installation, and test activities for major materials and equipment.
  - 2. Submittal and approval of shop and working drawings and material samples.
  - 3. Commissioning, training, and Operations & Maintenance (O & M) manuals.
  - 4. Access and availability to work areas.
  - 5. Delivery of any Authority-furnished equipment.
  - 6. Interfaces and dependencies with preceding, concurrent and follow-on contractors.
  - 7. Work to be performed by subcontractors.
- C. As part of the process of defining activities, the activities shall be coded in such a manner as to reflect the Work Breakdown Structure defined in Appendix C of this section.
- D. Each construction activity shall have only one responsible party performing the work.

**II. MILESTONES (EVENTS)**

- A. Milestones in the Contract Documents spell out conditions regarding necessary progress of work, construction planning milestones, and completion time which shall be incorporated into the Construction Schedule.
- B. Section 01010, "Summary of the Work", contain prerequisites for interfacing with other Authority contractors which shall be incorporated into the Construction Schedule.

**III. ACTIVITY DURATIONS**

- A. The construction process shall be divided into activities and durations which are reasonable, realistic, and feasible; and shall be representative of the separable portions of the Work.
- B. In the event there is other concurrent non-Authority construction occurring within the defined regional parameters of this Contract which may impact the efficiency with which the requirements of this Contract are met, the Contractor is to take this into consideration when determining the duration of activities defining the Construction Schedule.

**APPENDIX B  
TO  
SECTION 01320**

**SCHEDULE OF VALUES**

The following outline is to be used for further delineation of those items listed on the Schedule of Values for which the Contracting Officer requests more detailed information for the determination and substantiation of fair allocations of costs per activity.

<b>ACTIVITY ID NO.</b>	<b>ESTIMATED QUANTITY</b>	<b>UNITS</b>	<b>ACTIVITY DESC. ("TITLE")</b>	<b>UNIT BID PRICE</b>	<b>ALLOCATED COST PER ACTIVITY</b>
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**Cost Category**

**L** = Labor:

**E** = Equipment:

**M** = Material:

**C** = Subcontractor:

**O** = Overhead:

**P** = Profit:

**APPENDIX C  
TO  
SECTION 01320**

**WORK STRUCTURES**

**I. WORK STRUCTURE**

A. In order to achieve a standardized coding structure, the following activity code definitions are required as a minimum:

1. DART Project Code.
2. DART Function Code.
3. DART Contract Number.
4. Pay Item Number.
5. Area of Work.
6. Sub-Area of Work.

**II. ACTIVITY CODES DICTIONARY**

<u>Name</u>	<u>Length</u>	<u>Description</u>
PROJ	9	DART Project Code
FUNC	4	DART Function Code
CONT	10	DART Contract Number
PAY	6	Pay Item Number
AREA	6	Area of Work
SUBA	4	Sub-Area of Work

Note: Procurement should be an "AREA" and Submittal, Submittal Review by Contractor, DART Approval and Delivery should all be "SUB AREAS" of work.

**III. ACTIVITY CODE DEFINITIONS**

- A. DART Project Codes (**PROJ**): As Assigned by the Authority.
- B. DART Function Codes (**FUNC**): As Assigned by the Authority.
- C. DART Contract Number (**CONT**): As Assigned by DART Contracts Department.
- D. Pay Item Number (**PAY**): As per the associated item number in the Bid Schedule.
- E. Area of Work (**AREA**): As assigned by Contractor.
- F. Sub-Area of Work (**SUBA**): As assigned by Contractor.

END OF SECTION 01320

**SECTION 01321  
CONSTRUCTION SCHEDULE AND PROGRESS REPORTS FOR SMALL PROJECTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section includes specifications for the preparation, updating, revision, and submittal of the Construction Schedule, Three Week Look Ahead, Schedule of Values, and Progress Reports.

**1.2 CONSTRUCTION SCHEDULING SOFTWARE**

- A. Contractor shall use products of Primavera Systems, Inc., specially: Primavera Project Planner for Windows (latest version). Any versions of the specified scheduling software used by the Contractor shall be compatible with the version employed by the Authority.

**1.3 SUBMITTALS**

- A. Submit three copies of items required under this Section, with the exception of schedules.
- B. Schedules, including Preliminary Baseline Construction Schedule and Three Week Look Ahead, shall be submitted as one hard copy and one electronic copy as specified herein. The electronic copy shall be a full schedule "backup" in P6. Only a PRX file will be accepted.
- C. Submit preliminary Construction Schedule as specified under "Submittal of Preliminary Baseline Construction Schedule" herein.
- D. Submit Monthly Summary Report and updated Construction Schedule and Schedule of Values with each monthly progress payment application.
- E. Submit Three Week Look Ahead at Contractor's Coordination (Weekly Progress) Meetings. Submit revised Construction Schedule and analyses as required.
- F. Submit revised Construction Schedule and analyses as required.

**PART 2 - PRODUCTS**

**2.1 SCHEDULE FORMS**

- A. The Authority will provide criteria on schedule code definitions at a meeting between the Contractor's scheduler and the Authority. This meeting will be initiated by the Contractor and take place no later than 5 days after Notice to Proceed (NTP). The schedule format and structure will be presented and explained at this meeting.

- B. Updated schedules shall be submitted as a back-up (PRX) copy in "P6 Concentric" format on a CD with an attached hard copy as explained below.
- C. Prepare the Construction Schedule and Three Week Look Ahead in the form of a Gantt (Bar) chart.

**2.2 CONTENT OF SCHEDULES**

- A. Submittal of Preliminary Baseline Construction Schedule:
  - 1. Contractor shall prepare a Preliminary Baseline Construction Schedule for all work and submit it within 10 days after NTP. The schedule shall be coded as defined in the activity codes provided. The schedule shall cover the entire contractual duration and contain sufficient numbers of activities to cover all work in detail.
  - 2. The Construction Schedule shall consist of activities having durations no greater than 14 days and costs no greater than \$50,000.
  - 3. Refer to Paragraph entitled "Construction Progress (hard copy)" herein for detailed requirements.
  - 4. The Contracting Officer will review the preliminary schedule and return with comments within 10 days after receipt. Contractor shall incorporate comments and return within one week. When the Contracting Officer has accepted the schedule as fulfilling all of the contractual requirements, it will then be accepted as the Baseline Construction Schedule.
- B. Construction Progress (hard copy):
  - 1. Show activities required for construction in the bar-chart area, organized by Area, Early Start, and Early Finish.
  - 2. Show the following data in the activities column: Activity I.D., "Early Start" and "Early Finish" dates, original duration, remaining duration, calendar and total float.
- C. Schedule for Submittals of Shop Drawings, Product Data and Samples. Show:
  - 1. Activities for Contractor's submittals.
  - 2. Activities for DART approved submittals.



3. Refer to Sections 01330, "Submittals", for Submittal Control Document, and 01450, "Quality Control", for Submittal Status Log.

D. The Three Week Look Ahead shall relate to the physical progress during the preceding week and plans for the succeeding three weeks (three week look-ahead) in detail. The Data Date for the Weekly Update shall be on Sunday. If the monthly update coincides with the weekly, then only submit the monthly for that week.

1. If the Three Week Look Ahead does not contain sufficient detail to schedule work, then change the activity in question to a hammock activity and create detail activities in support of the hammock.

E. Develop the Schedule of Values using the Bid Schedule. Each pay item in the Schedule of Values shall be represented within an activity or activities in the baseline schedule by a corresponding cost as a resource. This shall be defined in "Define Resource", represented by the appropriate pay item number.

**2.3 PROGRESS REVISIONS**

A. The data date for the monthly updated Construction Schedule and the date of the submittal of the request for payment application shall be the 25th of the month or a mutually agreed date.

B. Indicate progress of each activity to the data date.

C. Show changes occurring since previous submission of schedule.

1. Major changes in scope (requires changes to baseline schedule).
2. Activities modified since previous submission.
3. Revised projections of completion.
4. Other identifiable changes.

D. The Monthly Progress Report shall contain activities sorted by area. Provide a narrative report by area, as needed to define:

1. Problem areas, anticipated delays and the impact on schedule.
2. Corrective action that will be taken by the Contractor to get the project back on schedule. This item is required whenever the progress of the job is impacting the contractual milestone dates.
3. The effect of changes on schedule or on sub-contractors.

**PART 3 - EXECUTION**

**3.1 PERFORMANCE CONDITIONS**

A. The Approved Construction Schedule does not relieve the Contractor of responsibility for the accuracy and feasibility of the Construction Schedule. However, to the extent the Approved Construction Schedule is reasonable, it shall become a part of this Contract and defines the obligations of both the Contractor and the Authority to achieve a timely Contract completion.

B. Failure by either the Contractor or Contracting Officer to include any element of work required for performance of the Contract in the Construction Schedule shall not excuse the Contractor from its obligation under the Contract to complete all work within the Contract completion time.

C. Contractor shall furnish sufficient forces, plant and equipment, and shall work such hours, including overtime operations, as necessary and approved by the Contracting Officer, to ensure the execution of work in accordance with the current monthly update of the Construction Schedule.

1. If, in the opinion of the Contracting Officer, the Contractor is failing to achieve the start and/or finish dates of the Approved Construction Schedule as presented in the current monthly updates, the Contractor shall submit a recovery plan for the Contracting Officer's approval within five working days of notification.

2. The recovery plan may require the Contractor to increase the number of shifts; days of work; institute or increase overtime operations; and/or the amount of construction plant and equipment without additional cost to the Authority.

D. It shall be the responsibility of the Contractor to maintain progress so as not to delay the work of other Authority Contractors participating in the Project.

E. If the Contractor delays the work of other Authority Contractors, the Contractor shall, with the approval of the Contracting Officer, increase the number of shifts; days of work; institute or increase overtime operations; and/or the amount of construction plant and equipment without additional cost to the Contract so as not to impede the work of others.

F. Float time is not for the exclusive use of, or benefit of, either the Authority or the Contractor.

**3.2 UPDATES, REVISIONS, AND CHANGE ORDERS**

- A. Updates to the Construction Schedule to reflect progress to date shall not be considered a revision to the Approved Construction Schedule. However, the Contractor shall submit to the Contracting Officer for review a revised Construction Schedule in the formats and quantities stipulated in PART 1, if one or more of the following conditions occur:
1. Approved change orders which reflect adjustments to activities.
  2. Contractor elects to change any major sequence of activities affecting the critical path or significantly change the previously approved update to the Construction Schedule. Contractor shall notify the Contracting Officer in writing, stating the necessity for proposed revisions and receive the Contracting Officer's approval prior to making any such revisions.
  3. When, in the opinion of the Contracting Officer, the status of work is such the Approved Construction Schedule is no longer representative for planning and evaluation of the Contractor's work.
- B. Acceptance of the revised Approved Construction Schedule by the Contracting Officer is a condition precedent to approval of progress payments.

**3.3 TIME EXTENSIONS**

- A. Requests, if any, for extensions of time resulting from changes issued by the Contracting Officer shall be accompanied by a full schedule analysis. The analysis shall include an updated Approved Construction Schedule reflecting proposed changes; a narrative explaining the impacts and any dollar amounts associated with the extension; and, if applicable, an updated Scheduled Earnings Curve. The requests shall be submitted in accordance with the General Provisions, Paragraph, "CHANGES".
- B. Construction Schedules revised as a result of the foregoing condition, shall be submitted in the formats and quantities stipulated in PART 1.
- C. Since Contract float belongs to the project, the Contractor shall not be entitled to any extension in Contract Time, or recovery for any delay incurred because of extensions in an early completion date, until all contract float is used or consumed and performance or completion of the work extends beyond the corresponding Contract Time. Contractor shall adjust or remove any float suppression techniques, e.g. preferential sequencing through imposed logic (crew

movements, equipment use, form reuse, etc.), extended durations, imposed dates, scheduling of Work not required, and others, as a prerequisite to a request for an increase in Contract Price or Contract Time. Use of restraint dates should be minimized and require approval by the Contracting Officer.

**3.4 EARLY COMPLETION**

- A. An early completion schedule is one which anticipates completion of all or specified parts of the work ahead of the corresponding Contract Time.

**3.5 NON-COMPLIANCE**

- A. Failure of the Contractor to comply with the requirements of this section may result in withholding of progress payments or in termination of the Contractor's right to proceed with the Work, or any separate part thereof, in accordance with the Contract.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements".

**APPENDIX A TO SECTION 01321**

**WORK STRUCTURES**

**I. WORK STRUCTURE**

In order to achieve a standardized coding structure, the following activity code definitions are required as a minimum:

- 1) DART Project Code
- 2) DART Function Code
- 3) DART Contract Number
- 4) Pay Item Number

**II. ACTIVITY CODES DICTIONARY**

<u>Name</u>	<u>Length</u>	<u>Description</u>
PROJ	9	DART Project Code
FUNC	4	DART Function Code
CONT	10	DART Contract Number
PAY	6	Pay Item Number

**III. ACTIVITY CODE DEFINITIONS**

- 1) **DART Project Codes (PROJ):** As Assigned by the Authority.
- 2) **DART Function Codes (FUNC):** As Assigned by the Authority.
- 3) **DART Contract Number (CONT):** As Assigned by DART Contracts Department.
- 4) **Pay Item Number (PAY):** As per the associated Item number in the Bid schedule.

END OF SECTION 01321

**SECTION 01330  
SUBMITTALS**

The provisions of the DART Standard Specification Section 01330, "Submittals", shall apply to the Work as modified herein.

Replace Figure NO. 01330-1 with figure below:

**FIGURE NO. 01330-1**

**Review/Disposition Stamp**

\_\_\_\_ APPROVED

\_\_\_\_ APPROVED, AS NOTED

\_\_\_\_ CORRECT AND RESUBMIT \_\_\_\_ CONFIRM

\_\_\_\_ DISAPPROVED

Approval does not relieve the Contractor from responsibility for any errors or omissions in these submittals and/or shop drawings or from the responsibility for complying with the requirements of this Contract (except as otherwise provided under the provisions of the "Specifications and Drawings" clause of this contract).

TRE

DATE: \_\_\_\_\_

By: \_\_\_\_\_

**END OF SECTION 01330**

## SECTION 01330 SUBMITTALS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. This Section includes specifications for the general requirements and procedures for preparing and submitting construction information and data for approval or information. Other requirements for submittals are specified under applicable Sections of the Standard Specifications and Contract Specifications. Requirements herein concern submittals directly related to the Work (non-administrative). Refer to General Provisions Paragraph, "SPECIFICATIONS AND DRAWINGS", for related requirements.
- B. Project progress schedules and status reports are specified in Section 01320, "Construction Schedule and Progress Reports" or Section 01321, "Construction Schedule and Progress Reports for Small Projects".
- C. General requirements and procedures for preparing and submitting Shop Drawings, product data, and samples are specified in Section 01340, "Shop Drawings, Product Data, and Samples". Field samples and mock-ups are a special form of sample too large to be transmitted in the specified manner for transmittal of sample submittals. Refer to Section 01454, "Field Samples and Mock-Ups".
- D. Submittals related to the Contractor's quality program are specified in Section 01450, "Quality Control".
- E. Submittals required to complete the Contract closeout are specified in Section 01770, "Contract Closeout".
- F. Preparation and submission of project record documents are specified in Section 01785, "Project Record Documents".
- G. Preparation and submission of equipment and systems operation and maintenance manuals are specified in Section 01786, "Operation and Maintenance Instructions".

#### 1.2 SUBMITTAL CONTROL DOCUMENT

- A. Submit a Submittal Control Document within 30 days after Notice to Proceed (NTP). Submittal Control Document shall be presented in a form acceptable to the Contracting Officer in both electronic and hard copy versions and shall be updated and sent to the Contracting Officer on a monthly basis noting deviations, if any. The completed Submittal Control Document shall be subject to final review and approval by the Contracting Officer. Once the Submittal Contract Document is finalized, the Contractor shall adhere to the outlined schedule.

- B. Identify all submittals which are required by the Contract Documents and determine the date on which each submittal will be submitted in conformance with the schedules specified in Section 01320, "Construction Schedule and Progress Report" or Section 01321, "Construction Schedule and Progress Reports for Small Projects".
- C. Submittal Control Document shall consist of a completed submittal schedule and list of products for all items requiring the Contracting Officer's review and approval, as follows:
  - 1. Description of submittal (i.e. shop drawing) and of the item including name of manufacturer, trade name and model number.
  - 2. Specification reference.
  - 3. Intended submission/resubmission date(s).
  - 4. Order release date.
  - 5. Lead-time to delivery/anticipated delivery date(s).
  - 6. Highlight any items for which expedited review is requested to meet the project schedule.
- D. Refer to Section 01450, "Quality Control", for Submittal Status Log requirements.

#### 1.3 GENERAL SUBMITTAL PROCEDURES

- A. Obtain the Contracting Officer's approval of shop drawings, product data, and other submittals before any work involving such submittal is performed. Initiate actions for procurement, fabrication, or construction only after obtaining the Contracting Officer's approval of the relevant submittals. Materials for which samples are required shall not be used in the Work until approved in writing by the Contracting Officer. Changes in products for which drawings, product data, or samples have been submitted will not be permitted unless those changes have been accepted and approved in writing by the Contracting Officer.
- B. Contractor shall be responsible for accuracy, completeness, and scheduling of submittals so as to facilitate the review and approval by the Contracting Officer.
- C. Printed quantities: Submit the following minimum quantities, unless specified under applicable Sections of the Standard and Contract Specifications:

SUBMITTALS

1. Drawings: One reproducible and 3 copies of each drawing.
  2. Calculations: 4 copies of Contractor's or manufacturers' calculations, including design calculations for bridge structures.
  3. Catalog Cuts: 4 originals, minimum, of manufacturers' catalog cuts or entire catalogs.
  4. Instructions: 4 copies of manufacturers' printed installation, erection, application, and placing instructions.
  5. Samples: 4 of each sample item specified in the various Specification Sections, except for color range samples and unless otherwise specified or requested.
  6. One original and 3 copies of inspection reports, test reports, certificates of compliance, delivery tickets, batch tickets and bills of materials.
  7. Survey Data: As specified in Section 01722, "Field Engineering - Surveying".
  8. Guarantees, Warranties, and Bonds: 1 executed original, if specified.
  9. Where submittals are submitted to the Contracting Officer for information or record purposes, submit 2 copies.
  10. Where permits and licenses and other such documents are obtained in the Authority's name, submit the original and 1 copy.
- D. Electronic quantities (applies to all submittals): Submit the following minimum quantities. Submit greater quantities when specified.
1. All submittals shall be delivered to the Authority in an electronic format in both their native software format and in PDF format. Digital electronic files shall be provided to the Authority on CD ROM disk or DVD and each CD ROM or DVD shall:
    - a. Provided in a protective cover with an exterior label.
    - b. Contain an index of the CD ROM or DVD's contents that lists each file name along with a file description.
    - c. Include PDF's of the submittal reports, files or drawings.
- E. Contracting Officer will return 2 sets of submitted items including the reproducible for shop drawings to the Contractor with the following exceptions:
1. Submittals for record of the Authority will not be returned.
  2. One of the 6 catalog cuts or catalogs will be returned to the Contractor after review. Submit additional copies if more than one are desired.
- F. Review Period: Transmit submittals sufficiently in advance of construction requirements to permit no less than 21 days for review and appropriate response by the Contracting Officer.
1. Contractor shall be responsible for determining whether or not certain governmental entities and utilities require longer review periods. Where longer review periods are required, the Contractor shall schedule the Work accordingly, so that the progress of the Work is not adversely impacted.
- G. Submittal Form: Include only 1 item per submittal, with form attached to each copy of the submittal, do not group different submittal items under one submittal form and number. Accompany submittals with a Contracting Officer approved submittal form containing the following information attached to each copy of submittal:
1. Sequential submittal number and date.
  2. Contract title and number.
  3. "To:" and "From": Including the Contractor's name, address, and telephone number.
  4. Supplier's, manufacturer's, or Subcontractor's name, address, and telephone number.
  5. Subject identification including Contract Drawing and Specification reference.
  6. Category and Type of Submittal.
  7. Purpose.
  8. Description.
  9. Signature of Submitter.
- H. Submittal Numbering:
1. Assign sequential numbers to each submittal using the related Specification Section number for the first 5 digits and a 3-digit number for each submittal, all initial

## SUBMITTALS

submittals will be issued as Rev. 0 (i.e. 03300-001-Rev.0, 16001-030-Rev. 0).

2. Assign revision numbers (i.e. 03300-001-Rev. 1, 03200-030-Rev. 3) to all re-submittals and cross-reference to previous submittals.
- I. Provide Contractor's Certification Stamp worded exactly as shown on Figure 01330-2 herein, and stamp and sign each submittal.
- J. Professional Seal Required: Submittals involving engineering expertise, such as excavation support structures, falsework for concrete, Systems design progression, load calculations and when required by the individual Specification Sections shall be sealed and signed by a professional engineer, currently registered in the State of Texas, for the discipline involved. Furnish information sufficient to completely explain the facility, product, machine, or system described and its intended manner of use. When professional certification is required by the Contract requirements, the Authority is entitled to rely upon the accuracy and completeness of such calculations and certifications.
- K. Space for Contracting Officer's Disposition Stamp: Include a 4 inch square blank space, on each submittal for the Contracting Officer's disposition stamp. On drawings, provide this space in the lower right corner, just above the title block.
- L. Maintain at the Worksite a complete up-to-date, organized file of all past and current submittals including an index and locating system that identifies the status of each submission. Refer to Section 01450, "Quality Control", for Submittal Status Log requirements.
  1. Quality Control Set: Maintain the returned final set of samples at the construction site in suitable condition and available for quality control comparisons by the Contracting Officer.
  2. Refer to Section 01785, "Project Record Documents", for maintenance of record and as-built documents.
- M. Submittal Delivery: Ship submittals prepaid or deliver by hand directly to the Contracting Officer or elsewhere as required by the Contracting Officer.
- N. Changes in Approved Submittals: Changes in approved submittals will not be permitted unless those approved submittals with changes have been resubmitted and approved, in the same manner as the original submittal.
- O. Supplemental Submittals: Supplemental submittals initiated by the Contractor for consideration of corrective procedures shall

contain sufficient data for review. Make supplemental submittals in the same manner as initial submittals.

### 1.4 CONTRACTOR'S RESPONSIBILITIES

#### A. Contractor's Review:

1. Examine and check the submittal for accuracy, completeness, and compliance with the Contract before delivery to the Contracting Officer. Each submittal shall be reviewed, stamped (refer to Figure 01330-2), and signed as reviewed and approved by the Contractor prior to submission. Approval represents that the Contractor has determined and verified materials, field measurements (as verified by surveying) and field construction criteria related thereto, and has checked and coordinated the information contained within such submittals with the requirements of the Work and the Contract.
  - a. Submittals without this stamp may be returned to the Contractor for re-submittal.
2. If the submittal is designated to be approved by another governmental agency or utility and to be sent to the Contracting Officer for information, approval by the governmental agency or utility shall take place before submission to the Contracting Officer.
3. Contractor shall coordinate each submittal with the requirements of the Work, ensuring that each submittal of one trade is compatible with other submittals of that trade and with the submittals of other trades. Ensure submittal is complete with all relevant data required for review.
4. Approval does not relieve the Contractor from responsibility for furnishing materials of proper dimensions, quantity and quality; from responsibility for errors and omissions in the samples, mock-ups, sample panels, product data and shop drawings, calculations, etc.; from responsibility for deviations from the Contract Documents, nor from responsibility for complying with the requirements of this Contract.
5. Contractor's liability to the Authority, in case of deviations in the submittals from the requirements of the Contract Documents, is not relieved by the Contracting Officer's review and approval of submittals containing deviations, unless the Contracting Officer expressly approves the deviations by issuing a Change. If the Contractor fails to describe such variations, the Contractor is not relieved of the

## SUBMITTALS

responsibility for executing the Work in accordance with the Contract, even though such submittals have been approved.

6. If submittals show variations from the Contract requirements due to standard shop practice or for other reasons, describe such variations on the first page of submittal. If acceptable, the Contracting Officer may approve such variations, subject to the proper adjustment in the Contract under General Provisions, paragraph entitled "CHANGES".

7. Contractor shall be responsible for the correctness of the submittals, for shop fits and field connections, and for the results obtained by the use of such submittals.

B. Distribution of Submittals after Review: Distribute prints or copies of approved submittals, bearing the Contracting Officer's or designated approval authority's stamp and signature, to the Contractor's field office and the Contracting Officer's field office; to affected and concerned Subcontractors, Suppliers, and fabricators; and to affected and concerned members of the Contractor's workforce.

### 1.5 CONTRACTING OFFICER'S REVIEW

A. In addition to the requirements of General Provisions Paragraph, "SPECIFICATIONS AND DRAWINGS", the Contracting Officer's actions with regard to shop drawings, working drawings, samples, mock-ups, sample panels, miscellaneous and other submittals are as hereinafter specified.

B. Contracting Officer will review and approve or take other appropriate action upon the Contractor's submittals only for the limited purpose of avoiding impacts on any other work and properties and of checking for conformance with information given and the design concept expressed in the Contract requirements. The Contracting Officer's action will be taken as to cause no delay in the Work or in the activities of the Contractor. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract. The Contracting Officer's review will not constitute approval of safety precautions or, unless specifically stated by the Contracting Officer of any construction means, methods, techniques, sequences, or procedures. The Contracting Officer's approval of a specific item does not indicate approval of an entire assembly of which the item is a component.

C. Failure of any material to pass the specified tests is sufficient cause for refusal to consider, under this Contract, further samples of the same brand,

make, or source of that material. The Contracting Officer reserves the right to disapprove any material or equipment that previously has proved unsatisfactory in service.

D. Contractor's submittals will be stamped with the date of receipt and with the Contracting Officer's Review/Disposition Stamp, see Figure 01330-1. The stamp will be marked, and the stamp will be signed and dated. Contracting Officer will indicate its reviews of submittals and the action taken (approvals and non-approvals) by means of its Review/Disposition Stamp. The stamp marks will have the following meanings:

1. APPROVED: Work may proceed, provided it complies with the Contract.

2. APPROVED AS NOTED (CORRECT AND RESUBMIT): Work may proceed, provided:

a. It complies with the Contract as well as the corrections on the submittal; and the Contractor resubmits within 15 days corrected copies of the shop drawing, working drawing, or miscellaneous submittal for final approval; and

b. Work performed by the Contractor prior to receiving final approval will be at the Contractor's risk.

3. APPROVED AS NOTED (CONFIRM): Work may proceed provided it complies with the Contract as well as the corrections on the submittal; and the Contractor confirms in writing within 15 days to the Contracting Officer prior to the commencement of work that the submittal have been duly noted and corrected as required.

4. DISAPPROVED: Work not recognized as being able to proceed.

a. Make corrections required by the Contracting Officer. Resubmit without delay.

b. Handle re-submittals in the same manner as first submittals. Refer to Paragraph entitled "Submittal Numbering" under Article "General Submittal Procedures" for revision numbering.

c. On re-submittals, direct specific attention in writing on re-submitted shop drawings, working drawings, samples, mock-ups, sample panels, or miscellaneous submittals to revisions other than the corrections of previous submissions.



SUBMITTALS

- 5. APPROVED and APPROVED AS NOTED (CONFIRM) shall not be construed:
  - a. As permitting any departure from the Contract requirements;
  - b. As relieving the Contractor of responsibility for errors and omissions, including details, dimensions, and quantity of materials; or
  - c. As approving departures from details furnished by the Contracting Officer.
- G. Plans such as Traffic Control Plans and Demolition Plans, submit as specified in individual specifications sections.
- H. Progress Photographs: Furnish progress photographs as specified in Section 01345, "Construction Photographs".
- I. Record (As-Built) Drawings and Specifications: Refer to Section 01785, "Project Record Documents".

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. Separate measurement or payment will not be made for work required under this Section. All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

END OF SECTION 01330

- E. Review stamps or other approval methods of the various designated approval authorities may not be the same as those of the Authority. Contractor shall work with the various designated approval authorities and shall obtain approvals in the clearest and most straightforward manner possible.

**1.6 MISCELLANEOUS DOCUMENTATION**

- A. Certificates of Conformance or Compliance for Materials or Products: Refer to Section 01450, "Quality Control", for detailed requirements.
- B. Certificates: When specified, submit certificates to demonstrate proof of compliance regarding qualifications of personnel, manufacturers, fabricators, and installers specified in the individual specification section. Certificates shall be signed by an official authorized to certify on behalf of the issuing organization with the name and address of the Contractor, the project name, and location.
- C. Certified Test Reports: Refer to Section 01450, "Quality Control", for detailed requirements.
- D. Certified Test Reports of Previous Testing: Where specified, submit certified test reports of previous testing of like items, if approved under similar Authority contracts. Include the following:
  - 1. Certification that materials meet or exceed specified test requirements.
  - 2. Name and address of testing laboratory.
  - 3. Dates of tests to which reports apply.
  - 4. Certification that materials provided are the same as those tested.
- E. Calculations: When certified calculations are specified, they shall be certified by a Professional Engineer registered in the State of Texas.
- F. Survey Data: Refer to Section 01722, "Field Engineering – Surveying".

SUBMITTALS

**FIGURE NO. 01330-1**  
**Review/Disposition Stamp**

- \_\_\_\_ APPROVED  
\_\_\_\_ APPROVED, AS NOTED  
 CORRECT AND RESUBMIT     CONFIRM  
\_\_\_\_ DISAPPROVED

Approval does not relieve the Contractor from responsibility for any errors or omissions in these submittals and/or shop drawings or from the responsibility for complying with the requirements of this Contract (except as otherwise provided under the provisions of the "Specifications and Drawings" clause of this Contract).

Dallas Area Rapid Transit

Date: \_\_\_\_\_

By: \_\_\_\_\_

**FIGURE NO. 01330-2**  
**Contractor's Certification Stamp**

Contractor's Certification

"Having checked this submission, we certify that it conforms to the requirements of the Contract in all respects, except as otherwise indicated."

Company Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Print Name: \_\_\_\_\_

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

Date: \_\_\_\_\_

**SECTION 01340**  
**SHOP DRAWINGS, PRODUCT DATA AND SAMPLES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section includes specifications for the general requirements and procedures for preparing and submitting Shop Drawings, Product Data, and Samples required by individual Specification Sections. Additional requirements are specified in the individual Specification Sections.
- B. Refer to Section 01330, "Submittals", for general requirements for submittals.
- C. Refer to Section 01785, "Project Record Documents", for requirements for submittal of final approved drawings and catalog cuts upon completion of the Work.
- D. Certificates of Compliance: Refer to Section 01450, "Quality Control".

**1.2 DEFINITIONS**

- A. Shop Drawings: As defined in the General Provisions Paragraph, "SPECIFICATIONS AND DRAWINGS", is an inclusive term and may include descriptive literature and test data. The term "Shop Drawings," as used herein, includes fabrication, erection and installation, application, layout, and setting drawings, lists or schedules of materials and equipment, manufacturer's standard drawings, wiring and control diagrams, all other drawings as may be required to show that the materials, equipment, and systems, and the positions thereof, comply with Contract requirements.
- B. Product Data: The term "product data," as used herein, includes manufacturer-prepared descriptive literature, catalog sheets, brochures, performance data, test data, printed diagrams, schedules, illustrations, and other information furnished by the Contractor or the various product and materials suppliers to illustrate and describe a product, material, system, or assembly for some portion of the Work.
- C. Samples: The term "samples," as used herein, are physical examples which illustrate materials, fixtures, appliances, equipment, colors, textures, finishes, and work quality, and establish the standards of quality and utility by which the Work will be judged for acceptance.
- D. Working Drawings: Working drawings are Contractor prepared plans for temporary structures and facilities such as decking, temporary bulkheads, support of excavation, support of utilities, groundwater control systems, underpinning and for such other items of work as may be required for construction but which do not

become an integral part of the completed Project.

- 1. Working drawings shall comply with the requirements for shop drawings.
- 2. Submit appropriate design calculations to support working drawings.
- 3. Working drawings and calculations shall be signed and sealed by the Contractor's engineer who shall be a Professional Engineer licensed in the State of Texas.

- E. Certificate of Compliance: Refer to Section 01450, "Quality Control", for definition.

**1.3 SUBMITTALS**

- A. Refer to Section 01330, "Submittals", for submittal procedures.

**1.4 SHOP DRAWINGS**

- A. General: Provide shop drawings complete, detailed, and dimensioned and including the following:
  - 1. Fabrication, erection, layout, and setting drawings.
  - 2. Complete list of materials.
  - 3. Schedules.
  - 4. Manufacturer's drawings.
  - 5. Wiring and control diagrams, as applicable.
  - 6. Drawings prepared by the Contractor for permanent structures, equipment, and systems designed by Contractor in accordance with Contract requirements.
  - 7. Additional requirements specified in the individual Specification Sections.
- B. Size of sheet: 22 inches by 34 inches or 11 inches by 17 inches as approved. Refer to Section 01330, "Submittals" for the space requirement for Contracting Officer's Review/Disposition Stamp. The title block in the lower right hand corner shall display the following:
  - 1. Contract number, name of project, and title of the drawing.
  - 2. Date of drawing or revision.
  - 3. Name of Contractor and subcontractor submitting the drawing.

- 4. Clear identification of contents and location of the work.
- 5. Title and number of Specification section.
- 6. Drawing Number.
- 7. Names of individuals who designed and checked drawings (Completed "Designed By" and "Checked By" boxes).

tag or sticker with a clear space for the stamps of the Contractor and the Contracting Officer. Label each sample as follows:

- 1. Contract number and name of project.
- 2. Name of Contractor and subcontractor.
- 3. Material or equipment represented.
- 4. Place of origin.
- 5. Name of producer and brand, if any.
- 6. Location in project. Furnish samples of finish materials with additional markings identifying them under the schedules.
- 7. Sequentially number using related section numbers as described in Section 01330, "Submittals" under "Submittal Numbers".

C. Each drawing shall include details necessary for the procurement, installation, maintenance, and repair of all components or facilities equipment provided. Change notices that are attached to drawings shall not constitute revised drawings. Each drawing shall include all changes and be upgraded to reflect the latest configuration.

**1.5 LIST OF MATERIALS SOURCES**

A. Refer to Section 01450, "Quality Control", for requirement for submittal of a list of Contractor's sources of materials and equipment requiring approval, certification, or testing.

C. Quantities: The following specifies exceptions to the quantity of samples specified in Section 01330, "Submittals", under the Article entitled "General Submittal Procedures".

**1.6 PRODUCT DATA**

A. Contractor shall modify manufacturers' standard diagrams, charts, illustrations, brochures, calculations, schematics, catalog cuts, and other descriptive data to delete information which is not applicable to the Contract. Contractor shall supplement standard information with additional information applicable to this Contract, and indicate dimensions, clearances, performance characteristics, capacities, wiring and piping diagrams, and controls. Wherever applicable, clearly indicate field-measured dimensions.

- 1. Where requested, or in case a range of color, gaining, texture, and other characteristics may be anticipated in finished products, furnish a number of samples of the specified materials to indicate the full range of such characteristics which will be present in the finished products and which will be considered one sample set. Such products delivered or erected without prior acceptance by the Contracting Officer are subject to rejection and removal or replacement.
- 2. Provide full sets of optional samples where the Contracting Officer's selection is required.

B. Contractor shall modify the manufacturer's printed installation, erection, application, and placing instructions to delete information which is not applicable to the Contract.

C. Submittals shall include the following:

D. Prepare samples to match the Contracting Officer's sample where so indicated.

- 1. Contract number and project name.
- 2. Reference Contract Drawing numbers.
- 3. Title and number of applicable Specification Section.
- 4. Applicable standards, such as ASTM or Federal specification numbers.

E. Provide samples of materials that are generally furnished in containers bearing the manufacturers' descriptive labels and printed application instructions. If these are not submitted in standard containers, supply such labels and application instructions.

F. Approval of a sample shall be only for the characteristics and use named in the submittal and approval, and shall not be construed to change or modify any Contract requirement.

**1.7 SAMPLES**

A. Contractor shall furnish to the Contracting Officer samples required by the Contract Documents.

G. Before submitting samples, the Contractor shall assure itself that the materials or equipment will be available in the quantities required in the Contract, as neither change nor substitution will be permitted after a sample has been approved

B. Mark samples, tag, or otherwise properly identify as specified in these Specifications. Provide each

unless the Contracting Officer in writing approves such change or substitution.

- H. Samples of material from local sources taken for testing shall be taken by or in the presence of the Contracting Officer or approved designee. Samples taken otherwise shall not be considered for testing.
- I. Approved samples not damaged in testing may be incorporated in the finished work if marked for identification and approved by the Contracting Officer. Materials incorporated in the Work shall match the approved samples.
- J. Send approved samples, mock-ups, and sample panels not destroyed in testing, nor accepted as a part of the built-in work, to the Contracting Officer. Samples, mock-ups, and sample panels which fail testing or are not approved by the Contracting Officer will be disposed of, unless the Contractor requests, at the time of submittal, that they be returned to the Contractor at Contractor's expense.
- K. The Contracting Officer may take for testing samples of material delivered to the site or installed in place. Failure of samples to meet Contract requirements shall annul previous approvals of the item tested.

## **PART 2 - PRODUCTS**

Not Used.

## **PART 3 - EXECUTION**

Not Used.

## **PART 4 - MEASUREMENT AND PAYMENT**

### **4.1 GENERAL**

- A. Separate measurement or payment will not be made for work required under this Section. All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

END OF SECTION 01340

**SECTION 01345  
CONSTRUCTION PHOTOGRAPHS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Work specified in this section includes employing a qualified photographer to take construction record photographs periodically during the course of the Work.

**1.2 PHOTOGRAPHY**

- A. The quality of the work must meet the following intended uses:
  - 1. Visual survey of pre-construction conditions including historic properties.
  - 2. Construction progress record.
- B. Views required:
  - 1. Vantage points will be determined by Contracting Officer who shall be notified at least 72 hours in advance of Photographer's scheduled visit to the construction site.
  - 2. At successive periods of photography, take at least one photograph from the same overall view as previously.
- C. Pre-construction photographs will include photographic recording of specific details on historic and other properties as directed by the Contracting Officer. Include minimum of 40 color photographs. Comply with requirements of Section 01715, "Pre-Construction Inspection".
- D. Construction progress: Each month during the Contract, take an average of 40 color photographs within the construction area as directed by the Contracting Officer.

**1.3 NEGATIVES AND PRINTS**

- A. All negatives shall become the property of the Authority. If a digital camera is used, resolution shall be at least 1080 X 1080 dpi. and, in addition to prints, the images shall be provided on in a format acceptable to the Authority.
- B. Type: color prints:
  - 1. Minimum film size: 35 millimeter or a digital camera of suitable resolution.
  - 2. Provide minimum of 4.1 mega pixels for digital cameras.
  - 3. Required quality: Sharp, accurate color representation.

- 4. Size: 3 inch x 5 inch plus 20 each 8 x 10 inches to be selected by the Contracting Officer.

- 5. Finish: glossy.

- 6. Paper: SINGLE weight.

**1.4 IDENTIFICATION**

- A. Include the following information on the face of each print:
  - 1. Orientation of view, station.
  - 2. Date and time of exposure.

**1.5 DELIVERY AND COORDINATION:**

- A. Deliver two sets of 3 inch x 5 inch processed prints, filed in three ring notebooks or bound books as suitable, to the Contracting Officer within 7 days of the date of photography. If a digital camera is used, also include electronic files of photographs on CD-ROM. In addition, deliver one set of twenty 8 inch x 10 inch prints as selected by the Contracting Officer from the 3 inch x 5 inch submitted.
- B. Photographer shall furnish additional prints, if required, to Contracting Officer at commercial rates applicable at the time of purchase. The Contracting Officer reserves the right to take possession of the negatives at any point during the Contract duration.
- C. The Authority obtains all rights for publication.

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements".

END OF SECTION 01345

**SECTION 01423  
REFERENCE STANDARDS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. This Section includes specifications for construction industry standards of industry associations, trade associations, societies, organizations, and regulatory agencies as they are invoked and used in these Standard Specifications.

**1.2 REFERENCE STANDARDS**

A. The Contract Documents contain references to various standard specifications, codes, practices, and requirements for materials, equipment, work quality, installation, inspections, and tests, which references are published and issued by the organizations, societies, and associations listed herein by abbreviation and name. Such references are hereby made a part of the Contract Documents to the extent specified in General Provisions Paragraph, "MATERIALS AND WORKMANSHIP".

B. Whenever a referenced standard contains administrative requirements, including measurement and payment provisions, such as the standard specifications of various government entities, utility districts, and other agencies, such administrative requirements shall not apply to the Work of this Contract. References to such standards shall be applicable to the pertinent technical provisions only.

**1.3 REFERENCED STANDARDS FILE**

A. The Contractor shall have access to the reference standards. Referenced standards shall be made readily available, when requested, for use by the Contracting Officer and the Contractor's staff in carrying out the quality assurance and quality control programs specified in the Contract Documents, and to assure compliance with the requirements of the codes, specifications, test methods, practices, and other standards referenced in the Contract Documents.

**1.4 ABBREVIATIONS**

A. Wherever in the Contract Documents an organization's abbreviation or acronym is used, it shall be understood to mean the full name of the respective organization as specified in the various Specification Sections, and as follows:

**1.5 REFERENCES TO STANDARDS**

A. In conjunction with the requirements of General Provisions Paragraph, "MATERIALS AND WORKMANSHIP", the listings below are acceptable

standards to be used by the Authority, unless specified otherwise.

B. Technical References - Interpretation of Documents:

1. With reference to codes, regulations, reference standards, and specifications, perform work conforming to the edition current as of the date of Notice to Proceed (NTP), unless otherwise specified.

2. Where reference standards and specifications conflict with local jurisdictional requirements, the more stringent standard shall govern, unless otherwise approved.

C. In this Contract, if the Contractor wishes to use standards other than those referenced, submit a comparison of the proposed standard and the referenced standards. Demonstrate in the comparison that the Authority is being given material equal to or better than that specified, at no extra cost, and certify the comparison as being accurate by an engineer licensed in Texas.

D. Reference to manufacturer's printed specifications for specified products shall mean most current edition of the Specifications as of the date of the Notice to Proceed, unless otherwise noted.

E. References are made to recognized standards by use of the acronyms listed below.

<b>AA</b>	<b>Aluminum Association</b>
<b>AABC</b>	<b>Associated Air Balance Council</b>
<b>AAMA</b>	<b>Architectural Aluminum Manufacturers Association</b>
<b>AAN</b>	<b>American Association of Nurserymen, Inc.</b>
<b>AAR</b>	<b>Association of American Railroads</b>
<b>AASHTO</b>	<b>American Association of State Highway &amp; Transportation Officials</b>
<b>ABPA</b>	<b>Acoustical and Board Products Association</b>
<b>ACI</b>	<b>American Concrete Institute</b>
<b>ACIL</b>	<b>American Council of Independent Laboratories</b>
<b>ACP</b>	<b>American Concrete Pipe Association</b>
<b>AFBMA</b>	<b>Anti-Friction Bearing Manufacturing Association</b>

REFERENCE STANDARDS

<b>AGA</b>	<b>American Gas Association</b>	<b>BHMA</b>	<b>Builders Hardware Manufacturers Association</b>
<b>AHA</b>	<b>American Hardboard Association</b>		
<b>AI</b>	<b>The Asphalt Institute</b>	<b>BIA</b>	<b>Brick Institute of America</b>
<b>AIA</b>	<b>American Insurance Association</b>	<b>CDA</b>	<b>Copper Development Association, Inc.</b>
<b>AISC</b>	<b>American Institute of Steel Construction, Inc.</b>	<b>COE</b>	<b>Corps of Engineers (U. S. Dept. of the Army)</b>
<b>AISI</b>	<b>American Iron and Steel Institute</b>	<b>CPMB</b>	<b>Concrete Plant Manufacturers Bureau</b>
<b>AITC</b>	<b>American Institute of Timber Construction</b>	<b>CRSI</b>	<b>Concrete Reinforcing Steel Institute</b>
<b>AMCA</b>	<b>Air Moving and Conditioning Association</b>	<b>CTI</b>	<b>Ceramic Tile Institute</b>
<b>ANCII</b>	<b>American Standard Code for Information Exchange</b>	<b>CS</b>	<b>Commercial Standard of NBS (U. S. Dept. of Commerce)</b>
<b>ANSI</b>	<b>American National Standards Institute</b>	<b>DHI</b>	<b>Door &amp; Hardware Institute</b>
<b>AOAC</b>	<b>Association of Official Analytical Chemists</b>	<b>EIA</b>	<b>Electronic Industry Association</b>
<b>APA</b>	<b>American Plywood Association</b>	<b>ETL</b>	<b>Electrical Testing Laboratories</b>
<b>APTA</b>	<b>American Public Transit Association</b>	<b>FED</b>	<b>Federal Construction Regulations</b>
<b>AREMA</b>	<b>American Railway Engineering and Maintenance-of-Way Association</b>	<b>FGMA</b>	<b>Flat Glass Marketing Association</b>
<b>ARI</b>	<b>Air-Conditioning and Refrigeration Institute</b>	<b>FM</b>	<b>Factory Mutual Engineering Corp.</b>
<b>ASHRAE</b>	<b>American Society of Heating, Refrigerating &amp; Air-Conditioning Engineers, Inc.</b>	<b>FRA</b>	<b>Federal Railroad Administration</b>
<b>ASME</b>	<b>American Society of Mechanical Engineers</b>	<b>FS</b>	<b>Federal Specifications</b>
<b>ASNT</b>	<b>American Society for Non-Destructive Testing, Inc.</b>	<b>FTA</b>	<b>Federal Transit Administration</b>
<b>ASTM</b>	<b>ASTM International (Formerly known as American Society for Testing and Materials)</b>	<b>GA</b>	<b>Gypsum Association</b>
<b>AWI</b>	<b>Architectural Woodwork Institute</b>	<b>GRI</b>	<b>Geosynthetic Research Institute</b>
<b>AWPA</b>	<b>American Wood-Preservers' Association</b>	<b>HI</b>	<b>Hydronics Institute</b>
<b>AWPB</b>	<b>American Wood Preservers Bureau</b>	<b>HMI</b>	<b>Hoists Manufacturers Institute</b>
<b>AWPI</b>	<b>American Wood Preservers Institute</b>	<b>HPMA</b>	<b>Hardwood Plywood Manufacturers Association</b>
<b>AWS</b>	<b>American Welding Society, Inc.</b>	<b>IBC</b>	<b>International Building Code</b>
<b>AWWA</b>	<b>American Water Works Association, Inc.</b>	<b>IECC</b>	<b>International Energy Conservation Code</b>
		<b>IPC</b>	<b>International Plumbing Code</b>
		<b>ICEA</b>	<b>Insulated Cable Engineering Association</b>
		<b>IEEE</b>	<b>Institute of Electrical and Electronic Engineers</b>
		<b>IES</b>	<b>Illuminating Engineer Society (Same as IEEE)</b>
		<b>ISA</b>	<b>Instrument Society of America</b>
		<b>ITE</b>	<b>Institute of Transportation Engineers</b>



REFERENCE STANDARDS

<b>LIA</b>	<b>Lead Industries Association</b>	<b>OSHA</b>	<b>Occupational Safety and Health Administration</b>
<b>LPI</b>	<b>Lightning Protection Institute</b>		
<b>MIA</b>	<b>Marble Institute of America</b>	<b>PCA</b>	<b>Portland Cement Association</b>
<b>MLSFA</b>	<b>Metal Lath/Steel Framing Association</b>	<b>PCI</b>	<b>Prestressed Concrete Institute</b>
<b>MSS</b>	<b>Manufacturers Standardization Society of Valve and Fittings</b>	<b>PEI</b>	<b>Porcelain Enamel Institute</b>
<b>NAAMM</b>	<b>The National Association of Architectural Metal Manufacturers</b>	<b>PI</b>	<b>Perlite Institute</b>
<b>NACE</b>	<b>National Association of Corrosion Engineers</b>	<b>PS</b>	<b>Product Standard of NBS</b>
<b>NBGQA</b>	<b>National Building Granite Quarries Association, Inc.</b>	<b>RIS</b>	<b>Redwood Inspection Service (Grading Rules)</b>
<b>NBS</b>	<b>National Bureau of Standards (U. S. Dept. of Commerce)</b>	<b>RTA</b>	<b>Railway Tie Association</b>
<b>NCMA</b>	<b>National Concrete Masonry Association</b>	<b>SAE</b>	<b>Society of Automotive Engineers</b>
<b>NCPWB</b>	<b>National Certified Pipe Welding Bureau</b>	<b>SDI</b>	<b>Steel Deck Institute</b>
<b>NCTCG</b>	<b>North Central Texas Council of Governments</b>	<b>SDI</b>	<b>Steel Door Institute</b>
	Copies of the Standard Specifications for Public Works Construction may be purchased from the North Central Texas Council of Governments, 616 Six Flags Drive, Arlington, Texas 76005-5888. May be available on-line at <a href="http://publicworks.dfwinfo.com/">http://publicworks.dfwinfo.com/</a> . This document is copyrighted.		
<b>NEC</b>	<b>National Electrical Code by NFPA</b>	<b>SIGMA</b>	<b>Sealed Insulating Glass Manufacturers Association</b>
<b>NESC</b>	<b>National Electrical Safety Code</b>	<b>SJI</b>	<b>Steel Joist Institute</b>
<b>NEMA</b>	<b>National Electrical Manufacturers Association</b>	<b>SMACNA</b>	<b>Sheet Metal &amp; Air Conditioning Contractor's National Association, Inc.</b>
<b>NFPA</b>	<b>National Fire Protection Association</b>	<b>SPIB</b>	<b>Southern Pine Inspection Bureau (Grading rules)</b>
<b>NFPA</b>	<b>National Forest Products Association</b>	<b>SSPC</b>	<b>The Society for Protective Coatings (Formerly known as Steel Structures Painting Council)</b>
<b>NHLA</b>	<b>National Hardwood Lumber Association</b>	<b>SWI</b>	<b>Steel Window Institute</b>
<b>NPA</b>	<b>National Particleboard Association</b>	<b>TACB</b>	<b>Texas Air Control Board</b>
<b>NRCA</b>	<b>National Roofing Contractors Association</b>	<b>TCA</b>	<b>Tile Council of America, Inc.</b>
<b>NRMCA</b>	<b>National Ready Mixed Concrete Association</b>	<b>TCEQ</b>	<b>Texas Commission on Environmental Quality</b>
<b>NWMA</b>	<b>National Woodwork Manufacturers Association, Inc.</b>	<b>TMUTCD</b>	<b>Texas Manual of Uniform Traffic Control Devices</b>
		<b>TNRCC</b>	<b>Texas National Resource Conservation Commission (TCEQ as of January 2003.)</b>
		<b>TRC</b>	<b>Texas Railroad Commission</b>
		<b>TWC</b>	<b>Texas Water Commission</b>
		<b>TxDOT</b>	<b>Texas Department of Transportation</b>
		<b>UBC</b>	<b>Uniform Building Code</b>
		<b>UFC</b>	<b>Uniform Fire Code</b>
		<b>UMC</b>	<b>Uniform Mechanical Code</b>
		<b>UPC</b>	<b>Uniform Plumbing Code</b>
		<b>UL</b>	<b>Underwriters' Laboratories, Inc.</b>

**USGPO      U.S. Government Printing Office**

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1      GENERAL**

- A. Separate measurement or payment will not be made for work required under this Section. Costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

**END OF SECTION 01423**

**SECTION 01430  
CONTRACTOR'S QUALITY ASSURANCE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section includes specifications for the Contractor's quality assurance of erection and installation of materials, equipment, systems, and assemblies, and construction of the Work, as indicated. The requirements specified herein are in addition to quality assurance requirements specified in other Sections of these Specifications.
- B. Contractor's Quality Control Plan, quality control requirements, and Authority's Testing and Inspection are specified in Section 01450, "Quality Control".
- C. Field samples and site mockups are specified in Section 01454, "Field Samples and Mockups".

**1.2 WORK QUALITY**

- A. Shop and field work shall be performed by mechanics, crafts-persons, artisans, and workers skilled and experienced in the fabrication and installation of the work involved. The Work shall be performed in accordance with the Contract Documents and the reviewed and accepted submittals including Shop Drawings.
- B. Work shall be erected and installed plumb, level, square, and true, or true to indicated angle, and in proper alignment and relationship to the work of other trades. Finished Work shall be free from defects and damage.

**1.3 MANUFACTURERS' SPECIFICATIONS AND INSTRUCTIONS**

- A. Unless otherwise indicated or specified, manufactured materials, products, processes, equipment, systems, assemblies, and the like shall be erected, installed, or applied in accordance with the manufacturers' instructions, directions, or specifications. Said erection, installation, or application shall be in accordance with printed instructions furnished by the manufacturer of the material or equipment concerned for use under conditions similar to those at the jobsite.
- B. Any deviation from the manufacturers' printed installation instructions and recommendations shall be explained and acknowledged as correct and appropriate for the circumstances, in writing, by the particular manufacturer and will require the Contracting Officer's approval prior to implementation. The Contractor will be held responsible for installations contrary to the respective manufacturers' instructions and recommendations.

**1.4 SPECIALIST APPLICATOR/INSTALLER**

- A. Materials, equipment, systems, and assemblies requiring special knowledge and skill for the application or installation of such materials, equipment, systems, or assemblies shall be applied or installed by the specified product manufacturer or its authorized representative or by a skilled and experienced Subcontractor qualified and specializing in the application or installation of the specified product.
- B. When required in the applicable specifications section, utilize an installation Subcontractor approved by the product manufacturer, as applicable.

**1.5 MANUFACTURERS' FIELD SERVICES**

- A. When required in the applicable specifications section, the Contractor shall have the manufacturer of a product, system, or assembly provide appropriate field or job service at no additional cost to the Authority. The Contractor shall have the manufacturer inspect and approve in writing the application or installation work. If required under the applicable specifications section, the manufacturer's representative shall also provide test reports attesting that completed work is in compliance with specified requirements.
- B. The Contractor shall make all necessary arrangements with the manufacturer of the products to be installed to provide onsite consultation and inspection services to assure the correct application or installation of the product, system, or assembly.
- C. The manufacturer's authorized representative shall be present at the time any phase of this work is started.
- D. The Contractor shall have the manufacturer's authorized representative inspect and approve all surfaces over which, or upon which, the manufacturer's product will be applied or installed.
- E. The Contractor shall have the manufacturer's representative make periodic visits to the site as the work progresses as necessary for consultation and for expediting the work in the most practical manner.

**1.6 FINISHED TOLERANCES**

- A. Except as specified otherwise in the individual Specifications Sections, finished tolerances shall conform with the following requirements:
1. Walls: Finished wall surfaces shall be plumb and shall have a maximum variation of 1/8 inch in 8 feet when a straightedge is laid on the surface in any direction, and no measurable variation in any 2-foot direction.
  2. Ceilings: Finished ceiling surfaces shall present true, level, and plane surfaces, with a maximum variation of 1/8 inch in 8 feet when a straightedge and water level are laid on the surface in any direction, and no measurable variation in any 2 foot direction.
  3. Concrete Floors: Tolerances for concrete floors and pavement are specified in Section 03350, "Concrete Finishing".
  4. Finished Floors: Where floor drains occur, slope finished floor to the drain at the rate of 1/8 inch per foot or as otherwise indicated on the Contract Drawings.

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. Separate measurement or payment will not be made for work required under this Section. Costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

**END OF SECTION 01430**

## SECTION 01450 QUALITY CONTROL

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. This Section includes specifications which describe the responsibilities for quality control of the Work including inspections and control testing by the Contractor. This Section describes the use of certificates of compliance. This Section also includes the Authority's inspections and quality assurance testing.
- B. Requirements specified herein are in accordance with and augment General Provisions Paragraph, "INSPECTION OF CONSTRUCTION". The Contracting Officer and other Authority personnel will identify discrepancies and nonconformances through daily oversight and the Authority's quality audits subject to the limitations stated in General Provisions Paragraph, "INSPECTION OF CONSTRUCTION".
- C. Wherever it is required to obtain the approval of the Authority's Quality Manager, it shall be understood that this approval shall be obtained through the Contracting Officer.
- D. CQC Plan shall be based on the quality system as described in FTA, "Quality Management System Guidelines – December 2012" and American National Standard Institute, ANSI/ISO/ASQ Q9001, "Quality Management Systems – Requirements".

#### 1.2 REFERENCED STANDARDS

- A. ASTM International (Formerly American Society for Testing and Materials) (ASTM)
  - 1. ASTM E329 Standard Specifications for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
- B. DART Quality Program Plan (QPP)
- C. FTA – Quality Management System Guidelines – December 2012
- D. International Organization for Standardization/ International Electrotechnical Commission (ISO/IEC)
  - 1. ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories
- E. American National Standard Institute (ANSI):
  - 1. ANSI/ISO/ASQ Q9000 – Quality Management Systems – Fundamentals and Vocabulary

- 2. ANSI/ISO/ASQ Q9001 – Quality Management Systems – Requirements

#### F. Institute of Electrical and Electronic Engineers (IEEE):

- 1. IEEE Standard 730 – Standard for Software Quality Assurance Plans
- 2. IEEE Standard 828 – Standard for Software Configuration Management Plans – IEEE Computer Society Document
- 3. IEEE Standard 1012 – Software Verification and Validation

#### 1.3 DEFINITIONS

- A. Acceptance Tests: Test conducted for the purpose of accepting or approving products and performance of the Contractor.
- B. Certificate of Compliance: Written statement, signed by a qualified party, attesting that the items or services are in accordance with specified requirements and accompanied by additional information to substantiate the statement.
- C. Certificate of Conformance: Written statement, signed by a qualified party, certifying that the items or services are in accordance with specified requirements.
- D. Certified Test Reports: Reports of tests signed by a qualified professional attesting that tests were performed in accordance with the test method specified, that the test results reported are accurate, and that items tested meet or fail to meet the stated minimum requirements. Include calibration certificates, if required.
- E. Certified Inspection Reports: Reports signed by Contractor's Quality Control Representative (CQCR) attesting that the items inspected meet the specification requirements other than any exceptions included in the report.
- F. Contractor Quality Control (CQC) Plan (System): Written description of proposed actions to control and assure quality. CQC Plan defines applicable quality policy for the project and applicable quality procedures. CQC Plan shall be established and maintained by the Contractor to ensure compliance with the Contract requirements. No portion of the Plan may be delegated to subcontractors or suppliers without the prior approval of the Contracting Officer.
- G. Corrective Action: Corrective action identifies action to be taken to correct immediate defects and correct the root cause to prevent recurring defects. Corrective action addresses systemic or chronic problems. Corrective action includes procedures for investigating the cause of nonconforming work.

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and procedures for analysis to detect and eliminate potential causes of nonconforming work.

prior to application and is applied in place of a recognized U.S. national standard.

H. Factory Tests: Tests made on various products and component parts prior to shipment to the job site.

R. Measurement Standard: A metrology reference standard device used to calibrate measuring and test equipment (M&TE) or other measurement standards where a measurement standard has a National Institute of Standards and Technology (NIST) traceability property such that comparative measurement or value of a measurement standard is related to stated references through an unbroken chain of comparisons all having stated uncertainties.

I. Procedure: Procedures as used in regard to Contractor's quality control shall be understood to mean written instructions for implementing various components of quality control and its management. Procedures shall identify what is to be done, who will do it, and how, where, and when it will be done.

S. Quality Assurance Audit: An examination of the Authority approved Contractor CQC Plan implementation to determine its compliance with and conformance to the CQC Plan and related documents.

J. Quality Control Inspection: Examining, testing, analysis, or sampling products or workmanship, including when appropriate, raw materials, components, and intermediate assemblies, to determine conformance to stated requirements.

T. Software Quality: A software product's totality of features and characteristics that determine its ability to satisfy stated needs and conformity to these Specifications. The degree to which a software system meets these Specifications.

K. Manufacturer's Certificate of Conformance or Compliance: Certificate signed by an authorized manufacturer's official attesting that the material or equipment delivered meets the Specification requirements.

U. Software Quality Assurance (SQA): SQA is the planned and systematic set of activities that ensure that software process including all activities involved in design, coding, testing, and maintaining products including software, associated data, documentation and all supporting and reporting paperwork conform to requirements, standards, and procedures.

L. Nonconformance: A discrepancy in characteristic, documentation, or procedure which affects form, fit, or function and renders the quality of an item unacceptable or indeterminate in regard to meeting relevant project requirements. Examples of nonconformance include physical defects, test failures, incorrect or inadequate documentation, or deviation from prescribed processing, inspection, or test procedures.

V. Software System Test: The activity of testing integrated hardware and software systems to verify whether the system meets the customer requirements and these technical Specifications.

M. Person: Associations, companies, corporations, educational institutions, firms, government agencies at the federal, state, and local level, partnerships, and societies, as well as divisions thereof, and individuals.

W. Software Validation: Formal process to confirm that software components are consistent with customer requirements, functional requirements, and these Specifications.

N. Product: A type or a category of manufactured goods, constructions, installations, and natural and processed materials or those associated services whose characterization, classification, or functional performance determination is specified by standards.

### 1.4 CONTRACTOR'S QUALITY CONTROL (CQC) PLAN (SYSTEM) - OVERVIEW

O. Quality Control Tests: Tests conducted and performed by the Contractor for the purpose of monitoring the quality of products and performance of the Contractor.

A. Contractor shall develop; establish; implement; maintain; and evaluate an organization and system herein called the Contractor's CQC Plan to perform inspections and tests to ensure compliance with the contract.

P. Testing Laboratory: Any person, as defined above, whose functions include testing, analyzing, or inspecting "products", as defined above, or evaluating the designs or specifications of such "products" according to the requirements of applicable standards. Refer to Article 1.8 entitled "Qualifications of Contractor's Testing Facility" herein for additional information.

B. CQC Plan shall include inspections and tests for items of work of subcontractors and/or suppliers. CQC Plan shall also include retesting in the event of failure. CQC Plan shall include activities associated with quality required in the technical provisions of the Specifications for design and construction operations, including onsite and offsite fabrication and materials.

Q. Consensus Standard: An artifact or process that is a de-facto standard by written agreement between the Contractor and the Authority where the de-facto standard's content and applicability are established

C. CQC Plan shall include procedures to verify that the quality related activities are performed. Procedures shall include assignment of CQC responsibilities to qualified, Authority-approved individuals and

organizations and documentation of the quality related activities to provide evidence and accountability of quality in the finished project.

- D. Obtain DART Quality approval of the CQC Plan prior to its implementation. No revisions to the Plan will be allowed without prior approval of DART Quality. Unless specifically authorized by the Authority, in writing, construction shall not be started until the CQC Plan (including all personnel associated with implementation of the plan) is approved.
  - 1. Contractor may identify quality control measures for early activities in its CQC Plan. With the Contracting Officer's written approval, Contractor may proceed with early activities prior to approval of overall CQC Plan.
- E. DART Quality will monitor the implementation of the CQC Plan.
- F. CQC Plan shall address the ANSI/ISO/ASQ Q9001, Section 4.0, and "Quality Management System – Requirements" and shall be implemented to satisfy the needs of the Contractor and the Authority. It shall address: the objectives for service quality; the approach to be adopted in pursuit of quality objectives; and define the role of the quality personnel responsible for implementing the quality policy. CQC plan shall be based on the technical and manufacturing aspects of the engineering design and materials supplied on this job and the inspection and quality procedures for the design, construction, and installation of materials for this project.

**1.5 CQC PLAN ELEMENTS**

- A. The CQC Plan shall address the requirements listed herein.
- B. Management Responsibilities:
  - 1. Quality Policy: Contractor shall define and document, in writing, a quality policy that will communicate, implement, and maintain that policy at all levels of its organization as well as to subcontractors and/or suppliers. This commitment to quality shall belong to the highest level of the Contractor's management. The CQC Plan shall define quality goals and objectives.
  - 2. Contractor's Quality Control Representative (CQCR): Contractor's management shall designate a full-time Contractor's Quality Control Representative who shall have defined authority and responsibilities for ensuring that the quality policy is implemented and maintained. A letter appointing the CQCR, signed by an officer of the firm, shall outline the CQCR's duties, responsibilities and authority, to include the authority to direct removal and replacement

of any nonconforming work. CQCR shall report to that officer of the firm who signed the letter appointing the CQCR. Refer to the Article 1.7 entitled "Qualifications of Contractor's Quality Control Staff" for CQCR qualifications.

- a. Contractor's Alternate – Quality Control Representative (ACQCR): A letter appointing the ACQCR, signed by an officer of the firm, delegating the CQCR's responsibilities including the authority to direct removal and replacement of nonconforming work. ACQCR will report to the officer of the firm who signed the letter. Refer to the Article 1.7 entitled "Qualifications of Contractor's Quality Control Staff" for Alternate CQCR qualifications.

- 3. Obtain DART Quality approval of the CQCR prior to beginning construction activities. The Contract time will not be extended for failure to propose an acceptable CQCR.
- 4. Upon receipt of a written notification that any Contractor's Quality Control Personnel (CQCP) failed to perform that individual's duties, a replacement shall be provided immediately. Contractor will not be entitled to any additional time or compensation if replacement of personnel is required.
- 5. Personnel List and Organization Chart: The Plan shall further identify all persons responsible for CQC functions and shall define in writing their responsibilities, authority, and interrelationship of these people. Personnel involved with quality related activities shall be identified and their interrelationship with management defined. This relationship shall be shown on an organization chart. Personnel responsible for ensuring quality shall be independent of those directly related for the work being performed and shall have no other work activities assigned except for ensuring quality. Personnel shall be free from the pressure of costs, construction scheduling, and production, and shall have the necessary independent authority to perform their roles effectively

- C. Documented Quality Plan (System): CQC Plan shall establish and maintain a documented quality plan to ensure that project quality objectives are met. No part of the Contractor's quality control responsibilities may be delegated to subcontractors or suppliers without prior approval of the Contracting Officer. Quality requirements shall be extended to both the subcontractors and suppliers. This shall be done by written procedures and instructions for activities affecting quality in any required design, procurement, manufacturing, and construction as applicable for the work being

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- performed. Procedures and instructions shall be developed for control of process including inspection; testing; nondestructive examination; maintenance of calibration equipment; disposition of nonconforming work (processes and/or products); corrective action; maintenance of quality records; reviewing shop drawings, samples, certificates, or other submittals; quality audits; and training.
- D. Design Control: Contractor shall, when required by the Contract, establish and maintain procedures to control and verify design efforts required for the Project to ensure that design criteria and regulations are satisfied (e.g MSE Walls). The design control shall ensure that the design requirements are understood; plan the design interfaces and design verification activities; execute the design verification activities; and control any design changes through the project completion.
- E. Document Control: Contractor shall establish and maintain procedures for control of project documents and data. The document control process shall ensure that relevant documents are current and available to users who require them.
1. Contractor shall establish and maintain procedures for quality records. These procedures shall identify which records will be kept, responsibility for production and collection, and responsibility for indexing, filing, storage, protection, maintenance, and disposition of quality records. Contractor shall certify that these records are current and accurate within each payment application. Failure to maintain these records shall be grounds for the Contracting Officer to withhold progress payments for the General Requirements.
  2. CQC records shall be prepared, maintained, and filed in accordance with approved procedures. These records shall be kept in approved fire-safe storage cabinets that preclude damage, loss, or deterioration.
- F. Purchasing: Contractor shall establish and maintain procedures for ensuring that services (subcontractors and/or manufacturers) or products comply with the Contract requirements. Contractor shall ensure that suppliers have a quality program appropriate to the work being performed and in accordance to the Contract requirements. The procedure shall ensure that purchasing documents are reviewed and approved by a designated authority prior to release.
- G. Product Identification and Traceability: Contractor shall establish and maintain procedures for identifying and controlling items of production (batch, materials, parts, and components) to prevent the use of incorrect or defective items and to ensure that only correct and acceptable items are used or installed in accordance with the Contract requirements.
- H. Process Control: Contractor shall establish and maintain procedures for identifying and planning the production and installation processes that shall be performed under controlled conditions as identified by the Contract requirements. Special processes, the result of which cannot be verified by subsequent inspection and testing of the product, shall be specifically identified and be continuously monitored. This shall also apply to both subcontractors and suppliers.
- I. Inspection and Testing: Contractor shall establish and maintain procedures for inspection and testing. Inspection and testing shall be planned and executed as necessary to verify quality. Procedures shall be specified, referenced to Contractor's schedule activity code numbers, implemented, and the results documented for receiving incoming products, for work in progress, and for final inspection and testing. For schedule activity code provisions, refer to Section 01320, "Construction Schedule and Progress Reports", or Section 01321, "Construction Schedule and Progress Reports for Small Projects", as applicable.
1. List of Tests: Contractor shall prepare a list of all tests the Contractor is to perform to meet the requirements of the Contract. The list shall give the test name, specification paragraph, if applicable, containing the test requirements, and the personnel and laboratory responsible for each type of test. The tests listed shall include, in addition to those specified, those required by manufacturers and those required at successive stages of the performance of the Work occurring in the field to document progressive quality of the Work such as compaction tests in various lifts in backfilling of a trench or the subgrade prior to construction of a facility.
    - a. Identify those tests that require the presence of the CQCR during testing and the CQCR's signed approval.
    - b. Preliminary Schedule: Include a preliminary schedule for coordination with the Authority's testing laboratory. Indicate tests to be performed by Contractor testing laboratory. Include at least 24 hours for on-site work and 48 hours for off-site work advance written notice to the Contracting Officer for collection of test samples, conducting field tests, and similar work by the Authority's testing laboratory. Include at least 30 days advance written notice to the Contracting Officer for off-site inspections.
  2. Establish procedures for inspection of incoming materials. Notify Contracting Officer of delivery and location of incoming material to facilitate Contracting Officer's



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- inspections. Coordinate with submittal of corresponding certifications.
3. Utilize 3-phase inspection process including preparatory, initial, and follow-up inspections.
    - a. Preparatory Inspection and Meeting: Perform preparatory inspection before beginning any work on any definable segment of work. Participants will include a representative of the Contracting Officer and shall also include a member of the Contractor's quality control staff assigned to inspect the work, the supervisor in charge of the work, and individuals responsible for accomplishing the work. Included in a preparatory meeting shall be a review of the Contract requirements, the review of approved shop drawings and other submittal data, the review of safety requirements, assurance that required control testing is to be provided, a physical examination to ensure that materials and equipment conform to approved shop drawings and submittal data, and assurance that required preliminary work has been completed. Participants shall discuss what will constitute a representative segment for purposes of the initial inspection of the particular item of work and shall come to a mutual agreement. If no mutual agreement is made, the Contracting Officer will define the representative segment. This inspection and meeting shall be conducted and documented by the CQCR.
    - b. Perform an initial inspection as soon as a representative segment of the particular item of work is accomplished. Include in the initial inspection the following: performance of scheduled tests, examination of the quality of workmanship, a review for omissions or dimensional errors, and approval or rejection of the initial segment of the Work.
    - c. Perform follow-up inspections daily and include continued testing and examinations to ensure continued compliance with the Contract requirements. Follow-up inspections shall be identified with schedule activity code numbers in accordance with Section 01320, "Construction Schedule and Progress Reports", or Section 01321, "Construction Schedule and Progress Reports for Small Projects", as applicable.
  4. Contractor shall provide Quality Control and Acceptance tests as necessary to ensure compliance with the contract. Where testing laboratory services are supplemented by the Authority, as described in the Article 1.11 entitled "Authority's Testing and Inspection" herein, the Contractor shall coordinate and cooperate with the testing laboratory and furnish samples of materials, design mix, equipment, tools, storage, and assistance as requested.
  5. Laboratory Reports: Notwithstanding that the testing laboratory provided by the Authority may be used, the Contractor shall provide reports which cite the Contract requirements, the test or analysis procedures used, the actual test results, and include a statement that the item tested or analyzed conforms or fails to conform to the Specification requirements. Stamp each report conspicuously on the cover sheet in large red letters a minimum of 1/2-inch high "CONFORMS" or "DOES NOT CONFORM" to the Specification requirements as the case may be. Submit test reports signed by a representative of the testing laboratory authorized to sign certified test reports.
    - a. Reports in Regard to Nonconformance: Include with submittal of the signed original, an additional copy of tests which indicated nonconformance to the Contract requirements and the CQCR's written explanation of proposed or actual corrective measures taken. When corrective measures are taken, submit a copy of the laboratory report indicating conformance, along with a copy of the nonconforming report and a description of the corrective action taken.
  6. Tabulation of Tests: Maintain an up-to-date tabulation of all tests performed in connection with the Contract, including conforming, nonconforming and repeated test results. Tabulation of tests shall include logs of each test performed, such as mandreling of conduits and ground resistance tests. Each nonconforming test listed shall indicate the status of the nonconforming test result, either by indicating the resolving test laboratory report number, or by indicating that it still remains nonconforming or open. Certify the current tabulation(s) as complete, and deliver directly to the Contracting Officer with each payment application. Failure to maintain and provide these records shall be grounds for the Contracting Officer to withhold progress payments for General Requirements and to require the replacement of the CQCP responsible for these records. Prior to final closeout,

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provide a tabulation of tests performed in connection with the Contract, including conforming, nonconforming, and repeated test results. Certify the tabulation(s) as complete, and deliver directly to the Contracting Officer.

7. Inspection and Test Record Numbering: Reports shall be numbered sequentially and traceable to Contract number, location, lot, part, and retest number, as applicable. Coordinate with the requirements specified under "List of Tests" and "Tabulation of Tests" herein.
  8. Ensure inspections, measurements, and tests are performed under appropriate environmental conditions.
- J. Inspection, Measuring, and Testing Equipment: Contractor shall establish and maintain procedures for identifying, controlling, calibrating, and maintaining inspection, measuring, and test equipment required to carry out inspection and testing. Procedures shall include maintenance of calibration records. Such equipment shall be identified, controlled, calibrated, and maintained in conformance to requirements established by ISO/IEC 17025. Such equipment shall be recalibrated in a timely manner. This shall apply to the Contractor and Contractor's subcontractors and suppliers.
1. In maintaining calibration, use reference standards traceable to the U. S. National Institute of Standards and Technology, if no documented standard exists in ISO/IEC 17025.
  2. Establish calibration intervals based on equipment manufacturer's recommendations, usage, accuracy, and maintenance history. In every case, calibration shall be performed at intervals not to exceed 1 year.
  3. Mark equipment indicating calibration status of the piece of equipment. Mark in a manner readily visible to operator but will not hamper operation of equipment.
  4. Perform calibrations under appropriate environmental conditions.
  5. Re-inspect and re-test equipment proven to be out of calibration.
  6. Establish handling procedures for equipment to prevent damage that may cause inaccurate readings. Safe guard equipment to prevent adjustments that would invalidate calibration settings.
- K. Nonconformances and Deficiencies: Contractor shall establish and maintain procedures for correcting and controlling nonconforming work and

for the investigation of the cause of nonconforming work and the corrective action needed to prevent a recurrence. Such procedures shall ensure that work is not inadvertently used or installed. Such procedures shall include analysis to detect and eliminate potential causes of nonconforming work.

1. Nonconforming materials, equipment, components, parts, and work shall be identified, documented, and (when possible) segregated.
2. Procedures shall also include disposition of items noted as Deficiency during inspections. Procedures shall take into account the following requirements in regard to Deficiencies.
  - a. Deficiencies shall be transferred to a Nonconformance Report when the deficiency is not corrected and is sufficiently severe to cause the product or service or associated product or service not to satisfy its intended usage requirements.
  - b. Deficiencies shall be transferred to a Nonconformance Report when the deficiency will affect follow-on work.
  - c. Deficiencies shall be transferred to a Nonconformance Report when required by the Contracting Officer.
3. Nonconforming items will be classified as follows by the Contracting Officer:
  - a. Reject: The item is unsuitable for its intended use and economically or physically incapable of being repaired/reworked.
  - b. Rework: The item can be brought into conformance with original requirements.
  - c. Repair: The item can be made acceptable for its intended purpose; however, it may not meet all requirements.
  - d. Use-As-Is: The item will be used without modifications; and will meet engineering functional requirements for performance and fit.
4. Upon rework or repair of those items classified as "Rework" and "Repair", obtain the Contracting Officer's inspection and approval prior to Nonconformance Report closure.
5. When and as determined by the Contracting Officer, a credit will be made to the Authority from those funds due to the Contractor for those for items dispositioned as "Repair" or

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“Use-As-Is” to reflect the decrease in function, longevity, and other characteristics of the repaired or “used-as-is” item.

6. Develop and use forms for tracking and dispositioning of deficiencies and nonconformances.

L. Quality Audits: Contractor shall establish and maintain procedures for auditing to ensure that the elements of the quality system are functioning as intended for the Contractor’s program and the Contractor’s subcontractors’ and suppliers’ programs. Refer to Article 1.12 entitled “Authority’s Quality Audits” for related requirements.

M. Training: Contractor shall establish and maintain procedures for training and documenting of personnel to perform any activity or job they are not qualified to perform. Only personnel qualified through experience and/or training shall perform activities that will affect quality for this Contract.

N. Include as part of the CQC Plan, a listing of outside organizations such as testing laboratories, architects, and consulting engineers to be employed by the Contractor. The listing shall include a description of the services these firms will provide, and list the authorized representatives for each organization that can sign reports. The services of such outside organizations may include the documentation of inspection activities of materials received; reports verifying the quantities of materials received; reports verifying factory tests completed on the materials received, as applicable; any physical damage of materials received; and other documentation of materials as required.

1. Include documentation of the accreditation of Contractor’s Testing Facilities. Refer to Article 1.8 entitled “Qualifications of Contractor’s Testing Facilities” herein.

O. Sources of Material: Include as part of the CQC Plan, a list of Contractor’s sources of materials to be incorporated in the work, which require approval, certification, or testing. This list shall make clear for which materials the Contractor proposes to use manufacturer’s certificates of conformance of compliance. Refer to Submittal Status Log specified herein for related requirements.

P. Sample forms are available for the Contractor’s use in the DART Quality Program Plan (QPP).

**1.6 SUBMITTALS**

A. Submit 3 copies of the following through the Contracting Officer to DART Quality for review and approval:

1. CQC Plan as defined herein within 14 days after the Notice to Proceed. Include samples of Contractor’s proposed Quality Control forms.

a. Sources of Materials: Submit list within 30 days of Notice to Proceed.

2. Qualifications of proposed Contractor’s Quality Control Personnel.

3. Matrix correlating the CQC Plan with the list at the end of the Section, Attachment 01450-1, showing the CQC Plan’s compliance with the requirements of this Section.

4. Qualifications of proposed Contractor’s testing laboratory including the name, address, and certification of compliance with ASTM E329, together with the scope of proposed services. Should the Contractor desire to use more than 1 firm for quality control testing, the required information shall be submitted for each such proposed firm.

B. Refer to Article 1.10 entitled “Specific Duties of the Contractor’s Quality Control Representative” for CQCR’s submittals.

**1.7 QUALIFICATIONS OF CONTRACTOR’S QUALITY CONTROL STAFF**

A. Contractor shall provide a full time CQCR supplemented by sufficient CQCP necessary to be physically at the job site at all times during work progress to provide continuous inspection of the work. For example, if the Contractor is performing work at separate locations or during more than 1 shift, an inspector shall be present at each location and during each shift to ensure that the work being performed meets the requirements specified by the Contract. The initial listing of staff in no way relieves the Contractor of meeting quality control requirements of the contract.

B. Qualification requirements for CQCP listed herein are minimum qualifications. Only individuals with qualifications, which meet the referenced standards, as applicable, shall be proposed. Each individual’s qualifications shall be detailed to show actual related experience in performing similar duties and responsibilities. If any proposed individual fails to meet the standard qualifications, that individual shall be withdrawn from consideration immediately.

C. CQCR shall have a minimum of 8 years verifiable construction experience in the type of construction prevalent for the contract being bid and who has developed the specialized knowledge, skills, and abilities to effectively perform the duties and responsibilities specified herein. Experience shall include 4 years managing a quality assurance/quality control program similar to the program specified herein. CQCR shall be a part of the Contractor’s staff, or an approved consultant working for the Contractor (not part of the staff of a subcontractor performing the work).

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D. ACQCR shall have a minimum of 5 years of verifiable construction experience of a similar type of construction. Designate the ACQCR to act for the CQCR (and notify the Contracting Officer) only when the CQCR is officially absent from the job site. ACQCR cannot act for the CQCR for a period longer than 10 consecutive calendar days in a 6-month period, without prior written approval from the Contracting Officer and DART Quality.

E. Inspectors shall have 4 years of verifiable experience on construction projects fulfilling similar type of positions.

### 1.8 QUALIFICATIONS OF CONTRACTOR'S TESTING FACILITIES

A. Contractor shall provide its own testing facilities or engage the services of an independent testing laboratory to perform tests and inspections at the Contractor's cost.

B. Contractor-provided testing laboratory, whether such laboratory is part of the Contractor's organization or an independent testing laboratory, shall hold and maintain an active accreditation in accordance with ASTM E329 throughout the course of the Contract.

C. Contractor shall notify the Contracting Officer if the accreditation status of its testing laboratory changes during the course of the Contract.

### 1.9 QUALITY CONTROL REQUIREMENTS

A. In accordance with the General Provisions Paragraph, "INSPECTION OF CONSTRUCTION", inspect and test the Work and maintain records of the inspections and tests. Obtain approvals, except those required for field installations, field applications, and field tests, before delivery of materials and equipment to the Project Site.

1. Factory Tests: Arrange for factory tests when required under the Contract and as required by the Contracting Officer.

2. Factory Inspection: Arrange for factory inspection when required under the Contract or as required by the Contracting Officer.

3. Field Inspections and Tests by the Contractor: Furnish equipment, instruments, qualified personnel, and facilities necessary to inspect the Work and perform all tests required to be conducted by the Contractor.

4. Field Inspections and Tests by the Authority: Provide assistance, equipment, instruments, qualified personnel, and facilities as required by the Contracting Officer for field inspections and tests conducted by the Authority in accordance with the following Article, "Authority's Testing and Inspection" and the General Provisions

Paragraph, "INSPECTION OF CONSTRUCTION".

5. Samples: Prepare samples and submit in accordance with Section 01330, "Submittals".

B. Mutual Understanding Meeting: Within 5 calendar days after the CQC Plan is approved, but before construction operations are started, meet with the Contracting Officer and discuss the quality control requirements. The purpose of the meeting is to develop a mutual understanding relative to details of the system, including forms to be used for recording the quality control operations, inspections, tests, approvals, certifications, administration of the system, coordination with jurisdictional authorities, and Authority surveillance. As a minimum attendees shall include DART Quality, CQCR, and representatives of affected entities. Refer to Section 01312, "Project Meetings", for related requirements.

C. Contracting Officer shall have access to all work areas during the Contractor's working time and shall have the right to monitor the methods and procedures used for construction related activities and/or CQC testing.

D. Certified Test Reports: Before delivery of materials and equipment, submit for approval certified copies of the test reports required in the technical sections. Accompany test reports with certificates from the manufacturer certifying that the material and equipment proposed to be supplied is of the same type, quality, manufacturer, and make as that tested.

E. Manufacturer's Certificates of Conformance or Compliance: Contractor may use certificates of compliance for certain materials and products in lieu of the specified sampling and testing procedures. However, the Authority reserves the right to refuse to permit the use of certain materials on the basis of a certificate of compliance. The Authority will accept manufacturer's certification furnished by the Contractor on items of materials and equipment incorporated into the Work only when this method will assure full compliance with the provisions of the Contract.

1. Certificates shall be originals; preprinted certifications will not be acceptable unless approved by the Contracting Officer. Certificates shall be signed by an authorized representative of the producer or manufacturer and shall state that the material complies with Contract requirements and the name and address of the Contractor, project name, and location.

2. Submit certificates with each lot of material delivered on the day the materials are delivered to the site. The lot certified shall be clearly identified by the certificate.

## QUALITY CONTROL

3. The certificate shall identify the materials or equipment being certified and give the information specified for submittals in Section 01330, "Submittals". The certificate shall also identify the referenced standard as applicable, the name and address of the organization performing the tests, the date of the tests, and the quantity of material shipped. Certificates for a material shall state the date(s) of shipment or delivery to which the certificates apply.
  4. Certificate of compliance shall be accompanied by a certified copy of test results or shall state that such test results are on file with the producer or manufacturer and shall be furnished to the Authority on request.
  5. Materials used on the basis of a certificate of compliance may be sampled and tested by the Contracting Officer at any time. The fact that material is used on the basis of a certificate of compliance shall not relieve the Contractor of its responsibility for incorporating material in the Work which conforms to the requirements of the Contract, and any such material not conforming to such requirements will be subject to rejection, whether in place or not.
- F. If Contractor fails to take Corrective Action in response to Corrective Action Reports, the Authority may terminate the right to proceed with the work or the separate part of the work in accordance with the General Provisions Article entitled "Default" or may remove the CQCR.
- G. Refer to Section 01722, "Field Engineering - Surveying", for requirements to provide surveying for both layout and for the subsequent verification that the work constructed complies with the dimensions and locations as shown.
- 1.10 SPECIFIC DUTIES OF THE CONTRACTOR'S QUALITY CONTROL REPRESENTATIVE**
- A. CQCR shall perform duties listed herein.
- B. Meetings: Refer to Section 01312, "Project Meetings," for the CQCR responsibilities in regard to Contractor's Quality Control (CQC) meetings.
- C. Document preparatory inspections and preparatory meetings. Refer to Article 1.5 entitled "CQC Plan Elements", under Paragraph "Inspection and Testing" herein.
- D. Prepare daily CQC reports identifying prime and subcontractor personnel and equipment on the site, idle equipment and personnel, material deliveries, weather conditions, work accomplished, inspections and tests conducted, results of inspection and tests, nature of defects found, causes for rejection, and corrective actions taken. Work shall be identified with schedule activity code numbers in accordance with Section 01320, "Construction Schedule and Progress Reports", or Section 01321, "Construction Schedule and Progress Reports for Small Projects", as applicable. Nonconforming tests and other nonconformances shall be noted on the daily CQC report. Daily CQC report shall note any questionable work identified by the Contracting Officer or other Authority representatives (called a Deficiency Notice). Daily CQC reports shall include the following certification: "On behalf of the Contractor, I certify that this report is complete and correct, and materials and equipment used and work performed during this reporting period are in compliance with the Contract Documents, to the best of my knowledge, except as noted above". This certification shall be signed on behalf of the Contractor by the authorized CQCR.
- E. CQCR shall submit the following for Contracting Officer's review and use:
1. Test reports, certifications and other testing and inspection documentation. Deliver signed original to the Contracting Officer within 7 days. Refer to specific requirements in Article 1.5 entitled "CQC Plan Elements", under Paragraph "Laboratory Reports".
    - a. Deliver a copy of preliminary field inspection and testing reports to the Contracting Officer on the day of inspection and testing. Copy shall be either a photocopy of the handwritten report or a printout if report is prepared electronically in the field.
    - b. Reports, including preliminary reports, shall identify inspections as preparatory, initial, or follow-up.
  2. Daily CQC reports. Submit by 9 am the following working day.
  3. Updated copy of Tabulation of Tests performed with each payment application. Also submit as part of closeout submittals; refer to Section 01770, "Contract Closeout".
  4. Daily "next day activity list." Submit at the end of normal work hours for the work to be performed the next day.
  5. Written responses to Nonconformance Reports, Corrective Action Reports, and Audit Finding Reports. Submit within the time frame designated in the applicable report.

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6. Original copies of reports dealing with nonconforming work.

### F. Responsibilities in Regard to Submittals:

1. Verify that submittals required by the various sections of the Specifications have been certified by the Contractor as specified in Section 01330, "Submittals", and that submittal quality control procedures have been followed in accordance with the CQC Plan.
2. Maintain at the Worksite an up-to-date Submittal Status Log showing the status of submittals required by the Contract. A sample format of an acceptable log is available on request. While the use of this sample format is not required, any other format shall contain the same information as shown on the sample. Submittal Status Log shall be based upon and be consistent with the Submittal Control Document specified in Section 01330, "Submittals". Failure to update and maintain this log accurately shall be grounds for the Contracting Officer to withhold progress payments from the lump sum for "General Requirements".

- G. Next Day Activity List: Provide a daily "next day activity list" identifying work to be performed for the next day. This shall include a list of tests and inspections that will be required to ensure that the work complies with the requirements of the inspections. List shall identify inspections as preparatory, initial, or follow-up. List shall identify tests and corrective work to be performed in regard to Deficiencies and Nonconformance Reports.

- H. Prepare a written response to any Nonconformance Reports (NCR), Corrective Action Reports (CAR), and Audit Finding Reports (AFR) that the Contracting Officer identifies to the Contractor.

- I. Refer to Section 01220, "Measurement and Payment", for CQCR responsibilities in regard to certifications of as-builts.

### 1.11 AUTHORITY'S TESTING AND INSPECTION

- A. The Authority will employ and pay for services of a certified testing laboratory that complies with ASTM E329 for the purpose of periodically performing quality assurance (QA) tests (solely for the Authority's purposes) of the worksite, plant, or laboratory to verify performance of the Contractor. Performance of quality assurance tests by the Authority does not relieve the Contractor of the responsibility of performing quality control inspection and testing to verify that work meets Contract requirements.

1. Copies of non-conforming tests will be furnished to the Contractor to ensure that nonconforming work is corrected.

2. Contractor shall bring nonconforming work into conformance and perform retest of failed test. When the nonconforming work has been successfully tested by the Contractor's testing laboratory, the Contractor shall then notify the Authority regarding when the Authority's testing laboratory can perform retest. The testing laboratory that performed the failed test will perform the retests.

- B. Repeat Quality Assurance Tests and Inspection by the Authority: In the event of a quality assurance test or inspection performed by the Authority fails, the Contractor shall be responsible for payment of cost for repeat quality assurance tests and inspections after each correction made to non-conforming materials and workmanship until tests and inspections by the QA testing laboratory or inspections of the Authority have certified that the materials, equipment, and workmanship conform to the contract requirements.

### C. Coordination:

1. Under the general direction of the Contracting Officer, the Contractor shall cooperate and coordinate with the Authority's testing laboratory to perform the tests specified by the Contract or required by the Contracting Officer to verify that the Contractor quality control measures and/or performance are adequate to provide a product which conforms to the contract requirements.

2. Refer to coordination and preliminary scheduling requirements specified in Article 1.5 entitled "CQC Plan Elements" under Paragraph "Preliminary Schedule" herein. To avoid delays to the progress of the Work, the Contractor shall submit written notice to the Contracting Officer at least 24 hours in advance for on-site work and 30 days in advance for off-site work of the time Authority-furnished testing laboratory field services are required. Contractor shall coordinate with the Contracting Officer in obtaining the required field services. Contractor shall provide assistance as necessary and as directed by the Contracting Officer to enable the Authority-furnished testing laboratory to perform the tests as specified.

### 1.12 AUTHORITY'S QUALITY AUDITS

- A. The Authority may perform quality audits of the Contractor's, subcontractor's, and supplier's quality records and performance. Contractor shall ensure that quality control records and places of work are open and available to the Authority for inspection during normal working hours.

1. Contractor shall reply to any findings resulting from such audit within 10 working days. Reply shall describe what caused any

## QUALITY CONTROL

deficiencies, what corrective actions are being taken, who is responsible for corrective actions, and when corrective actions will be complete.

- B. Contractor, subcontractor, or supplier being audited shall be available during the audit as required by the audit team.

### **PART 2 - PRODUCTS**

Not Used

### **PART 3 - EXECUTION**

Not Used

### **PART 4 - MEASUREMENT AND PAYMENT**

#### **4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements".

END OF SECTION 01450

QUALITY CONTROL

**ATTACHMENT 01450-1**

**CQC Plan Element and its Paragraph No. within Section 01450**

- 1.5B.1. Quality Policy
- 1.5B.2. Contractor's Quality Control Representative (CQCR): Include letter appointing the CQCR
- 1.5B.5. Personnel List and Organization Chart: Define responsibilities, authority, and interrelationships
- 1.5C. Documented Quality Plan (System)
- 1.5D. Design Control
- 1.5E. Document Control
- 1.5F. Purchasing
- 1.5G. Product Identification and Traceability
- 1.5H. Process Control
- 1.5I. Inspection and Testing
  - 1.5I.1. List of Tests
    - 1.5I.1.b. Preliminary Schedule
  - 1.5I.2. Procedures for inspection of incoming materials
  - 1.5I.5. Laboratory Reports
    - 1.5I.5.a. Reports in Regard to Nonconformance
  - 1.5I.6. Tabulation of Tests
  - 1.5I.7. Inspection and Test Record Numbering System
- 1.5J. Inspection, Measuring, and Testing Equipment
- 1.5K. Nonconformances and Deficiencies
- 1.5L. Quality Audits
- 1.5M. Training
- 1.5N. Listing of outside organizations
  - 1.5N.1. Contractor's Testing Facilities: Include documentation of accreditation
- 1.5O. Sources of Materials

END OF ATTACHMENT



**SECTION 01454  
FIELD SAMPLES AND MOCKUPS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section includes specifications for providing the field samples and site mock-ups required by the individual Specifications Sections.

**1.2 FIELD SAMPLES AND MOCK-UPS**

- A. Field samples and mock-ups shall be prepared at the jobsite by the Contractor as specified in the various Sections of these Specifications. Affected finish work shall not be started until the Contracting Officer has approved the field samples and jobsite mock-ups in writing.
- B. Preserve approved field samples and mock-ups for comparison purposes until the affected work is completed and accepted by the Authority. Finished work shall match the approved field samples and mock-ups.

**1.3 SUBMITTALS**

- A. Comply with the requirements for samples, and process a transmittal form for each mock-up or sample panel as a record of the activity.
- B. Transmit documentation regarding the mock-up and sample panels as specified for submittals.
- C. Refer to Section 01330, "Submittals", for Contracting Officer's review and approval.

**1.4 QUALITY ASSURANCE**

- A. NONCONFORMANCE
  - 1. Completed work which does not exactly match approved field samples and mock-ups will be rejected, and shall be replaced with work which does exactly match the approved field samples and mock-ups at the Contractor's expense.
  - 2. If the Contractor elects to start work before the Contracting Officer has approved the related field samples or mock-ups, the Contractor does so at the risk of having the work rejected by the Contracting Officer without compensation.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. As specified in individual Specification Sections.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Construct and prepare field samples and jobsite mock-ups at designated locations at the jobsite or on the structure as directed by the Contracting Officer.
  - 1. Take photographs of the existing conditions and substrates before beginning the field sample or mock-up.
  - 2. Contractor shall have product manufacturers inspect and approve field samples and mock-ups, which involve their materials, for proper application or installation of the materials in accordance with their respective instructions and recommendations for the conditions or circumstances involved in the application or installation.
  - 3. Contractor shall make arrangements with the respective product manufacturers to provide job or field service as specified in Section 01430, "Contractor's Quality Assurance".
- B. Construct or prepare as many additional samples and mock-ups as may be required, as determined by the Contracting Officer, until desired features, textures, finishes, and colors are obtained. Approved samples and mock-ups shall serve as the standards of quality for the various affected units of work.

**3.2 REMOVAL AFTER COMPLETION**

- A. Field samples and mock-ups not incorporated into the final construction shall be removed from the jobsite and structures after completion and acceptance of the affected work or as otherwise specified or directed by the Contracting Officer.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. Separate measurement or payment will not be made for work required under this Section. Costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

END OF SECTION 01454

**SECTION 01500  
TEMPORARY FACILITIES AND SERVICES**

The provisions of the DART Standard Specification Section 01500, “Temporary Facilities and Services”, shall apply to the Work as modified herein.

**PART 1 - GENERAL**

**1.14. CONTRACTING OFFICER’S FACILITY:** Change Paragraphs 1.14/E, 1.14/E/1, 1.14/O, 1.14/P/1, and 1.14/P/2 to read as follows:

E. The office shall have water service; electrical service; heating, ventilation, and air conditioning (HVAC).

1. Telephone service and facsimile (fax) line is not required. Contractor shall use cell phones for telephone service.

M. Computer Network Capability:

Add Paragraph 3.

3. Contractor shall provide DSL or Cable internet line with minimum 50 Mbps down and 5 Mbps up with option to upgrade to faster speed if deemed necessary by Contracting Officer. Contractor shall include router switch and NAS w/Dual 2TB drives for redundancies. Trinity Metro shall be able to access NAS remotely. NAS will nightly backup to Cloud storage. If the Contractor plans to provide one source internet for Trinity Metro and Contractor, the contractor's router shall allow Trinity Metro to remote access the NAS.

O. Furnishing and Equipment: Furniture and equipment shall be new and as approved by the Contracting Officer. In replacement to furniture and equipment specified elsewhere under this Article “Contracting Officer’s Facility”, furnish and equipment the office facilities follows:

<u>Quantity</u>	<u>Description</u>
1	First aid kit, industrial-type
-	Fire extinguishers, quantity as required
5	Desks, 24 inches by 60 inches, six lockable drawers
5	Utility tables (30 inches by 60 inches by 30 inches high)
6	Swivel chairs on casters with adjustable height tilt seat and arm rest
12	Side chairs (in addition to meeting room chairs)
9	Waste baskets
2	File cabinets, four-drawer lockable;
1	File cabinets, four-drawer lockable fireproof
5	Bookcases, three-shelf (34 inches wide by 12-1/2 inches deep)
1	Storage cabinet (36 inches by 18 inches by 6 feet) with lock
2	Plan Tables, 3 foot by 6 foot
-	40 feet of overheard shelving, arranged as directed
1	Refrigerator, 16 cubic foot minimum size
1	10 cup coffee maker with supplies
1	Microwave oven
1	Electric sanitary water cooler
1	Electric wall clock (9 inch minimum diameter)

1 Electric printing calculators

P.

1. Must have Wifi connectivity to allow for printing from computer, email connectivity. Must be equal to Ricoh C6502 model.
2. Auto color feed copy machine with scanning capabilities.

**1.15. SANITARY:** Add sentence to Paragraph 1.15/A to read as follows:

- A. Toilet facilities to be interior in office facility with sink and mirror.

**1.17. ACCESS TO FIRE HYDRANTS AND FIRE ALARM BOXES:** Change Paragraph 1.16/B to read as follows:

- B. Safeguard, maintain, and protect the wires, cables, ducts, manholes, posts and poles, signals, and alarm boxes of others and FWTA/TRE. Do not cause interruption to the fire department fire alarm service, and in case of accident, promptly notify the fire department. Do not disturb fire department wire, cable, duct, manhole, post or pole, signal or fire alarm box except in the presence of the representative of the local fire department. In case such wire, cable, duct, manhole, post or pole, signal, or fire alarm box is disturbed, restore immediately to its original condition, and notify the Contracting Officer.

**END OF SECTION 01500**

**SECTION 01500  
TEMPORARY FACILITIES AND SERVICES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Work specified in this section includes furnishing, installing, maintaining, and subsequently removing temporary facilities (including services required during construction) for use by the Contractor and the representatives of the Authority.
- B. This section supplements the General Provisions Paragraph, "OPERATIONS AND STORAGE AREAS".
- C. Work in or near Airports: Equipment type and heights, sign heights, hours of construction and sequencing, illumination and signal work in or near airports shall meet clearance and lighting restrictions of the Federal Aviation Administration and airport owner.

**1.2 REFERENCED STANDARDS**

- A. Occupational Safety and Health Administration (OSHA)
  - 1. 29 CFR 1926 – Safety and Health Regulations for Construction
  - 2. 29 CFR 1926 Subpart F – Fire Protection and Prevention
- B. Texas Department of Transportation (TxDOT)
  - 1. Texas Manual on Uniform Traffic Control Devices (TMUTCD)

**1.3 SUBMITTALS**

- A. Submit working drawings showing the proposed locations and sizes of staging area, offices, storage areas, shops, security fencing, stationary equipment, and similar facilities.
- B. Submit floor plans for proposed Contracting Officer's facility.
- C. Submit a plan for temporary fire protection system.

**1.4 UTILITY CONNECTIONS**

- A. Provide and maintain temporary utility services necessary for the performance of the Work and related operations. At the completion of the Work, remove all temporary utility services and terminate connections to main service lines in a manner acceptable to the utility companies.

**1.5 TEMPORARY SERVICES, EXISTING FACILITIES**

- A. Provide temporary utility service, heating, ventilating, cooling, and other services as

necessary to ensure no degradation of existing conditions in portions of the facilities remaining in use during construction.

- B. Erect temporary partitions and closures as necessary to protect the existing facilities and the users/occupants thereof from weather and environmental nuisances caused by construction, such as dust and noise.
- C. Provide temporary drainage from the Worksite in accordance with Section 01562, "Soil Erosion and Sediment Control".

**1.6 TEMPORARY ELECTRICAL SERVICE**

- A. Provide power distribution throughout the Worksite as required to facilitate construction operations. Provide terminations for each voltage supply complete with circuit breakers, disconnect switches and other electrical devices as required to protect the power supply system.
- B. Furnish, install, and maintain a temporary lighting system as required by the building trades installed in accordance with OSHA requirement to satisfy the requirements of safety and security. Provide temporary lighting system to afford illumination in all areas.
- C. Install all temporary equipment and wiring for power and lighting in accordance with the applicable provisions of the governing codes.
- D. Provide power centers for electrically operated and controlled construction facilities including tools, equipment, testing equipment, and interior construction lighting and ventilation equipment. Locate power centers so that power is available at any desired point with no more than 100 feet extension. Provide, as a minimum, one power center per floor level.
- E. When the permanent electrical power and lighting systems are in operating condition, they may be used for temporary power and lighting for construction purposes if approved by the Contracting Officer in writing.
- F. At the completion of the construction work or at such time after the Contractor makes use of the permanent electrical installation, remove temporary electrical service equipment, including restoration of existing source of supply.

**1.7 TEMPORARY WATER SERVICE**

- A. Furnish water necessary for construction purposes and assure continuous water supply to the site for emergencies. Make temporary connections to existing mains; provide temporary meter; and make all arrangements and pay charges for the temporary water service including cost of installation and maintenance thereof.

- B. When the permanent water supply and distribution system has been installed, it may be used as a source of water for construction purposes if approved by the Contracting Officer in writing.
- C. At the completion of the construction work or at such time after the Contractor makes use of the permanent water installation, remove temporary water service equipment and piping, including restoration of the existing source of supply.

**1.8 TEMPORARY ENCLOSURES**

- A. Provide temporary weather tight enclosures and temporary heating as required during construction to make the building weather tight and to protect the work from damage, and as necessary to ensure suitable working conditions for the construction operations.
- B. Provide adequate ventilation (as required) to prevent accumulation of excess moisture in the building.
- C. When the permanent air circulation system, or suitable portion thereof, is in operating condition, it may be used without refrigeration or chilling if approved in writing by the Contracting Officer. If such use is approved:
  - 1. Provide temporary filters to adequately filter air being distributed through the duct work to the supply outlets; place disposable filters in front of all exhaust duct work.
  - 2. Thoroughly clean the interior of the air handling units and ductwork prior to requesting acceptance of the Work.
- D. Upon conclusion of the temporary period, remove all temporary piping, or other equipment and pay all costs in connection with repairing any damage caused by the installation or removal of temporary equipment; and thoroughly clean and recondition those parts of permanent heating and air circulation systems used for temporary service and install new filters.
- E. Build where shown and as required by property owner, closed, dustproof, weatherproof, and burglar-proof temporary partitions and closures of suitable materials to isolate the Site from remainder of the structure. Comply with local building code requirements.
- F. Provide emergency exits, with appropriate hardware.
- G. Provide temporary protection against dust and damage.
- H. Remove temporary protective installations upon completion of work and restore area.

**1.9 TEMPORARY CONSTRUCTION OPENINGS**

- A. Provide openings in slabs, walls and partitions where required for moving in large pieces of equipment of all types. Close and restore all openings and finish them after the equipment is in place. Structural modification, if required, shall be performed in accordance with Section 01731, "Cutting and Patching".

**1.10 FIRE PROTECTION**

- A. Submit a plan for a temporary fire protection system for use during the term of the Contract, which is subject to approval by the Contracting Officer. This plan includes provisions for fire protection systems and equipment as required by OSHA 29 CFR 1926 Subpart F.
- B. Store gasoline and other flammable liquids in Underwriters' Laboratories listed safety containers in conformance with the recommendations of the National Fire Protection Association (NFPA). Do not allow such storage, within buildings located on the site. Refer to Section 01560, "Environmental Protection", for related requirements
- C. Take adequate precautions against fire throughout all operations. Keep flammable material to an absolute minimum and properly handle and store. Do not permit fires in any part of the Work. Do not store flammable/combustible materials within 50 feet of stored flammable liquids.
- D. Perform construction work, including cutting and welding and protection during construction, in accordance with the published standards of the Factory Mutual Association and the National Fire Protection Association. Provide a sufficient number of Authority-approved non-freeze portable fire extinguishers distributed about the project.
- E. At the earliest possible date, complete and make operable, the permanent standpipe system, as applicable, and incorporate into temporary fire protection system. At that time, furnish sufficient hose to provide adequate coverage as determined by the local Fire Department.
- F. Make arrangements for periodic inspection by local fire protection authorities and insurance underwriters' inspection personnel; cooperate with and aid authorities and promptly carry out their recommendations.

**1.11 MATERIALS HOIST AND OTHER EQUIPMENT**

- A. Provide material hoists (as required) for normal use by all trades and employ skilled operators. Provide all necessary guards, signals, and safety devices required for safe operations. Provide suitable runways from the hoists to each level where work is being done. The safe load capacity shall be shown on each hoist and a label showing safe operating procedures.

- B. Furnish and maintain temporary ramps, scaffolds, and chutes; and other construction plants and equipment as required, for proper execution of the Work under the Contract.
  - C. For the construction and operation of the material hoist and other construction aids, conform to all applicable Federal, State, and Local safety codes and regulations.
- 1.12 CONTRACTOR'S FACILITY**
- A. In accordance with the General Provisions Paragraph, "OPERATIONS AND STORAGE AREAS", submit working drawings showing the proposed locations and sizes of staging area, offices, storage areas, shops, security fencing, stationary equipment, and similar facilities.
  - B. Contractor's plant and equipment:
    - 1. Submit a plan of the proposed plant layout for approval within 20 calendar days after receipt of NTP (Notice to Proceed). Do all necessary construction in connection therewith in a manner satisfactory to the Contracting Officer.
    - 2. Provide and maintain sufficient construction plants and equipment at points where work is in progress to adequately meet demands of the Work and with ample margin for emergencies or overload. Provide plants and equipment of adequate size, capacity, and numbers, to the satisfaction of the Contracting Officer, to permit a rate of progress which will ensure completion of Work within the time specified in the Contract. The Contracting Officer has the right to order testing of all plants and equipment, and to reject or condemn any plant, apparatus, or staging which, in his opinion, is unsafe, improper, or inadequate. Whether the Contracting Officer exercises this authority or not, the Contractor is not relieved of his responsibility for the safe, proper, and lawful construction, maintenance, and use of such plant, apparatus, or staging. Rework condemned plants or equipment to an acceptable condition or remove from site and replace within 5 days from the date of instruction of the Contracting Officer.
    - 3. The location of stationary equipment and the location of miscellaneous mobile equipment are subject to approval of the Contracting Officer.
  - C. Security: It is the responsibility of the Contractor to provide and maintain security of his facilities, utilities, plant, and equipment and the work during the entire contract period.
- 1.13 CONTRACTOR'S STAGING AREAS**
- A. Refer to Section 01010, "Summary of the Work", for provisions regarding Contractor's Staging Areas.
- 1.14 CONTRACTING OFFICER'S FACILITY**
- A. Provide, maintain, and service office facilities for the use of the Contracting Officer and staff in administering the Contract (herein called "office"). The office shall be installed, ready for operation, within 20 days of Contractor receiving the Notice-to-Proceed. Obtain approval of the location of the office from the Contracting Officer. Unless directed otherwise, maintain office on location through completion of the Contract and for 30 calendar days after final completion after which remove office which shall become the Contractor's property.
  - B. Permits and Inspections: Arrange for and comply with all necessary local permits and inspections including any incidental costs.
  - C. The office shall be secured and security shall be provided and maintained by the Contractor during the entire Contract period.
  - D. The office including entrance, toilet facilities, and parking shall be accessible by disabled individuals and shall comply with Americans with Disabilities Act (ADA) requirements.
  - E. The office shall have water service; electrical service; heating, ventilation and air conditioning (HVAC); and telephone service.
    - 1. The telephone service shall consist of six telephones with five voice lines and one facsimile (fax) line. The T1 Line service will be provided by DART from the Contracting Officer's facility to DART's 1401 Pacific location.
  - F. During the entire Contract period, maintain the office, including janitor service on a daily basis, and supply consumables such as toilet paper, soap, paper towels, paper cups, light bulbs, etc., for the equipment provided.
  - G. Provide all-weather paved access to the office and an all-weather parking area with space for 15 vehicles adjacent to the office.
  - H. The office shall include separate toilet facilities for men and women. The toilet facilities shall be outfitted with water closet, lavatory, utility cabinets, hot and cold water supply, mirror, soap dispenser, paper towel holder, adequate light, HVAC, and a lockable door.
  - I. The offices and exterior doors shall all be keyed and lockable.
  - J. Floors shall be covered with flooring material such as resilient tile or sheet linoleum or wall-to-wall

TEMPORARY FACILITIES AND SERVICES

carpet. Floors shall withstand a load of 125 psf. Wall surfaces shall be neatly painted.

K. The level of lighting to be provided in the office shall be at least to the levels noted in the following:

1. Desktop: 100 footcandles.
2. Toilet Facilities: 60 watt incandescent fixture.

L. Wall receptacles: 120 Volt 2-ampere duplex receptacles, located at ten foot intervals around the perimeter of the office.

M. Computer Network Capability:

1. The computer network server room size shall be a minimum of 6 foot by 6 foot with a keyed and lockable heavy-duty door (opening outward). Keys shall be submitted to the Contracting Officer for delivery to DART Project Management IS Coordinator. The room shall have one wall covered with plywood (5/8 inch minimum). If one wall is an exterior wall that one shall be used (windows covered). The wood shall completely cover the wall with access holes created for switches and plugs. Provide the server room with its own HVAC vent and return and furnish with one utility table (30 inches by 60 inches, 30 inches high). Provide network relay rack (19 inches by 72 inches) for network computer equipment.
2. The Contracting Officer's Facilities shall be cabled with Category level 5 cabling originating from the computer network server room and going to each desk location as well as a location for the network printer. Each individual cable end shall be terminated with an RJ-45 jack box using the EIA 568B wiring scheme and the computer network server room shall terminate cables to a 24 port category 5 patch panel. The data patch panel shall be wall mounted using a hinged stand off bracket and shall use the EIA 568B wiring scheme. Cable runs shall be routed underneath the floor up to the specified station. Prior to installation, a detailed layout diagram will be provided by the DART Proj/Mgt. IS Coordinator. Connections shall be tested and verified.

N. Office Square Footage and Layout:

1. Provide a minimum 2100 square foot office consisting of 5 lockable offices, 1 secretary and reception space, an open office work area (with 60 feet of low partitions arranged as directed) for inspectors, and 1 meeting room. Office shall also include computer network server room and toilet rooms as specified herein.

2. The meeting room shall be large enough to accommodate up to 18 people at any one time. The meeting room shall be furnished with a meeting table that can accommodate 18 persons, 18 side chairs, one white board (mounted) and 1 tack board.

3. The office shall have 2 coat closets; 1 coat closet equipped with rods, 10 plastic hangers, and 1 floor broom with dust pan.

O. Furnishings and Equipment: Furniture and equipment shall be new and as approved by the Contracting Officer. In addition to furniture and equipment specified elsewhere under this Article "Contracting Officer's Facility", furnish and equipment the office facilities follows:

<u>Quantity</u>	<u>Description</u>
1	First aid kit, industrial-type
-	Fire extinguishers, quantity as required
5	Desks, 24 inches by 60 inches, six lockable drawers
5	Utility tables (30 inches by 60 inches by 30 inches high)
6	Swivel chairs on casters with adjustable height tilt seat and arm rests
12	Side chairs (in addition to meeting room chairs)
9	Waste baskets
1	Secretarial chair and desk
1	Drafting table, slant top, 36 inches by 72 inches minimum size, equipped with swivel type lamp and stool on casters.
5	File cabinets, four-drawer lockable;
5	File cabinets, four-drawer lockable fireproof
5	Bookcases, three-shelf (34 inches wide by 12-1/2 inches deep)
2	Plan storage racks, rolling-type (six sticks each)
2	Storage cabinet (36 inches by 18 inches by 6 feet) with lock
2	Plan tables, 3 foot by 6 foot
-	40 feet of overhead shelving, arranged as directed
1	Refrigerator, 16 cubic foot minimum size
1	Microwave oven
1	Electric sanitary water cooler
1	Electric wall clock (9 inch minimum diameter)
3	Electric printing calculators

P. Provide the following equipment complete with supplies including toner and paper and maintenance for the duration of Contract. Refer to the Contract Specifications for additional criteria for this equipment.

1. Fax machine with dedicated phone line.
2. Auto feed copy machine with scanning capabilities.

**1.15 SANITARY**

A. Sanitary Provisions: Provide toilet facilities for men and women available at all times. Locate portable facilities, insofar as practicable, secluded from public view. Keep toilet facilities clean and sanitary and in compliance with regulations of jurisdictional agencies.

**1.16 ACCESS TO ADJACENT PROPERTY**

- A. Conduct construction operations in such a manner as to cause as little inconvenience as possible to owners of property affected by such operations. Refer to Section 01570, "Maintenance and Control of Traffic", for access requirements.
- B. Refer to Section 01010, "Summary of the Work", for Contractor's use of private property requirements.

**1.17 ACCESS TO FIRE HYDRANTS AND FIRE ALARM BOXES**

- A. Whenever the Work is being carried on, give free access to each fire hydrant, fire extinguishers, fire alarm box and standpipe; when required, extend hydrants by suitable tubes or piping to an accessible point as approved and to the satisfaction of the jurisdictional fire department. Do not pile obstructions at any time or place within 15 feet of any fire hydrant or fire alarm box and, where materials are placed in the vicinity of a fire hydrant or fire alarm box and to such height as to prevent same from being readily seen, indicate the position of such hydrants or fire alarm boxes by suitable signs and lights, both day and night.
- B. Safeguard, maintain, and protect the wires, cables, ducts, manholes, posts and poles, signals, and alarm boxes of others and DART. Do not cause interruption to the fire department fire alarm service, and in case of accident, promptly notify the fire department. Do not disturb fire department wire, cable, duct, manhole, post or pole, signal or fire alarm box except in the presence of a representative of the local fire department. In case such wire, cable, duct, manhole, post or pole, signal, or fire alarm box is disturbed, restore immediately to its original condition, and notify the Contracting Officer.

**1.18 PROTECTIVE DEVICES**

A. General:

1. Wherever necessary, shown or specified, erect and maintain signs, fences, barricades, and pedestrian bridges and provide watchmen and flagmen for the protection of or for performance of other contractors, maintaining public travel, the Worksite, adjoining property and adjoining public places.
2. Take positive measures to prevent entry into the site of the Work and storage areas by children, animals, and unauthorized adults and vehicles.
3. Provide protective devices in accordance with codes and regulations of jurisdictional agencies.

B. Fences:

1. In addition to the fencing indicated on the Drawings, furnish and construct approved wooden or metal fencing within the construction area to fence off pedestrian sidewalks, streets, and parking areas from operating areas as required for public safety and security of the site and as required by the Contracting Officer. Locate fencing for pedestrian sidewalks as shown on the Contractor's Working drawings or as directed by the Contracting Officer.
2. Construct temporary fences of sound materials, neat in appearance and painted with two coats of approved exterior paint of approved color. Unless otherwise shown, provide fences 6 feet high consisting of a stud framework with a covering of tightly fitted plywood sheets. Provide the type of fence, whether fixed or movable, as shown on the Contractor's Working drawings. Construct and maintain fences accessible to the public, so they are smooth, safe and do not splinter or catch clothing.
3. Immediately prior to completion of the Contract, restore site to original condition and repaint fencing shown to remain in place.

C. Barricades:

1. During the prosecution of the work, barricade or close excavations and openings in floors, walls, and other parts of the structures and excavations while such openings are not in regular use. Provide traffic area barricades to comply with the TMUTCD.



## TEMPORARY FACILITIES AND SERVICES

2. Barricade or close such openings before final acceptance of the Work.
3. Provide barricades substantial in character, neat in appearance, constructed of approved materials, and of approved size and arrangement.
4. Anchor barricades to the ground on all sides of excavations.
5. Provide flashing yellow lights and maintain on barricades at maximum intervals of 25 feet.
5. Protect finished surfaces, including jambs and soffits of openings used as passageways through which materials are handled, against possible damage.
6. Provide and maintain adequate protection for adjacent structures. When required by law, or for the safety of the Work, shore, brace, underpin, or otherwise protect those portions of adjacent structures which may be affected by the Work. Refer to Section 02150, "Underpinning, Support, and Restoration of Structures".

- D. Pedestrian bridges: Construct bridges for pedestrians of suitable materials in accordance with local requirements, provide with handrails or with sides tightly boarded in accordance with such requirements and construct a minimum width of 6 feet or such greater minimum width as will accommodate the normal traffic flow at the particular location. Submit as part of Traffic Control Plans under Section 01570, Maintenance and Control of Traffic", working drawings for required bridges.

### 1.19 PROTECTION OF PROPERTY

- A. Requirements hereinafter specified are in addition to General Provisions Paragraph, "PROTECTION OF EXISTING SITE CONDITIONS".
- B. Existing surfaces and facilities including building structures immediately outside the Contractor's Worksite:
1. Take positive action to protect existing surfaces and facilities from damage resulting from construction operations unless modifications to the surfaces or facilities are required as a part of the Contract.
  2. Protect existing vegetation, including existing turf, not designated to be removed. Refer to Section 01532, "Tree and Shrub Protection and Care", for protection of trees and shrubs.
  3. Where modifications to existing facilities or surfaces are required, provide such modifications in accordance with the applicable requirements of Section 01731, "Cutting and Patching".
  4. Protect paving, landscaping, and utility facilities from damage. In regard to utility facilities, refer to Section 02760, "Maintenance, Support and Restoration of Existing Utility Facilities," for detailed requirements.

### C. New Work:

1. Ensure finished surfaces of items are clean and not marred upon acceptance of the Work. Refinish all surfaces that have been damaged.
2. Do not permit traffic or material storage on roof surfaces. Where some activity must take place on the roof in order to perform the Work, provide and maintain adequate protection of the roof surfaces.
3. Provide and maintain protection against weather so as to preserve work, materials, equipment, apparatus, and fixtures free from injury or damage.
4. Do not load or permit any part of a structure to be so loaded as to either create an unsafe condition or affect its structural integrity.
5. Do not use items of equipment that are intended to form a part of the completed work as construction equipment without specific approval from the Contracting Officer in each instance.

### D. Restoration and Repair of Damages:

1. Restore facilities which are removed during construction, which are to remain in place, to their pre-construction conditions.
2. Repair damage to surfaces or facilities which are to remain in place, as required by the Contracting Officer. Make repairs resulting in conditions equal in quality and strength to the previous conditions. Make repaired surfaces identical in color and texture to the adjacent existing materials, except that where materials cannot be matched, refinish the affected area and surrounding area to give a uniform appearance acceptable to the Contracting Officer and the owner of the damaged facility.

- E. Salvaged Materials and Equipment:
  - 1. Maintain property control records for materials and equipment designated to be salvaged.
  - 2. Store and protect salvaged materials and equipment from damage. Replace salvaged materials and equipment which are broken or damaged as the result of Contractor's negligence during salvage operations, during storage, or when the Contractor is transporting salvaged items.
  - 3. Refer to Section 02072, "Removal and Restoration of Miscellaneous Existing Structures", for detailed requirements regarding salvage of miscellaneous facilities.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements".
- B. Barricades for temporary decking and for installation of water distribution systems, storm sewer systems, sanitary sewer systems, underground duct banks, and traffic signal systems will not be paid for under the lump sum for "General Requirements", but will be paid for under the lump sum and unit prices for the temporary decking and respective utility system.

END OF SECTION 01500

**1.20 MAINTENANCE OF WORK DURING CONSTRUCTION**

- A. Contractor shall maintain the Work during construction and suspensions of work, if any, until the issuance of certificate of final completion for the entire contract. This maintenance shall include continuous and effective work performance as required, with adequate equipment and labor as well as security forces to the end that all parts of the Work be kept in safe and satisfactory condition at all times.
- B. Particular attention shall be paid to weather action and drainage both permanent and temporary at all times. Contractor shall use reasonable precautionary measures to avoid damage or loss that might result from accumulations and concentrations of drainage water and material carried by such water and such drainage shall be diverted or removed when necessary to protect the Work and the work area. Coordinate with the requirements of Sections 01560, "Environmental Protection", and 01562, "Soil Erosion and Sediment Control".
- C. Electrical and mechanical equipment shall be protected against weather, duly attended to, and maintained in satisfactory condition, including after testing, until the final acceptance of the entire Work. Maintenance shall include grease, oil, cleaning, and periodic operation, as appropriate. Contractor shall repair or replace at no cost to the Authority any work that is damaged or deteriorated due to Contractor's failure to comply with this Article.

**PART 2 - PRODUCTS**

Not Used

**PART 3 - EXECUTION**

Not Used.

## SECTION 01505 MOBILIZATION

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. This Section includes specifications for the following:
  - 1. Organization and mobilization of the Contractor's forces;
  - 2. Transporting construction plant and equipment to the jobsite and setting up of same;
  - 3. Transporting various tools, materials, and equipment to the jobsite; and
  - 4. Erection of temporary buildings and facilities as required for field offices, staging, storage, and construction operations. Refer to Section 01500, "Temporary Facilities and Services", and Section 01580, "Project Signs" for specific requirements, as applicable.
- B. Mobilization shall include mobilization of all construction equipment, materials, supplies, appurtenances, facilities, and the like, staffed and ready for commencing and prosecuting the Work; and the subsequent demobilization and removal from the jobsite of said equipment, appurtenances, facilities, and the like upon completion of the Work.
- C. Mobilization shall also include assembly and delivery to the jobsite of plant, equipment, tools, materials, and supplies necessary for the prosecution of work which are not intended to be incorporated in the Work; the clearing of and preparation of the Contractor's work area; the complete assembly, in working order, of equipment necessary to perform the required work; personnel services preparatory to commencing actual work; obtaining permits as required under General Provisions Paragraph, "PERMITS AND RESPONSIBILITIES;" and all other preparatory work required to permit commencement of the actual work on construction items for which payment is provided under the Contract.

#### 1.2 SUBMITTALS

- A. Refer to Section 01330, "Submittals", for submittal requirements and procedures.
- B. Submit a plan of the proposed layout of the construction site, including fences, roads, parking, buildings, staging, and storage areas, within 20 days after the effective date of the Notice to Proceed.

#### 1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery to the jobsite of construction tools, equipment, plant, temporary buildings, materials, and supplies shall be accomplished in conformance with local governing ordinances and regulations.

#### 1.4 TOOLS AND SUPPLIES

- A. Provide construction tools, equipment, materials, and supplies of the types and quantities necessary to facilitate the timely execution of the Work.
- B. Provide personnel, products, construction materials, equipment, tools, and supplies at the jobsite at the time they are scheduled to be installed or utilized.

#### 1.5 PLANT LOCATION

- A. Locate plant, or plants, appropriately close to the portion of the Work for which it will be used.

#### 1.6 DEMOBILIZATION

- A. Upon completion of the Work, remove construction tools, apparatus, equipment mobile units and buildings, unused materials and supplies, plant, and personnel from the jobsite.
- B. Restore areas utilized for mobilization to their original, natural state or, when called for in the Contract Documents, complete such areas indicated.

### PART 2 - PRODUCTS

Not Used.

### PART 3 - EXECUTION

Not Used.

### PART 4 - MEASUREMENT AND PAYMENT

#### 4.1 GENERAL

- A. Payment for mobilization will be made on a lump sum basis wherein no measurement will be made.
- B. Payment for mobilization will be made in the following manner:
  - 1. Payment for mobilization will be made in four equal portions:
    - a. The first 75 percent will be paid in the first 3 progress payments, provided the Contracting Officer is satisfied the Contractor is making a

## MOBILIZATION

reasonable effort to mobilize for construction in a timely manner.

- b. The last 25 percent will be paid when the Contractor has demobilized to the satisfaction of the Contracting Officer.
2. The value allocated to mobilization shall not exceed 3 percent of the Total Bid Amount.

END OF SECTION 01505

**SECTION 01532  
TREE AND SHRUB PROTECTION AND CARE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section includes specifications for protection and care of existing trees and shrubs indicated to remain on the Contract Drawings. Protection includes protection of plant system above and below grade. Care includes watering and maintenance of protected vegetation and irrigation to ensure plant growth and health until final acceptance.
- B. Existing vegetation to remain is designated on the Contract Drawings. Trees, shrubs, and vegetation to be removed are shown on the Contract Drawings and will be marked in the field prior to construction.
- C. Refer to Section 02131, "Tree Pruning", for provisions for pruning existing vegetation designated to remain.

**1.2 DEFINITIONS**

- A. Barrier: A fence installed as a temporary divide for the purpose of preventing unauthorized access during the full period of construction.
- B. Disturbance/Damage: Physical or visual change to the site or trees and shrubs, which, in the opinion of the Contracting Officer, is detrimental to the viability of the vegetation being protected. Equipment, material, or personnel may cause such disturbance. Damage includes protected plant which partially dies within the duration of the Contract, thereby damaging shape, size or symmetry.
- C. Violation: Damage to trees and shrubs caused by any construction or delivery vehicle, construction material storage or disposal of solid or liquid debris shall be considered a violation to the Contract.

**1.3 GUARANTEE**

- A. Guarantee existing trees and shrubs against damage until final acceptance of the Project. Repair damage, which, in the opinion of the Contracting Officer, can be satisfactorily corrected. Replace plant material that dies within the duration of the Contract, and replace damaged plant material which partially dies within the duration of the Contract, thereby damaging shape, size or symmetry. Guarantee replacement plants for duration of the Warranty of Construction described in the General Provisions.

**PART 2 - PRODUCTS**

**2.1 BARRIER MATERIALS**

- A. Minimum 4 foot high orange plastic netting ("Snow Fence") with steel posts.

- B. Where chain link fencing is indicated on the Contract Drawings for tree and shrub protection or is otherwise required, provide 6 foot high, temporary chain link fencing, in accordance with Section 02830, Chain Link Fencing.

**2.2 MISCELLANEOUS MATERIALS**

- A. Mulch: Coarsely shredded hardwood mulch.

**2.3 REPLACEMENT PLANT MATERIALS**

- A. Trees 9 inch caliper or less that are damaged shall be replaced with a new tree of same size and species. Size will be determined by measuring caliper at 12 inches above grade for trees from 4 to 12 inch caliper and at 6 inches above grade for trees from 0 to 4 inch in caliper.
- B. Trees larger than 9 inch caliper that are damaged shall be measured at 4 feet above natural ground elevation, or from top of stump, if removed. Contracting Officer will assess the following damages for damaged or removed trees:

<u>Tree Size-Diameter, in inches</u>	<u>Value Each</u>
Greater than 9 to 12	\$5,000
Greater than 12 to 15	\$10,000
Greater than 15	\$20,000

- C. Replacement shrubs shall be replaced at the existing sizes.
- D. Replacement of vines, grasses, or other vegetation shall be replaced in kind with the approval of the Contracting Officer.

**PART 3 - EXECUTION**

**3.1 IDENTIFICATION AND VERIFICATION**

- A. Verify trees to be removed and trees to be protected and saved with the Contracting Officer prior to commencing site work. Clearly mark trees for removal and trees for protection.
- B. Field verify and photo document the existing tree, shrub, and plant health with the Contracting Officer prior to commencing work.

**3.2 PRESERVATION**

- A. Protect and preserve trees, shrubs, and vegetation to remain by the use of temporary enclosures, wrapping or other means. Protection shall be in place prior to any site work, demolition, or grading.

## TREE AND SHRUB PROTECTION AND CARE

- B. Obtain Contracting Officer's approval of plant protection prior to starting any site work. Protect plants with approved barrier as indicated on the Contract Drawings. Spread and maintain mulch to a depth of two to three inches to cover 100 percent of the root zone.
1. Protect tree and shrub trunks, limbs, foliage, and root zones from damage. If fencing is not possible due to proximity of construction, then the Contractor shall wrap tree trunk with material sufficient to protect the trunk from damage. The Contractor may use 2x4 wood pieces wired together to protect the trunk to a minimum height of 8 feet above grade.
  2. Protect the root zone from compaction and damage. In areas of vehicular traffic, place and maintain plywood boards in addition to the mulch to protect the root zone from damage.
  3. When excavation is required in tree root zones, hand excavate whenever possible and avoid cutting of roots greater than 1 inch during construction. When it is not possible to avoid cutting roots, roots over 1-1/2 inch shall be coated on the faces with acceptable dressing for horticultural use for cut or damaged plant tissues.
- C. Barrier: Protect vegetation to be saved by erecting a barrier around all existing vegetation in the construction area. Maintain barriers in place until all construction in the vicinity is completed and approved by the Contracting Officer. Barriers shall consist of either orange plastic netting or temporary chain link fencing. If barrier material is not designated on the Contract Drawings, then material shall be Contractor's option, subject to approval by Contracting Officer.
1. Orange plastic netting: Set posts at 6 foot on center. Secure netting at each post with wire to provide a continuous barrier. Locate ends of netting at posts, lap ends, and fasten with wire to posts.
  2. Install temporary chain link fencing as specified in Section 02830, "Chain Link Fencing".
- D. Repair injuries, abrasions and other damage to plants by cleanly removing broken members, loose and torn bark, and shape edges in order to permit drainage of rain water from wounds. Paint wounds with an approved tree wound paint.
- E. Where depth of soil over root system of existing plantings is to be modified by final grading, provide the following:
1. Where increase of 1 foot or more in elevation is shown, spread continuous layer of rock aggregate, graded 1/4 inch to 2 inches, 6 inches deep from trunk to drip line of branches prior to installation of fill.
2. Provide proper aeration by installing within perimeter of spread, a system of 4 inch clay drain tile. Install vertically flush with soil surface and penetrating into layer of aggregate fill.
  3. Construct stone wells around trunks as shown, as detailed or as approved. Extend stone wells vertically from rock fill layer to final grade, allowing sufficient space for trunk growth.
  4. Install tree guard fencing at the tree drip line or as noted on the Contract Drawings.
- F. Do not install gates in tree guard fencing. Do not stack or store any equipment inside the tree fence.
- G. Do not clean construction equipment, dump liquids, nor perform field maintenance on vehicles in the vicinity of the trees to be preserved.
- H. If tree designated to remain is damaged so as to cause death or severely injure the tree, then remove and replace the tree at no extra cost to the Contracting Authority. The replacement tree shall be the same caliper size and species as the tree removed, with the exception of trees larger than 9 inch caliper. For trees larger than 9 inch caliper, refer to Article entitled "Replacement Plant Materials" herein for details concerning assessment for trees. The Contractor shall provide a one-year warranty for the replacement tree.
- ### 3.3 REMOVAL OF TREE BRANCHES
- A. Where tree limbs or branches impede construction, the Contractor may remove limbs only with the written approval of the Contracting Officer. Branches shall be removed according to recommended horticultural practices using a three cut process for limbs over 2 inches in diameter. Comply with "Pruning and Weed Removal" below.
- B. Obtain Contracting Officer's approval of branch removal in the field.
- ### 3.4 EXISTING TREE AND PLANT MAINTENANCE AND CARE
- A. The Contractor shall be responsible for maintaining the health of the existing trees and vegetation during the Contract period.
- B. Maintain existing trees, shrubs, and vegetation to remain during the construction by keeping fencing upright and secure. Provide protective fencing as indicated on the Contract Drawings and approved by the Contracting Officer.
- C. Notify Contracting Officer at first sign of distress or if grass stops growing within protective fencing. Notify the Contracting Officer if protected trees start to show signs of stress, insects or disease, or decline.

## TREE AND SHRUB PROTECTION AND CARE

D. Treat any Fire Ant mounds around or on top of a tree root zone immediately and physically remove mound. Do not allow mound to build on the tree trunk as this will cover the tree root flare and possibly cause injury or death. Ensure that any chemical application to the Fire Ant mound is safe for application atop tree root zones.

E. Pruning and Weed Removal:

1. Pruning shall be carried out by experienced pruning personnel. Pruning qualifications are specified in Section 02131, "Tree Pruning".
2. Obtain approval in the field for extent of pruning from Contracting Officer. Remove all damaged and diseased branches.
3. Sterilize pruning tools between individual plants; take particular care in sterilizing tools for the genus *Quercus*. Paint all wounds on plants of the genus *Quercus* with wound paint as soon as possible. Paint deliberate wounds (pruning) within one hour and accidental wounds (storm or equipment damage or vandalism) as soon as they are observed.
4. Raise limbs to an acceptable height as approved by the Contracting Officer. Raise limbs to seven foot height for trees within 10 feet of parking or sidewalk.
5. Use no weed-eaters or edgers within 15 inches of any tree. Should the need for trimming be necessary within 15 inches of any tree, perform trimming by hand only.
6. Remove dead wood, broken branches, mistletoe, and suckers from trees as needed. Sterilize pruning tools between individual plants to keep down spread of disease. Paint all wounds of plants of the genus *Quercus* with wound paint as soon as possible. Paint deliberate wounds within one hour and accidental wounds due to storms, etc. as soon as they are observed.
7. Clean up after tree pruning and clearing activities. Remove and legally dispose of all debris off site.

### 3.5 WATERING

- A. Water existing trees, shrubs and plants to remain as needed to maintain health, growth, and vigor throughout Contract period.
1. Deep root water trees once every two weeks during the months of June, July, August, and September. Adjust this watering to take into account the amount of rain or signs of stress.

2. Should drought of more than three weeks occur from October through May, provide deep root watering of existing trees. Unless it has rained at least 1/2 inch since the last watering, continue to deep root water.

### 3.6 SITE RESTORATION

- A. Continue protection and care of trees, shrubs, and vegetation until final Acceptance.
- B. Upon the approval of the Contracting Officer, remove barriers including posts and footings, wrapping, and other protective devices. Backfill holes resulting from removal of posts and footings. Fencing and other materials, with the exception of mulch, shall remain the property of the Contractor and shall be removed from the site.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.1 GENERAL

- A. The work described in this Section will not be measured for payment but will be paid for on a lump sum basis for "tree and shrub protection and care".
- B. Tree pruning performed as part of tree and shrub protection and care will be measured and paid for as specified under Section 02131, "Tree Pruning".
- C. Pruning performed for the Contractor's convenience and pruning to help mitigate damage caused by the Contractor will not be measured and no payment will be made therefore.
- D. Orange plastic netting and temporary chain link fencing for tree and shrub protection, including posts and footings, maintenance, removal, and disposal, will not be measured separately but will be paid for at the lump sum price for "tree and shrub protection and care".
- E. Assessments for trees larger than 9 inch caliper, which are damaged and not replaced, will either be deducted from the Contract Price or billed to the Contractor, at the Authority's discretion.

END OF SECTION 01532

**SECTION 01533  
TEMPORARY DECKING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the installation, maintenance, and removal of temporary street decking and its support system over excavated areas for the purpose of maintaining the flow of pedestrian and vehicular traffic during the construction period.

**1.2 REFERENCED STANDARDS**

- A. American Association of State Highway and Transportation Officials (AASHTO):
  - 1. AASHTO HB-17 - Standard Specification for Highway Bridges
- B. American Welding Society (AWS):
  - 1. AWS D1.1/D1.1M - Structural Welding Code Steel
- C. ASTM International (Formerly known as American Society for Testing and Materials) (ASTM):
  - 1. ASTM D2555 - Standard Test Methods for Establishing Clear Wood Strength Values.
  - 2. ASTM E274 - Standard Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire.
- D. Occupational Safety and Health Administration (OSHA)
  - 1. 29 CFR 1926 Subpart P - Excavations
    - a. 29 CFR Part 1926.650 – Scope, Application and Definitions Applicable to this Subpart
    - b. 29 CFR Part 1926.651 – Specific Excavation Requirements
    - c. 29 CFR Part 1926.652 – Requirements for Protective Systems
  - 2. 29 CFR 1926 Subpart S – Underground Construction, Caissons, Cofferdams, and Compressed Air
    - a. 29 CFR 1926.800 – Underground Construction

**1.3 DESIGN CRITERIA**

- A. Design of temporary decking shall be performed by and working drawings and computations shall be signed and sealed by the Contractor's engineer who shall be a Professional Engineer registered in the State of Texas.

- B. Unless otherwise specified design temporary street decking and support system for AASHTO HS20-44 loading and impact, earth pressures, utility loads, and other applicable live impact and dead loads including the Contractor's equipment.
- C. When excavation and construction equipment is to be operated from decking, design decking using actual maximum loads in accordance with design criteria of referenced AASHTO specification, unless otherwise shown.
- D. Design members supporting decking to allow clearance for existing and relocated utilities.
- E. Provide suitable openings in deck for access for servicing utilities and fire fighting. Provide flush covers for openings.
- F. Unless otherwise indicated, maintain vehicular and pedestrian access to buildings at levels existing prior to start of Contract work.
- G. Working drawings shall indicate details of lighting and ventilation, where required.

**1.4 SUBMITTALS**

- A. Working Drawings:
  - 1. Prior to installation of elements for temporary decking, submit working drawings and design calculations.
  - 2. Show proposed procedures and methods of constructing temporary decking including support system, anchorage system, and necessary construction details.
  - 3. After existing utility facilities have been located by field investigations make necessary revisions to working drawings to reflect actual site conditions and resubmit drawings.
- B. Certification:
  - 1. If used materials are utilized, submit certified information concerning each previous use. The information shall include the purpose, duration, and type of loading.
  - 2. Submit certifications verifying that welding, welding inspector, and testing personnel have been qualified in accordance with AWS D1.1/D1.1M or other AWS standard, as applicable, within the last 12 months prior to start of fabrication and erection.

**1.5 REGULATORY REQUIREMENTS AND PERMITS**

- A. Design and perform work of this section in accordance with OSHA 29 CFR 1926 Subpart P, 29



CFR 1926.650 through 1926.652, 29 CFR 1926 Subpart S and 29 CFR 1926.800, and Texas Trench Excavation Safety Law.

**1.6 PROJECT CONDITIONS**

- A. Refer to Section 01500, "Temporary Facilities and Services" and Section 01570, "Maintenance and Control of Traffic", for traffic control, barricades, and protective device requirements. Coordinate with Traffic Control Plan.
- B. Perform work in accordance with construction sequence and maintenance of traffic schedules as shown and requirements of the jurisdictional agencies.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Steel, Concrete, and Other Materials: Used materials are permitted in lieu of new materials provided they are sound and free from defects, which might impair their strength.
- B. Timber: Structural lumber, visually graded in accordance ASTM D2555, minimum working stress 1,100 psi.
- C. Skid-Resistant Surface: Provide skid-resistant surface having a Skid Number at 30 mph (SN30) of no less than 35 when measured in accordance with ASTM E274.

**PART 3 - EXECUTION**

**3.1 DECKING INSTALLATION**

- A. Install and maintain decking at design elevations.
- B. Provide and maintain skid-resistant surface.
- C. Maintain decking free of snow, ice, water, mud, and debris.
- D. Secure decking to maintain its location or position over or next to the work by an approved anchorage system. If decking is dislodged or becomes unsecured, take all necessary measures to secure decking and protect public, workers, and the Work.
- E. Place premixed asphaltic patching material to provide smooth transitions between existing pavement surfaces and decking and elsewhere as required to provide proper drainage and prevent ponding of water.
- F. As removal of pavement and sidewalk progress, furnish and install barricades in accordance with Section 01500, "Temporary Facilities and Services", and requirements of the jurisdictional agencies.

G. Along sides of decked areas for pedestrian walkways where such walkways are adjacent to vehicular traffic, install concrete barriers as shown.

H. Install wooden fence along sides of decked areas for pedestrian walkways where such walkways are adjacent to open areas, storage areas and other areas used by the Contractor. Paint barricades and fences, and maintain in good repair.

I. Provide walkways or galleries for full length of excavation when excavation reaches depth of approximately 15 feet.

J. Erect and maintain load limit and other signs, if needed, to restrict loading on decking, so that it does not exceed maximum design loading.

K. Remove temporary decking and support system when no longer required. Comply with requirements of Section 02160, "Support of Excavation", when removing support system.

**3.2 WELDING**

A. Welding shall only be performed by certified welders and in accordance with the requirements of the AWS D1.1/D1.1M.

**3.3 FIELD QUALITY CONTROL**

- A. Allowable Tolerances:
  - 1. Maintain surface elevations at abutting elements within plus or minus 1/4 inch.
  - 2. Do not allow horizontal gaps in decking to exceed 3/8 inch.
  - 3. Where necessary or expedient to raise elevation of temporary decking above elevation of existing street or sidewalk, do not grade in excess of ten percent on ramp approaches.

**3.4 VENTILATION AND ILLUMINATION**

- A. When excavations are decked, provide ventilation and lighting as required by regulatory requirements, jurisdictional agencies, and utility company access requirements.
- B. In areas covered by decking, supply and maintain illumination of sufficient intensity to permit safe and expeditious conduct of all phases of construction, and inspection of support system, lagging, bracing, and utilities maintained in place.
- C. Provide ventilation and illumination which meets specified safety requirements.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. Work specified in this section will not be measured but will be paid for at the lump sum prices for "Temporary Decking - Steel Plates" and "Temporary Decking - Bridge". "Temporary Decking - Steel Plates" shall include temporary decking consisting of steel plates spanning excavation without support structure. "Temporary Decking - Bridge" will include all other temporary decking.
  
- B. Maintenance and control of traffic, illumination, ventilation, anchorage, fences, and barricades will not be measured separately but will be considered as included in the lump sum prices paid for "Temporary Decking".

END OF SECTION 01533

**SECTION 01560**  
**ENVIRONMENTAL PROTECTION**

The provisions of the DART Standard Specification Section 01560, "Environmental Protection", shall apply to the Work as modified herein.

**PART 1 - GENERAL**

**1.2. GENERAL:** Change Paragraph 1.2/F to read as follows:

- F. Provide and maintain a rain gauge, approved by the Contracting Officer, for FWTA/TRE use during environmental inspection.

**1.3. PROTECTION OF ANTURAL RESOURCES:** Change the second sentence of 1.3/B/1 and the first sentence of 1.3/I to read as follows:

B.

- 1. In the event of any accidental violation of the requirements of the regulatory agencies, notify immediately the Contracting Officer and take remedial measures as directed.
- l. Illicit Dumping by Others: If applicable, copies of any and all waste manifests shall be transmitted to the Contracting Officer in a timely manner.

**1.5. HAZARDOUS WASTE, REGULATED MATERIALS, AND TOXIC SUBSTANCES:** Change Paragraph 1.5/A and 1.5/B and 1.5/B/1/a and 1.5/B/1/b and 1.5/B/2 to read as follows:

- A. FWTA/TRE Construction projects are subject to regulations promulgated by Federal, state, and local, regulatory agencies. Agencies include but are not limited to the Texas Commission on Environmental Quality (TCEQ), Texas Department of Health (TDH), U.S. Environmental Protection Agency (EPA), Occupation Health and Safety Administration (OSHA), U.S Department of Transportation (DOT), municipal fire departments and storm water management departments. Following is a summary of environmental regulations that may impact FWTA/TRE construction projects. This summary is not intended to be exhaustive; discovery of additional regulations that may apply are the responsibility of the Contractor.
- B. The Contractor and all sub-contractors working on FWTA/TRE construction projects, shall comply with all existing applicable environmental laws and and/or regulations promulgated and enforced by Federal, state and local agencies. This includes, but is not limited to, the storage, handling, transport, and disposal of all hazardous waste, regulated materials and/or toxic substances.
  - 1. Hazardous Waste and Regulated Materials:
    - a. Hazardous waste is a broad term used to denote industrial by-products and waste materials discarded from homes, commercial establishments, and industrial facilities that pose a risk to human health, safety, property, and the environment. Encountering heavy metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) defined by the Resource Conservation and Recovery Act of 1976 (RCRA) is the most common occurrence for FWTA/TRE construction projects.
    - b. Regulated materials are usually thought of as those materials that may pose a risk but are not classified as hazardous. For FWTA/TRE construction projects, the discovery of total petroleum hydrocarbon (TPH) contaminated materials, associated with gasoline stations, is the most common occurrence.
  - 2. Toxic Substances: The Toxic Substances Control Act (TSCA) of 1976 provided EPA with authority to require testing of chemical substances, both new and old, entering the environment and to regulate them where necessary. The chemical substances addressed by TSCA, which are most commonly encountered during a FWTA/TRE construction project are asbestos or polychlorinated biphenyls (PCB's).

- 1.6. RESPONDING TO HAZARDOUS WASTE, REGULATED MATERIALS, AND TOXIC SUBSTANCES:** Change the first sentence of 1.6/A to read as follows:
- A. FWTA/TRE personnel shall be notified immediately in the event the Contractor, during the course of the work, encounters or suspect the presence of hazardous waste, regulated materials, toxic substances, and/or underground storage tank.
- 1.8. CONTROL AND DISPOSAL OF CHEMICAL AND SANITARY WASTES:** Change the last sentence of 1.8/B to read as follows:
- B. Immediately notify the Contracting Officer and FWTA/TRE personnel of oil and hazardous material spills that may be large enough to violate state, and local regulations.

**END OF SECTION 01560**

**SECTION 01560  
ENVIRONMENTAL PROTECTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Environmental protection considerations consist of, but are not limited to, the following factors:
  - 1. Natural resources including air, water, and land.
  - 2. Solid waste disposal.
  - 3. Noise and vibration.
  - 4. Hazardous Waste, Regulated Materials and Toxic Substances.
  - 5. The presence of chemical, physical, and biological elements and agents that adversely effect and alter ecological balances.
  - 6. Degradation of the aesthetic use of the environment.
  - 7. Historical, archaeological, and cultural resources.
  - 8. Storm water discharges Texas Pollutant Discharge Elimination System (TPDES)
- B. Storm Water Pollution Prevention: See Section 01562, "Soil Erosion and Sediment Control" for provisions regarding the TPDES General Permit TXR 150000, Relating to Discharges from Construction Activities, including requirement for Contractor's Environmental Compliance Manager (ECM).

**1.2 GENERAL**

- A. Provide and maintain environmental protection defined herein.
- B. Comply with all applicable Federal, state, and local laws, ordinances, and regulations pertaining to environmental protection.
- C. Compliance by subcontractors with the provisions of this and various other sections of these specifications is the responsibility of the Contractor.
- D. Use of equipment from which factory-installed anti-pollution and noise control devices are removed or rendered ineffective, either intentionally or through lack of proper maintenance, is prohibited.
- E. Furnish a certificate that all materials and operating equipment installed as a part of this project, the installation thereof, and all equipment used in the construction, are in compliance with all applicable local laws, ordinances, regulations, and permits

concerning environmental pollution control and abatement.

- F. Provide and maintain a rain gauge, approved by the Contracting Officer, for Authority use during environmental inspection.

**1.3 PROTECTION OF NATURAL RESOURCES**

- A. General: It is intended that the natural resources within the project boundaries and outside the limits of permanent work be preserved in the pre-construction condition or be restored to an equivalent of the pre-construction condition, as approved by the Contracting Officer, upon completion of the Work. Confine onsite construction activities to areas defined by the drawings and specifications, and as approved by the Contracting Officer. Ensure off-site storage areas are included in the Storm Water Pollution Prevention Plan (SWP3) and locations shown on site map. If no temporary usage areas are defined, shown or otherwise approved, restrict operations to permanent construction areas and those areas noted as Construction Staging or Storage.

**B. Spills and Releases:**

- 1. At all times, take measures to prevent oil or other regulated/hazardous substances from entering the ground, drainage areas, and local bodies of water. In the event of any accidental violation of the requirements of the regulatory agencies, notify immediately the Contracting Officer and the Authority's Manager of Environmental Compliance and take remedial measures as directed. Contractor through its ECM shall determine whether a spill is reportable and shall initiate and complete remediation. Contractor (through its ECM) shall report spill as soon as possible no later than immediately following implementation of initial remediation or control but no later than within the time period stipulated by regulation. Costs for all cleanup and remediation activities shall be the responsibility of the Contractor.
- 2. Do not spray, pour or otherwise release oil, antifreeze or other regulated/hazardous substances onto the ground, roadways, parking lots, storm drains, creeks, bodies of water or elsewhere. In the event of a release or spill, the Contractor shall comply with all regulatory reporting requirements, including those promulgated in the Texas Administrative Code (TAC), Chapter 327, *Spill Prevention and Control*.

C. Protection of Existing Waterways and Highways:

1. Do not dump debris or rubbish of any kind into or otherwise allow it to fall into any body of water, onto adjacent banks, or onto highways. This includes paint splatters and spillage during painting operations as well as sediments, debris, and other materials that may be carried in storm water runoff. Capture waste paint from cleaning paint equipment, remove from site, and dispose of properly. Take care to prevent damage and injury to personnel, vessels, and vehicles using waterways, highways, or pedestrian ways. Provide and maintain devices to prevent such occurrences. Promptly remove any material or items falling into any body of water, onto adjacent banks, or onto highways and immediately report to the Contracting Officer and the jurisdictional agency. Use spill control materials where appropriate, to control spillage from paint and related materials. Contractor shall at all times be in compliance with the TPDES General Permit TXR 150000, Relating to Discharges from Construction Activities, as well as the SWP3 developed for this Project. Refer to Section 01562, "Soil Erosion and Sediment Control" for detailed requirements regarding the TPDES storm water permit program.
2. Do not close streets, walks, or other passageways to public access due to construction, demolition, or other related activities until an alternative routing plan is filed and written approval given by the appropriate local authority. For detailed *Maintenance and Control of Traffic Plan*, refer to Section 01570, "Maintenance and Control of Traffic".

D. Land Resources:

1. Except in areas indicated to be cleared, do not remove, cut, deface, injure, or destroy trees, shrubs, and vegetation without special permission from the Contracting Officer. Do not fasten or attach ropes, cables, or guys to any existing nearby trees for anchorage. Do not grade or store soil or debris against trees, shrubs, or vegetation that is outside the area to be cleared.
2. The use of herbicides is not permitted unless otherwise specified.
3. Submit a plan for protecting existing trees and vegetation to remain and that could be injured, bruised, defaced, and otherwise damaged by construction operations. Plan shall be in accordance with Section 01532, "Tree and Shrub Protection and Care", and shall be referenced in the SWP3 under maintaining existing vegetation. Remove rocks that are displaced into uncleared areas.

4. Protect monuments, monitor wells, markers, and works of art prior to the start of operations.

5. Trees and other landscape features scarred or damaged by the Contractor's equipment and operations shall be repaired and restored in accordance with the approved SWP3 and Section 01532, "Tree and Shrub Protection and Care". Submit for the Contracting Officer's approval the repair and restoration plan prior to its execution.

6. Construction Facilities:

a. Requirements of this subparagraph are in addition to General Provision paragraph, "OPERATIONS AND STORAGE AREAS", and Section 01500, "Temporary Facilities and Services Required During Construction".

b. The location of the Contractor's staging area, storage area, and other construction buildings on public or privately owned property required temporarily in the performance of the Work, if not shown on the drawings, require approval of the Contracting Officer. Store equipment and materials at the job site in conformance with applicable Federal, state, and local statutes, ordinances, regulations, and rulings of the proper jurisdictional authority. Do not store unnecessary materials, equipment or containers on the jobsite. Take care to prevent any structure from being loaded with a weight that will endanger its structural integrity or the safety of persons. Do not store materials on or encroach upon private property without the written consent of the owners of such private property.

E. Water Resources:

1. At all times, the Contractor shall comply with the terms and conditions of the Clean Water Act of 1977, including the TPDES Storm Water Discharge Permit and SWP3 for this Project. Refer to Section 01562, "Soil Erosion and Sediment Control", for detailed requirements regarding the TPDES storm water-permitting program.

2. Permit no stream crossings except as indicated in the Contract Documents. If the Contracting Officer agrees in writing that stream crossing is unavoidable, properly design and obtain required permits and construct such crossings according to such design and permit restrictions. The SWP3 shall include the design of any stream

crossings including properly sized culverts that remain in place in low flows/minor storms and allow high flows from major storms to pass over. Remove temporary culverts or bridge structures, if used, upon completion of the project and repair the area in conformance with its original condition and as specified herein.

material in an appropriate manner. If the material is suspected of being either hazardous or regulated, prior to its removal the Contractor shall conduct testing and handle the material appropriately. If applicable, copies of any and all waste manifests shall be transmitted to the Contracting Officer and the DART Environmental Compliance Section in a timely manner.

- 3. Protection of Existing Wetlands and Watercourses:
  - a. Plan, schedule, and undertake work in a manner that will ensure the protection and preservation of existing wetlands and watercourses.
  - b. Undertake work in and around wetlands and watercourses in a manner to prevent any detrimental impact upon existing wetlands and watercourses.
  
- F. Flood Plain Management: Undertake work that may involve floodplains in full compliance with the National Flood Insurance Act of 1968, as amended (42 U.S.C. 4001 et seq.) and the Flood Disaster Protection Act of 1973 (P.L. 93-234, 87 Stat. 975). Executive Order 119-88 as amended (Floodplain Management) to be accommodated in all pertinent work through compliance with the DOT implementation plan as defined in the June 22, 1978 Federal Register, page 27148.
  
- G. Fish and Wildlife Resources: Do not alter water flows or otherwise disturb native habitat near or adjacent to the project construction area.
  
- H. Staging Areas:
  - 1. Do not use in connection with this Contract, for storage, as a staging area, or as a preparation site, any cultural resource facility, building, site, or cleared area that is, as of the date of this Contract, on or eligible for listing on the National Register of Historic Places (16 U.S.C., paragraph 470a), without the prior approval of the Contracting Officer.
  - 2. For the purpose of the preceding paragraph the term "cultural resource" includes districts, sites, building, structures, and objects significant in American history, architecture, archaeology, or culture.
  
- I. Illicit Dumping by Others: Contractor shall inform the Contracting Officer in the event that trash, debris or any other type of waste material is dumped or otherwise deposited on the site. The following applies whether or not the Contractor is responsible for the waste material's presence on the site. Contractor has 7 days to clean up illicit dumping on the site unless the ECM determines the schedule must be extended to safely and effectively clean up or remove the material. Contractor shall make arrangements to dispose of the waste

- J. Historical and Scientific Specimens:
  - 1. Protect and preserve intact all historic architectural features indicated on the drawings, the SWP3, or designated by the Contracting Officer. Protect these features from damage, including, but not limited to that resulting from the elements, vandalism, and effects of excavation, demolition, removal, and construction operations. Remove reserved features in an appropriate manner to prevent damage, and pack or crate in a manner to protect from damage. Mark all containers with proper identification and deliver to designated on-site areas for storage or transfer to a warehouse. Replace or repair lost or damaged designated architectural features as directed by the Contracting Officer. Submit proposed protection and removal procedures for review by the Contracting Officer prior to commencing the Work. Provide procedures for: the identification and protection of historic architectural features to be removed; safe conduct of the Work; careful removal and disposition of preserved features; and the protection and storage of preserved features. Notify the Contracting Officer in writing of the Contractor's proposed schedule of removal of designated items. Protect the Authority's right of ownership with regard to all preserved items.
  - 2. If during the course of work, artifacts or other evidence of archaeological, historical, or scientific value are discovered or accidentally exposed, report such artifacts or evidence immediately to the Contracting Officer. Halt work in the immediate area and protect the artifacts or other evidence from damage, including that resulting from the elements, vandalism, and the effects of excavation, demolition, removal, and construction operations until such time as qualified officials are able to conduct appropriate investigations. Do not proceed with work in the immediate area until authorization to proceed is obtained from the Contracting Officer. Deliver any such evidence or artifacts found during construction operations or subsequent investigations required by this section into the custody of the Authority; these items shall not become the property of the Contractor. Any delay in the progress of work on the project as a result of encountering archaeological or historical artifacts is to be mitigated by the Authority in

accordance with the General Provisions paragraph, "CHANGES".

tanker delivering oil products to the site.

**1.4 PETROLEUM STORAGE REQUIREMENTS**

A. Contractor is responsible for all oil and oil products brought onto the site, including those introduced by sub-contractors. For the purposes of this section, oil and oil products shall include, but not be limited to, motor oils, hydraulic oils, transmission fluids, fuel (diesel, gasoline, kerosene, etc.), grease, grease guns, grease cartridges, form release oil (if petroleum based), used oils, and used oil filters.

B. Prior to commencement of any on-site activities, the Contractor shall review and address the following:

1. Follow all applicable petroleum storage requirements and regulations, including those for underground, aboveground and mobile tanks. The location of all storage containers shall be clearly marked on the SWP3 as outlined in Section 01562, "Soil Erosion and Sediment Control".

2. Spill Prevention Control and Countermeasures Plan:

a. Contractor through its ECM shall prepare and submit a *Spill Prevention Control and Countermeasures Plan* (SPCC) if the total (cumulative of all contractors on project) on-site oil or oil product storage capacity is expected to meet or exceed 1,320 gallons at any time during the project. Contractor shall and all other contractors on site will be required to communicate in a weekly meeting to assess the on site storage to determine if the SPCC has been triggered. All containers with a capacity of 55 gallons or greater will be included in determining on-site capacity including those of the Contractor and subcontractors.

b. At a minimum, the Contractor's SPCC shall conform to the requirements of 40 CFR, Part 112, *Oil Pollution Prevention*, as well as any laws or regulations imposed by state or local authorities.

c. The on-site oil and oil product storage capacity shall be cumulative and include all containers introduced by the Contractor as well as all subcontractors. Containers will include tanks, drums, cartons, etc.

d. The SPCC shall include the Contractor's plan for containing a catastrophic spill from his largest on-site tank and/or the largest mobile

e. Underground storage should be avoided but if used, comply with applicable regulations and cover under SPCC.

3. Containers, drums, and storage tanks shall be clearly marked as required by the authority having jurisdiction. At a minimum, markings shall include the contents of the container, drum, tank and/or other storage device. Markings shall be legible and permanently attached to the outside of the container. There shall be no unmarked drums or containers (including trash containers) on the site.

4. Maintain an inventory of oil and oil containing products stored on-site.

5. Submit a list of oil and oil products to be used and stored on-site. All oil and oil products will be stored in appropriate containers. Used oil filters, grease cartridges, plastic oil containers, etc. will be disposed of promptly and in an appropriate manner. Appropriate disposal may include recycling.

6. Oil and oil product storage containers shall be placed within secondary containment structures. Each secondary containment structure shall be sufficiently sized to confine the contents of the largest container, drum, or tank stored within and shall be impervious so that any spilled product will be retained. Spilled and/or leaked products shall be promptly removed from containment structures. Secondary containment structures shall be configured or situated to prevent storm water from entering. Storm water entering any secondary containment shall be considered contaminated and shall be disposed of appropriately by the Contractor.

7. All containers, storage tanks, hoses, and piping shall conform to EPA, TCEQ, and/or local regulations, guidelines and codes.

8. SPCC shall be prepared under the direction of, and signed and sealed by a Professional Engineer licensed in the State of Texas.

**1.5 HAZARDOUS WASTE, REGULATED MATERIALS, AND TOXIC SUBSTANCES**

A. DART construction projects are subject to regulations promulgated by Federal, state, and local, regulatory agencies. Agencies include but are not limited to the Texas Commission on Environmental Quality (TCEQ), Texas Department of Health (TDH), U.S. Environmental Protection Agency (EPA), Occupational Safety and Health



ENVIRONMENTAL PROTECTION

Administration (OSHA), U.S. Department of Transportation (DOT), municipal fire departments and storm water management departments. Following is a summary of environmental regulations that may impact DART construction projects. This summary is not intended to be exhaustive; discovery of additional regulations that may apply are the responsibility of the Contractor.

1. Construction and Fire Prevention Resolution and Amendments to the Codes by the judicial authority.
  2. Title 31, TAC Chapters 334, and 335.
  3. RCRA - Resource Conservation and Recovery Act.
  4. TCEQ - Soil Remediation/Reuse/Treatment Levels. Adopted regulations 3/3/93, TAC Section 334.481-510
  5. TSCA - Toxic Substances Control Act.
  6. Petroleum Engineers Institute (PEI) Publication RP100 Recommended Practices for Installation of Underground Liquid Storage Systems.
  7. API Publication 2219, Safe Operating Guidelines for Vacuum Trucks in Petroleum Service, 1999
  8. API Publication 1604, Closure of Underground Petroleum Storage Tanks, 1996
  9. National Institute for Occupational Safety and Health (NIOSH), Publication 80-106, Criteria for Recommended Standard. Working in Confined Spaces, 1979.
  10. NIOSH Publication 87-113, A Guide to Safety in Confined Spaces, 1987
  11. Occupational Safety and Health Administration (OSHA) 29CFR1926, Excavation and Trenching Operations, 2001
  12. OSHA 40CFR1926, Training Requirements for the Construction Industry, applicable sections.
  13. OSHA 29CFR1910.1200, Hazard Communications Standard (HAZCOM).
  14. Texas Hazard Communication Act, Chapter 502 of the Health and Safety Code (revised 1993).
- B. Contractor and all sub-contractors, working on Authority construction projects, shall comply with all existing applicable environmental laws and/or regulations promulgated and enforced by Federal, state and local agencies. This includes, but is not

limited to, the storage, handling, transport, and disposal of all hazardous waste, regulated materials and/or toxic substances.

1. Hazardous Waste and Regulated Materials:
  - a. Hazardous waste is a broad term used to denote industrial by-products and waste materials discarded from homes, commercial establishments, and industrial facilities that pose a risk to human health, safety, property, and the environment. Encountering heavy metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) defined under the Resource Conservation and Recovery Act of 1976 (RCRA) is the most common occurrence for DART construction projects.
  - b. Regulated materials are usually thought of as those materials that may pose a risk but are not classified as hazardous. For DART construction projects, the discovery of total petroleum hydrocarbon (TPH) contaminated materials, associated with gasoline stations, is the most common occurrence.
2. Toxic Substances: The Toxic Substances Control ACT (TSCA) of 1976 provided EPA with authority to require testing of chemical substances, both new and old, entering the environment and to regulate them where necessary. The chemical substances addressed by TSCA, which are most commonly encountered during a DART construction project are asbestos or polychlorinated biphenyls (PCB's).

- C. HAZCOM: Contractor shall maintain all applicable Material Safety Data Sheets (MSDS), as required under Federal, state and local laws. MSDS(s) shall be kept current and made available for on-site review.

**1.6 RESPONDING TO HAZARDOUS WASTE, REGULATED MATERIALS, AND TOXIC SUBSTANCES**

- A. Authority personnel (Manager, Environmental Compliance and Construction Engineering Manager) shall be notified immediately in the event the Contractor, during the course of work, encounters or suspects the presence of hazardous waste, regulated materials, toxic substances, and/or underground storage tank. Contractor shall not perform any work in the area of suspected contamination prior to receipt of special instruction from the Authority through the Contracting Officer. Any delay in the progress of the Work as a result of encountering hazardous or regulated materials, toxic substances, and/or underground storage tanks

on the Project will be mitigated by the Authority in accordance with the General Provisions paragraph, "CHANGES". Within 24 hours of the notification to the Authority through the Contracting Officer of the encountering of the presence of regulated or hazardous materials, the Contractor will meet with the Contracting Officer to replan and work around the affected area. The Contracting Officer will provide the special instructions without delay and upon confirmation by regulating agencies of the actions taken, authorize the work to progress.

**1.7 CONTROL AND DISPOSAL OF EXCESS MATERIAL, TRASH, DEBRIS, AND EFFLUENT**

- A. Dispose of excess excavated material that is approved by the Contracting Officer as clean fill onsite if the Contracting Officer approves an onsite soil disposal area. If no such site is approved, dispose of the material in accordance with the provision of Paragraph 1.7.C. herein. Small amounts of material generated by excavation for fencing will be exempted from this provision. In all cases the provisions of Article 1.3 hereinbefore apply to the onsite disposal of excavated material.
- B. Pick-up trash and place in containers. Develop a schedule for emptying containers regularly. Conduct handling and disposal to prevent contamination of the site and other areas. Do not dispose of any material or otherwise contaminate wetlands. On completion, leave the disposed areas clean.
- C. Dispose of rubbish and debris as follows: Transport all waste off the site and dispose of in a manner that complies with State, and local requirements. Secure a permit or license, if required by the jurisdictional authority, prior to transporting any material off the site. Submit copies of approval documents from appropriate Authorities to the Contracting Officer prior to use of the disposal sites. Do not burn waste materials on the site.
- D. Effluent: Contractor shall take all necessary measures to assure compliance with the requirements and intent of the TPDES Permit obtained for this Project and with the SWP3 developed for this Project.
- E. Wash Down of Concrete Trucks: Wash down shall be performed only at locations designated by the ECM and in accordance with applicable laws and regulations. Indicate location on SWP3, as applicable.

**1.8 CONTROL AND DISPOSAL OF CHEMICAL AND SANITARY WASTES**

- A. Dispose of sewage through authorized connections to municipal sanitary sewage systems. Where such systems are not available, use chemical toilets or comparably effective units with wastes regularly emptied. Include provisions for pest control and for masking or eliminating odors.

- B. Store chemical waste in separate corrosion-resistant, properly labeled containers. Remove from the Project Site and dispose of as necessary, but not less frequently than monthly. Provide for disposal of chemical waste, including paint-related material, in accordance with TCEQ regulations, in addition to standard established practices as approved by the Contracting Officer. Conduct fueling and lubricating of equipment and motor vehicles on-site in a manner that affords the maximum protection against spills and evaporation. Dispose of lubricants, including used oil, in accordance with approved procedures meeting Federal, state and local regulations. Provide spill control materials in fueling and lubrication areas; and use them when needed. Immediately notify the Contracting Officer and the Authority's personnel (as required in Paragraph 1. 6. herein) of oil and hazardous material spills that may be large enough to violate state, and local regulations.

**1.9 DUST CONTROL**

- A. Do not use oil or any other petroleum product to control dust.
- B. Keep dust down at all times including non-working hours, weekends, and holidays. Treat soil at the site, haul roads, and other areas disturbed by the Contractor's operations as well as materials stockpiled for the project with dust suppressors or cover to control dust. Power brooming for dust control will not be permitted; use street vacuuming machines. Air blowing shall only be permitted for cleaning off non-particle debris, such as that from reinforcing bars. Sandblasting shall not be permitted except as specified elsewhere. Only wet cutting of concrete block, concrete, and asphalt will be permitted.
- C. Secure and cover trailers and other transport equipment to prevent loose soil, debris and other materials from becoming airborne during transit.
- D. Stabilized construction entrances shall be used to prevent offsite tracking of sediments and debris as shown in the SW3P for the site. Design of the stabilized construction entrance shall prevent all washing effluent from leaving the site. The ECM shall monitor the washing of vehicles at the stabilized entrances to prevent tracking and to evaluate the quality of effluent leaving the construction site from washing of vehicles.

**1.10 VEHICLE AND EQUIPMENT EMISSION LIMITATIONS**

- A. Contractor shall adhere to applicable requirements for vehicle and equipment emission limitations.

**1.11 CONSTRUCTION NOISE AND VIBRATION CONTROL**

- A. Perform construction operations in a manner minimizing noise and vibration. Provide working machinery and equipment with efficient noise

suppression devices, and other noise and vibration abatement measures necessary for protection of both employees and the public. Schedule operations in a manner that will minimize the disturbance to the public in areas adjacent to the Work to the greatest extent feasible. Restrict working hours as required by municipal ordinances.

Protect employees and the public against noise exposure in accordance with the requirements of the Occupational Safety and Health Act of 1970 and the current statutory noise limits set by OSHA. Comply with all other applicable Federal, state and local laws, regulations and ordinances.

B. Require the use of machines with effective mufflers or enclosures and the selection of quieter alternative procedures. Compliance may also require the use of complete enclosures (tongue-and-groove plywood or sheathing as specified in Section 01500) around the Worksites or a combination of closed boarding and effective mufflers and/or enclosures. Arrange haul routes to minimize noise and vibration at residential sites, and if necessary, place operating limitations on machines and trucks if suitable routes cannot be found. Submit shop drawings of the Worksites and haul routes showing provisions for the control of construction noise to the Contracting Officer for approval.

C. Monitor work operation noise and vibration levels to assure they comply with the noise and vibration limitations specified. Retain records of these noise and vibration measurements for inspection by the Contracting Officer. Inform the Contracting Officer of any complaints received from the public regarding noise and vibration. Propose the remedy and recommend if remedial action is required. If action is warranted, submit a proposed remedy and schedule to the Contracting Officer for approval prior to commencement of such actions.

D. Definitions:

1. Daytime/Nighttime: Daytime refers to the period from 7:00 a.m. to 9:00 p.m. local time, daily except Sundays and legal holidays, or as defined by the local jurisdictional agency, whichever is more restrictive. Nighttime refers to all other times, including all day on Sunday and all day on legal holidays.

2. Noise Level Restrictions at Affected Structures. Conduct construction activities so that the noise levels 200 feet from the construction limits or at the nearest affected building, whichever is closer, do not exceed the levels listed hereafter in Tables 01560 - 1 and 01560-2.

3. Continuous Noise. Prevent noises from stationary sources, parked mobile sources, or any combination of sources producing repetitive or long-term noise lasting more than one hour from exceeding the limits of Table 01560-1.

4. Intermittent Noise. Prevent noises from non-stationary mobile equipment operated by a driver or from any source of non-scheduled, intermittent, non-repetitive, short-term noises not lasting more than one hour from exceeding the limits of Table 01560- 2.

5. More Than One Limit Applicable. Where more than one noise limit is applicable, the more restrictive requirement shall be used for determining compliance.

E. Noise Emission Restrictions: Use only equipment meeting the noise emission limits listed in Table 01560 - 3 as measured at a distance of 50 feet from the equipment. Take the measurements in accordance with the latest revisions of SAE J366b, SAE J88, and SAE J952b or in accordance with the measurement procedures specified.

F. Vibration Level Restrictions:

1. Vibration Limits in All Areas. Conduct construction activities so that vibration levels at a distance of 200 feet from the construction limits or at the nearest affected building (whichever is closer) do not exceed root-mean-square (rms) vibration velocity levels of 0.1 inch per second in any direction over the frequency range of 1 to 100 Hz.

2. Special Zones. In zones designated by the local agency having jurisdiction as a special zone or special premise or special facilities, the vibration level and working time restrictions imposed by the agency shall apply.

G. Noise and Vibration Control: The control measures listed below may be utilized to minimize the noise and vibration levels in all areas outside the construction limits in order to meet the specified limitations:

1. Shields, impervious fences, or other physical sound barriers that inhibit transmission of noise.

2. Sound retardant housings and/or enclosures placed around noise producing equipment.

3. Intake and exhaust mufflers installed on internal combustion engines and compressors.

4. Lining or covering hoppers, storage bins and chutes with sound-deadening material.

5. Minimizing the use of air or gasoline driven saws.

6. Conducting truck loading, unloading, and hauling operations so that noise and vibration is kept to a minimum.

## ENVIRONMENTAL PROTECTION

7. Planning the route used by construction equipment and vehicles carrying concrete, or other materials over streets that will cause the least disturbance to residents. Advise the Contracting Officer in writing of the proposed haul routes prior to securing a permit from the local government, in accordance with Section 01570, "Maintenance and Control of Traffic".
8. Subject to the approval by the Contracting Officer, placing stationary equipment to minimize noise and vibration impact to the community.
9. Using vibratory pile drivers or augering for setting piles rather than impact pile drivers wherever feasible. If impact pile drivers must be used, the hours shall be limited to 8:00 a.m. to 5:00 p.m. weekdays in residential and semi-residential/commercial areas.

### **1.12 BLASTING**

- A. Blasting is expressly prohibited.

## **PART 2 - PRODUCTS**

Not Used

## **PART 3 - EXECUTION**

Not Used

## **PART 4 - MEASUREMENT AND PAYMENT**

### **4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements".

**TABLES 01560 - 1 and 2**

**CONTINUOUS AND INTERMITTENT CONSTRUCTION NOISE LIMITS**

Affected Structure or Area	TABLE 01560 - 1		TABLE 01560 - 2	
	Maximum Allowable Continuous Noise Level, dBA		Maximum Allowable Intermittent Noise Level, dBA	
<u>Residential</u>	<u>Daytime</u> <sup>1</sup>	<u>Nighttime</u> <sup>2</sup>	<u>Daytime</u> <sup>1</sup>	<u>Nighttime</u> <sup>2</sup>
Single family residence, multi-family residential areas, including hospitals and hotels	70	50	85	70
<u>Commercial</u>	<u>Daytime</u> <sup>1</sup>	<u>Nighttime</u> <sup>2</sup>	<u>Daytime</u> <sup>1</sup>	<u>Nighttime</u> <sup>2</sup>
Mixed residential/commercial areas, including schools	75	65	90	80
Commercial areas with no nighttime residents	75	75	90	90
<u>Industrial</u>				
All locations	85	85	90	90

**Notes:**

1. Daytime refers to the period from 7:00 a.m. to 9:00 p.m. local time, daily except Sundays and legal holidays, or as defined by the local jurisdictional agency, whichever is more restrictive.
2. Nighttime refers to all other times, including all day on Sunday and all day on legal holidays.

**TABLE 01560 - 3  
CONSTRUCTION NOISE EMISSION LIMITS**

<u>TYPE OF EQUIPMENT</u>	<u>MAXIMUM NOISE LIMIT</u>	
	<u>Date Equipment Acquired</u>	
	<u>Before 1-1-1986</u>	<u>On or After 1-1-1986</u>
All equipment other than highway trucks; including hand tools and heavy equipment	95 dBA	90 dBA
<u>TYPE OF EQUIPMENT</u>	<u>MAXIMUM NOISE LIMIT</u>	
	<u>Date Equipment Acquired</u>	
	<u>Before 1-1-1988</u>	<u>On or After 1-1-1988</u>
Highway trucks in any operating mode or location	90 dBA	87 dBA

**Note:**

Peak levels due to impact pile drivers may exceed the above noise emission limits by 10dBA.

END OF SECTION 01560

**SECTION 01562**  
**SOIL EROSION AND SEDIMENT CONTROL**

The provisions of the DART Standard Specification Section 01562, "Soil Erosion and Sediment Control", shall apply to the Work as modified herein.

**PART 1 - GENERAL**

**1.1. DESCRIPTION:** Change Paragraph 1.1/A to read as follows:

- A. This section specifies soil erosion and sediment control measures and stabilization practices required during construction in order to help minimize to level of pollutants in storm water run-off from FWTA/TRE construction sites.

**1.4. PERFORMANCE REQUIREMENTS (PERMIT APPLICABILITY AND COVERAGE):** Change the second sentence of 1.4/D/1/e and Change Paragraph 1.4/F/4 and the first sentence of 1.4/F/5 to read as follows:

D.

- e. In either case, the ECM shall only perform duties directly related to environmental compliance, be at the job site minimum once per week and immediately upon any occurrences, and be delegated the comprehensive authority necessary to enforce the Contractor's compliance with the applicable Federal, state and local environmental laws, regulations and ordinances.

F.

- 4. The Contractor shall be responsible for completing and posting the NOI for public information as required by the CGP.
- 5. Prior to being granted "Substantial Completion of the project", the Contractor shall request through the Contracting Officer a field inspection.

**END OF SECTION 01562**

**SECTION 01562**  
**SOIL EROSION AND SEDIMENT CONTROL**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies soil erosion and sediment control measures and stabilization practices required during construction in order to minimize the levels of pollutants in storm water run-off from DART construction sites.
- B. Soil erosion and sediment control measures are required under Texas law, specifically Section 26.040 of the Texas Water Code and Section 402 of the Clean Water Act. Under the provisions of these laws, the Texas Commission on Environmental Quality (TCEQ) has developed the Texas Pollutant Discharge Elimination System (TPDES) General Permit TXR150000, relating to discharges from construction sites located in the State of Texas. Throughout this section, the TPDES General Permit TXR150000 with effective date March 5, 2013, will be referred to as the Construction General Permit (CGP). In the event TCEQ issues an update or otherwise a new permit, the Contractor shall adhere to any and all provisions, including those that may conflict with this section.
- C. This section also specifies Contractor's responsibilities under the TPDES CGP. These responsibilities include assuming operational control of the site (as defined in the CGP), updating and maintaining a Storm Water Pollution Prevention Plan (SWP3), performing inspections, submitting various notices, and providing qualified personnel to assure compliance with Federal, state and local environmental regulatory requirements.
- D. Contractor shall also be responsible for furnishing, installing, maintaining throughout construction, and removing temporary measures and practices defined in the CGP as Best Management Practices (BMPs). BMPs include silt fences, stabilized construction entrances, ditch checks, storm sewer inlet protection and other structural controls, as required; as well as temporary and permanent seeding, mulching, sodding, and other stabilization methods.
- E. Contractor shall also develop appropriate procedural controls that will facilitate compliance with the CGP and the SWP3. These may include BMP maintenance, trash removal, and employee training.

**1.2 REFERENCED STANDARDS**

- A. American Association of State Highway and Transportation Officials (AASHTO),
  - 1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications - H-22
- B. ASTM International (Formerly known as American Society for Testing and Materials) (ASTM):
  - 1. ASTM A116 - Standard Specification for Metallic Coated, Steel Woven Wire Fence Fabric
  - 2. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
  - 3. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
  - 4. ASTM A641/A641M Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
  - 5. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
  - 6. ASTM D3776 - Standard Test Methods for Mass Per Unit Area (Weight) of Fabric
  - 7. ASTM D3786 - Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
  - 8. ASTM D4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
  - 9. AASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
  - 10. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles
  - 11. ASTM D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
  - 12. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of Geotextile
  - 13. ASTM D4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

## SOIL EROSION AND SEDIMENT CONTROL

14. ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples

15. ASTM D5735 - Standard Test Method for Tearing Strength on Non-woven Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine)

C. North Central Texas Council of Governments (NCTCOG): "Integrated STORM WATER MANAGEMENT Design Manual for Construction".

D. Texas Department of Transportation (TxDOT): "Storm Water Management Guidelines for Construction Activities"

E. U.S. Environmental Protection Agency (EPA): "Storm Water Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices"

### 1.3 DEFINITIONS

A. The Definitions found in Part I of the CGP are included by reference and shall apply to this Section.

B. Jurisdictional Entities, as used herein, is defined as the US Environmental Protection Agency (USEPA), TCEQ, U.S Army Corps of Engineers (USACE), as well as the operators of the Municipal Separate Storm Sewer Systems (MS4) receiving discharge from the construction site. (The MS4 operator is usually the city in which the construction activities are occurring, however, it may also be another government entity, such as the Texas Department of Transportation or North Texas Tollway Authority.) This definition shall also include any other entity having legal jurisdiction or ownership over the project or any portion of thereof.

C. Construction Site Notice (CSN) shall be defined as the on-site contact information sheet required by the CGP. The CSN shall include all information required to be posted in public view. Contractor shall strictly adhere to placement requirements as specified in the CGP.

### 1.4 PERFORMANCE REQUIREMENTS (PERMIT APPLICABILITY AND COVERAGE)

A. Contractor shall be considered the "Primary Operator". As Primary Operator, Contractor

shall fulfill all requirements of the CGP as well as any other applicable laws, regulations, or ordinances.

#### B. Compliance with Storm Water Permitting Regulations:

1. Contractor shall comply with all requirements of the CGP in addition to other requirements stated elsewhere in this Specification as well as Specification 01560, "Environmental Protection".

2. Under this permit, TCEQ requires the development and implementation of an SWP3, including erosion and sediment controls, storm water management measures, other site controls and housekeeping BMPs, and prevention of prohibited discharges to storm water.

3. Contractor shall meet with all appropriate Jurisdictional Entities prior to commencing any onsite work activities. Jurisdictional Entities, in this case, shall include the operator(s) of the Municipal Separate Storm Sewer System (MS4) where the construction activity will occur. Contractor shall document this (these) meeting(s) and submit this documentation to the Contracting Officer's Representative.

4. Jurisdictional Entities may impose additional storm water pollution prevention requirements under the provisions of their local ordinances or MS4 permit.

C. Notices of Intent (NOI), Notices of Termination (NOT), Notices of Change (NOC) Letters and CSNs shall be signed in accordance with 30 TAC (Texas Administrative Code), §305.44 (relating to Application for Permit).

D. Environmental Compliance Manager: Prior to commencing construction activities, the Contractor shall propose a qualified Environmental Compliance Manager (ECM) and receive concurrence from the Authority. The ECM shall be formally delegated the responsibility for assuring compliance with the CGP, the SWP3, as well as all other environmental requirements imposed by applicable Jurisdictional Entities.

1. The delegated ECM shall have acquired, through a combination of education, training, and experience, the knowledge necessary to ensure that the Contractor's activities on the project site meet environmental regulatory requirements, as described in this Section, Section 01560, "Environmental Protection", as well as any other requirements imposed by applicable Jurisdictional Entities. Minimum qualifications for the ECM shall include familiarity, knowledge, and an understanding of:

a. Environmental construction issues, including the NPDES and/or TPDES storm water discharge permitting regulations (preferably the most current CGP),



## SOIL EROSION AND SEDIMENT CONTROL

- b. Spill response and reporting requirements necessary to protect human health and the environment, which shall include regulatory deadlines for making notification to the applicable Jurisdictional Entities. (Contractor shall be fully responsible for completing all required notification requirements within the timeframes dictated by each applicable Jurisdictional Entity),
  - c. Applicable regulations and requirements governing product containers, storage, and disposal, as well as chemical and product management, including documentation requirements and applicability of product use.
  - d. The ECM shall have obtained competency recognition via college degree, certification, registration, and/or licensing from a recognized professional or technical association, state agency, or other Jurisdictional Entity. The ECM shall also have acquired the regulatory knowledge and field experience necessary to understand and ensure compliance with the requirements of applicable Jurisdictional Entities, particularly during environmental emergencies.
  - e. The ECM can be a direct employee of the Contractor or an environmental professional or qualified technician employed by a third party environmental consultant. In either case, the ECM shall only perform duties directly related to environmental compliance, be at the job site full time, and be delegated the comprehensive authority necessary to enforce the Contractor's compliance with the applicable Federal, state and local environmental laws, regulations and ordinances. Delegation shall be from, and the ECM shall report directly to, the Contractor's executive officer who signed the Authority's Contract, the CSN, and when applicable, the NOI. In no case shall the ECM be subordinate to the Contractor's superintendent or project manager. The ECM shall have full authority to stop work on the project in order to prevent or correct non-compliance with the CGP or other environmental regulations. The ECM shall only perform duties associated with ensuring environmental compliance for this project.
2. The duties of the ECM, relative to the CGP, shall be as follows:
- a. Oversee the installation of storm water pollution prevention devices and BMPs to assure that they are installed as depicted in the SWP3, accompanying detail drawings, the recommendations of the manufacturer, or Jurisdictional Entity.
  - b. Supervise the repair and maintenance of temporary and permanent BMPs.
  - c. Prepare SWP3 modifications when BMPs either prove ineffective or are no longer necessary due to changed site conditions, or changes to the progress or sequence of construction.
  - d. Assure that field modifications to the baseline SWP3 are depicted on, and incorporated into, the updated SWP3 maintained on the project site.
  - e. Make annotations to the SWP3 denoting devices or controls that are temporarily removed to facilitate construction. These annotations shall explicitly state why the specific BMPs was removed and when it will be reinstalled.
  - f. Develop site inspection reports summarizing each inspection. A copy of the inspection results, including a list of all deficiencies, shall be provided to the Contracting Officer's Representative at the close of the inspection. A formal written report shall be transmitted as soon as it is prepared, but no later than 7 days following the inspection. The formal report shall detail the actions taken to correct each deficiency as well as include photographic documentation noting BMP repair and maintenance. Minimum report content shall include the name(s) and qualifications of personnel making the inspection, the date of the inspection, and major observations relating to the implementation of the SWP3. Major observations shall include:
    - 1) The locations of discharges of sediment or other pollutants from the site;
    - 2) Locations of all BMPs;
    - 3) Locations of BMPs that require maintenance, failed to operate as designed, or proved inadequate for a particular location;

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- 4) Locations where additional BMPs are needed.
  - a. Prepare a formal written report including actions taken as a result of inspections, which shall be described within, and retained as a part of, the SWP3. Reports shall identify any incidents of non-compliance. Where a report does not identify any incidents of non-compliance, the report shall contain a certification that the site is in compliance with the SWP3 and the CGP. The report shall be signed in the manner required by 30 TAC §305.128.
3. The ECM shall also perform the duties specified in Section 01560, "Environmental Protection".
- E. Contractor shall conform to the requirements stipulated within the CGP and mandated by the Jurisdictional Entities and shall be solely responsible for responding to any citations, paying any fines, or otherwise addressing any written notices of non-compliance with the CGP as may be issued by TCEQ, EPA, or other Jurisdictional Entities.
- F. Projects equal or greater than 5 acres or part of a larger common plan of development that is equal or greater than 5 acres shall be considered "Large Construction Activity", as defined in the CGP, and shall comply with all CGP requirements, including:
  1. NOI: As site operator, the Contractor (or subcontractor if subcontractor has operational control of site or portion of site) shall complete and submit an NOI and associated fees to TCEQ and all applicable Jurisdictional Entities. NOIs shall be submitted within the timeframes identified within the CGP. A copy of the NOI shall be included in the SWP3 documents maintained for the project. Contractor shall post the NOI for public information per CGP.
  2. CSN: As site operator, the Contractor (or subcontractor if subcontractor has operational control of site or portion of site) shall complete and submit a CSN to the Jurisdictional Entities no later than 10 business days prior to the commencement of any on-site soil distributing activities, or as otherwise required by the CGP. A copy of the CSN shall be included in the SWP3 documents maintained for the project. Contractor shall post the CSN for public information per CGP.
  3. Contractor shall be responsible for all subcontractors and ensure their compliance with the CGP and SWP3. Contractor shall determine if a subcontractor will meet the definition of "Operator" within the CGP. Subcontractors determined by the Contractor to be Operators shall comply with all Operator requirements stipulated in the CGP as well as those imposed by applicable Jurisdictional Entities.
  4. Contractor shall be responsible for paying all permitting fees associated with its TPDES permit. Payment shall be made in a manner considered timely by the TCEQ. In the event a subcontractor files an NOI, the Contractor shall be responsible for assuring payment of fees by the subcontractor.
  5. Contractor shall be responsible for posting and maintaining all notices and documents required by the CGP as well as applicable Jurisdictional Entities. Contractor shall also obtain a copy of DART's Secondary Operator CSN from the Contracting Officer's Representative and shall be responsible for posting and maintaining it as required by the CGP.
  6. Prior to being granted "Substantial Completion of the project", the Contractor shall request through the Contracting Officer's Representative a field inspection from DART's Environmental Compliance Section (ECS). This inspection will determine if minimum stabilization requirements established by TCEQ and applicable Jurisdictional Entities have been met. Contractor shall furnish a copy of the final updated SWP3 at the beginning of the inspection. This final SWP3 shall note any BMPs that the Contractor proposes to leave in place. A punch list shall be developed during the inspection. "Substantial Completion" shall not be granted until after all items on the list have been addressed and written approval from ECS is received.
  7. NOT: Upon receipt of written approval from ECS, the Contractor shall submit an NOT for its portion of the project to TCEQ and all applicable Jurisdictional Entities. A copy of the NOT shall be included in the SWP3 documents maintained for the project.
  8. Contractor shall be responsible for ensuring submission of NOTs by subcontractors, as applicable. In no case shall the Contractor submit its NOT prior to that of all subcontractors.
- G. Projects equal to 1 acre but less than 5 acres shall be considered "Small Construction Activity", as

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defined in the CGP, and shall comply with all CGP requirements, including:

1. CSN: As site operator, the Contractor (or subcontractor if subcontractor has operational control of site or portion of site) shall complete and submit a CSN to the Jurisdictional Entities no later than 10 business days prior to the commencement of any on-site soil distributing activities, or as otherwise required by the CGP. A copy of the CSN shall be included in the SWP3 documents maintained for the project. Contractor shall post the CSN for public information per CGP.
  2. Contractor shall be responsible for all subcontractors and ensure their compliance with the CGP and SWP3. Contractor shall determine if a subcontractor will meet the definition of "Operator" within the CGP. Subcontractors determined by the Contractor to be Operators shall comply with the CGP.
  3. Contractor shall be responsible for posting and maintaining all notices and documents required by the CGP as well as applicable Jurisdictional Entities. Contractor shall also obtain a copy of DART's Secondary Operator CSN from the Contracting Officer's Representative and shall be responsible for posting and maintaining it as required by the CGP.
  4. Prior to being granted "Substantial Completion of the project", the Contractor shall request through the Contracting Officer's Representative a field inspection from ECS. This inspection will determine if minimum stabilization requirements established by TCEQ and applicable Jurisdictional Entities have been met. Contractor shall furnish a copy of the final updated SWP3 at the beginning of the inspection. This final SWP3 shall note any BMPs that the Contractor proposes to leave in place. A punch list shall be developed during the inspection. "Substantial Completion" shall not be granted until after all items on the list have been addressed and written approval from ECS is received.
  5. Site Termination: Upon receipt of written approval from ECS, the Contractor shall comply with CGP and complete the applicable portion of the CSN and submit a copy to Jurisdictional Entities within 30 days after the completion of the project. A copy of the completed CSN shall be included in the SWP3 documents maintained for the project.
  6. Contractor shall be responsible for ensuring submission of the complete CSN by subcontractors, as applicable. In no case shall the Contractor submit its completed CSN prior to that of all subcontractors.
- H. TCEQ Website: Additional information relating to the CGP, forms, and general information on storm water permitting requirements may be obtained from the TCEQ, either directly or from their website.

### 1.5 STORM WATER POLLUTION PREVENTION PLAN

- A. The Authority has prepared a "Baseline" SWP3 for this project that meets the requirements of the CGP; the Municipal Storm Water Discharge Permit issued to the Jurisdictional Entity; and other local codes, standards and regulations.
- B. Contractor shall prepare an "Erosion Control Plan" based on its intended sequence of construction activities as well as the storm water BMPs it proposes to use.
- C. Contractor shall update and certify the SWP3 before performing any soil disturbing activities at the project site or delivering materials to its material storage areas. The updated SWP3 shall incorporate the Baseline SWP3, the Contractor's Erosion Control Plan, related provisions of the Contract Documents, the CGP, NOI, CSN, and any additional items required by the CGP and/or applicable Jurisdictional Entities. Refer to Paragraph 1.5.1 "SWP3 Modifications" herein for additional provisions.
- D. Contractor shall install all BMPs per manufacturer's specifications or the recommendations of an appropriate technical or Jurisdictional Entity. In no case shall soil disturbing activities take place prior to installation of BMPs.
- E. In the event that a BMP proves ineffective in meeting the requirements or intent of the CGP, the Contractor shall propose and install alternate BMPs that will protect the quality of storm water being discharged from the site.
- F. The location and installation dates of each BMP shall be recorded in the SWP3 by the Contractor's ECM. BMPs shall be maintained throughout the construction process until project completion, or as otherwise directed by the Contractor's ECM, an authorized Jurisdictional Entity, the CGP, the SWP3, or the Contracting Officer's Representative.
- G. Contractor's ECM shall record and date annotations to the SWP3 denoting devices or controls that are temporarily removed to facilitate construction. These annotations shall explicitly state why the specific device or control was removed, when it was removed, and when it will be reinstalled.
- H. Contractor shall be responsible for keeping the SWP3 current at all times, as required by the CGP. The information listed below shall be incorporated by the Contractor into the Baseline SWP3. Updates to the

## SOIL EROSION AND SEDIMENT CONTROL

SWP3 shall be documented within 7 days and shall be dated.

1. In addition to the detailed Erosion Control Plan site map or maps required by the CGP, site map(s) shall be annotated and shall include the following additional information:

- a. Areas subject to clearing and grubbing, grading, excavation, and utility and infrastructure installation;
- b. Locations for stockpiles of topsoil, fill soils, sands, aggregates and other similar construction materials;
- c. Construction staging areas, office trailer locations, haul roads, and vehicle and construction equipment parking areas;
- d. Locations for equipment repair and maintenance;
- e. Storage areas for hazardous and regulated materials;
- f. Storage areas for miscellaneous construction or waste materials;
- g. The location of concrete batch plants as well as all specific BMPs installed to address runoff from these areas;
- h. Locations of solid waste dumpsters and portable toilets for sanitary waste;
- i. Areas where major construction activities have ceased (either temporarily or permanently, as identified in the CGP) and site stabilization practices are underway;
- j. Off-site locations of material, waste, borrow, fill, or equipment storage areas shall also include including estimates of the total area of such sites;
- k. Any additional items required by the CGP, Jurisdictional Entities, or as directed by the Contracting Officer's Representative.

2. A construction sequencing plan or schedule exhibiting relevant dates for major grading, excavation and construction activities, the temporary or permanent cessation of these activities, and for the initiation of interim or

permanent site stabilization practices. This plan or schedule shall be updated as necessary to reflect overall progress at the site and may reference the Construction Schedule specified in Section 01320, "Construction Schedule and Progress Reports" or 01321, "Construction Schedule and Progress Reports for Small Projects" as applicable.

3. A description of any construction or waste materials stored on-site or within 1 mile of the project site. If any hazardous and regulated materials, toxic substances, or other chemicals are stored on-site, the Contractor shall update the SWP3 to include proper storage, handling, and disposal procedures and show locations on site map. If the quantity or means of storage of oil and oil-products on site triggers the requirements for a Spill Prevention Control and Countermeasures Plan (SPCC), the Contractor shall provide a written SPCC that meets the requirements of the USEPA. Said SPCC shall be signed and stamped by a Professional Engineer licensed in the State of Texas. Refer to Section 01560, "Environmental Protection", for detailed SPCC requirements including when an SPCC is required.

4. A description of any other potential pollutant sources not identified in the Baseline SWP3.

I. SWP3 Modifications: Contractor is responsible for determining means and methods of construction. Modification of BMPs shown within the Baseline SWP3, whether to facilitate construction or to conduct operations differently than were assumed during design and/or project planning, shall be consistent with the intent of the CGP as well as good engineering principles and practices. Contractor movement, relocation, or substitution of any BMP shown within the plans shall meet the requirements of this section, the Authority's Standard Erosion and Sediment Control Detail Drawings, and applicable codes and regulations. Any change or substitution shall be noted on the SWP3 by the Contractor within 7 days after it has been implemented. Substitute BMPs that follow the following standards and guidelines may be acceptable:

1. NCTCOG - Storm Water Quality Best Management Practices for Construction Activities.
2. TxDOT - Storm Water Management Guidelines for Construction Activities.
3. USDA-SCS - Erosion & Sediment Control Guidelines for Developing Areas in Texas.

4. USEPA - Storm Water Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices.

J. Each modification to the baseline SWP3 shall be signed and certified by the Contractor as required by 30 TAC § 305.44. The signed certification shall be retained as part of the SWP3 documentation.

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- K. Contractor shall maintain all BMPs identified in the SWP3 in effective operating condition. A schedule for maintaining BMPs conforming to the CGP shall be developed by the Contractor and incorporated into the SWP3. BMPs that are not functioning properly shall receive maintenance before the next anticipated storm event or as otherwise required under the CGP. Contractor shall document all maintenance, repairs, and their respective dates in the SWP3.
- L. Contractor shall immediately address any deficiencies in implementation and adherence to the provisions of the SWP3 as determined during regular site inspections. In addition, any storm related damage to any BMPs (either temporary soil erosion and sediment control measures or permanent storm water management devices) shall be repaired as soon as is practicable, but not longer than 7 days following the date of the storm which caused said damage. Contractor shall implement alternative temporary soil erosion and sediment control measures when a particular control measure has failed repeatedly or completely as determined by the ECM. Any damage caused by construction operations or equipment shall be repaired immediately. Contractor shall also document damage repairs in maintenance logs that accompany inspection reports.
- M. The Authority's development of the Baseline SWP3 and periodic audit of the Contractor's overall compliance shall not in any way relieve the Contractor of the responsibility to comply with the terms and conditions of the CGP and other applicable codes and regulations, including all notification and record keeping requirements.
- N. When construction requires other contractors to work within the site or to take over portions of the site prior to completion of the contract, the Contractor shall cooperate with each contractor through the Contracting Officer's Representative(s) to coordinate overall storm water pollution prevention. The SWP3 shall be modified to recognize the areas of responsibility for each contractor, based on their work location and type. In addition, the contractors shall draw up and sign a Memorandum of Agreement formalizing their acceptance of responsibility for their respective portions of the site. Contractor shall continue to have operational control of its portion of the site and conform to CGP requirements.
1. A copy of the completed and executed NOI filed with the TCEQ and the Jurisdictional Entities.
2. A copy of the proposed CSN.
3. Copies of any other documentation the Contractor is required to submit to the applicable Jurisdictional Entity(ies) for Municipal Storm Water Discharge Permit compliance, or to meet the requirements of local erosion and sediment control, storm water management or land development codes, ordinances and regulations.
4. Copy of Contractor's SWP3 Certifications.
5. Copies of the pre-construction inspection report and pre-construction photographs.
6. Copies of all inspection reports and deficiencies noted in SWP3. Each submitted inspection report shall also not those steps taken to correct the deficiencies.
7. A copy of the final SWP3 for the project, which has been updated and revised to reflect the site stabilization verification inspection.
8. A copy of the completed and executed CSN filed with the Jurisdictional Entity (ies) upon completion of the project.
9. A copy of the completed and executed NOT filed with TCEQ the Jurisdictional Entity (ies).
10. Copies of the information listed herein shall also be included as part of the SWP3 documents maintained for the project.
11. Documentation of all meetings between the Contractor and Jurisdictional Entities. Meeting documentation shall include signed attendance sheets.
- B. SWP3 and Personnel Qualifications: These submittals shall be made to the ECS through the Contracting Officer's Representative.
1. Contractor shall submit prior to the Pre-Construction Conference, a copy of this section of the specifications and of the Standard Drawings showing which temporary soil erosion and sediment control products and structural control measures (BMPs) will be applied to the work. Non-applicable products and measures shall be crossed out.
2. Contractor's initial update of SWP3 and any subsequent on-going modifications.
3. The credentials of the ECM proposed by the Contractor as being responsible for CGP and SWP3 compliance. Submittal shall include a letter delegating appropriate authority to the ECM. Upon

### 1.6 SUBMITTALS

- A. Regulatory Compliance Documentation: Submit the following documentation:

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approval of the ECM, this letter shall be filed with the applicable Jurisdictional Entities.

4. The credentials of the environmental inspector(s) and/or third party environmental or engineering subcontractor designated by the Contractor to perform site inspections. Submittal shall include a letter delegating appropriate authority to the inspectors and/or subcontractor. Upon approval of the inspectors and/or subcontractor, this letter shall be filed with the applicable Jurisdictional Entities.
5. The proposed NOI or CSN at least 14 working days prior to commencement of site work. Contractor shall not submit NOI to TCEQ, or CSN to the Jurisdictional Entities, prior to receipt of review comments from the Contracting Officer's Representative.

### C. Product Data and Test Reports:

1. Product Data: Submit copies of manufacturer's specifications and installation instructions or catalog information ("catalog cuts") for products furnished under this section. Submit product samples if requested.
2. Test Reports: Materials testing laboratory test reports exhibiting gradation and other appropriate physical and chemical properties as specified herein for stone, rock, and gravel filter material for used in stabilized construction entrances, rock berms, stone ditch checks, or as part of storm sewer inlet protection measures.

## 1.7 QUALITY ASSURANCE

- A. Comply with the appropriate codes and regulations promulgated by regulatory agencies, including the EPA, the TCEQ, Texas Department of State Health Services (DSHS), MS4, and all other applicable Jurisdictional Entities.

## PART 2 - PRODUCTS

### 2.1 SILT FENCE

#### A. Geotextile Filter Fabric:

1. In accordance with AASHTO M288, the following requirements shall apply:
  - a. Geotextile filter fabric weighing approximately 0.02 to 0.05 pounds per square foot.

- b. Fabric: Shall consist of long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins or polyesters.
- c. Filter fabric shall be formed into a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.
- d. Fabric edges shall be selvaged.
- e. Physical properties: All property values listed below shall be minimum average roll values in the weakest principle direction (or cross direction, as indicated) except for grab tensile elongation and apparent opening size. Grab tensile elongation and apparent opening size shall be maximum average roll values as per Table 01562 - 1.

#### 2. Labeling, shipment and storage: In accordance with ASTM D4873, including the following:

- a. Each roll of filter fabric shall include a product label clearly showing the name of the manufacturer or supplier, the product and style name, the roll number, and shall state that the geotextile is in accordance with the manufacturer's certification.
- b. Each roll of filter fabric shall be wrapped with a material to protect the geotextile from damage due to shipment, water, sunlight, and contaminants. The integrity of the protective wrapping shall be maintained during periods of shipment and storage.
- c. During storage, rolls of filter fabric shall be elevated off the surface of the ground and adequately covered to further protect them from site construction damage; precipitation; extended exposure to ultraviolet radiation; chemicals, including strong acids or bases; flames, including welding sparks; temperatures in excess of 160 degrees F.; and any other potentially damaging physical or environmental conditions.

#### B. Wire Backing Support:

1. Woven Wire Mesh:
  - a. Mesh Size: 4x4 - W1.4 x W1.4 minimum.
  - b. Wire Size: 14 gauge minimum.
  - c. Coated in accordance with ASTM A116, Class 3.
2. Chain Link Fence Fabric:
  - a. Wire Size: 9 gauge minimum.

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- b. Coated in accordance with ASTM A392, Class 2 or ASTM A 491.
3. Hog Wire:
- a. Opening Size: 6 inches x 6 inches.
  - b. Galvanized in accordance with ASTM A641.
- C. Posts:
- 1. Steel, T-section or L-section.
    - a. Length: 4 feet minimum.
    - b. Weight: 1.3 pounds per linear foot minimum.
    - c. Fabricated with ground anchor plate and lugs or projections for fastening wire backing support.
    - d. Factory painted with rust resistant primer and finish coat, or galvanized in accordance with ASTM A641.
  - 2. Wood:
    - a. Length: 4 feet minimum.
    - b. Diameter: 3 inches minimum or nominal cross-section of 2 inches by 4 inches for pine, 2 inches by 2 inches for hardwoods.
- D. Fasteners:
- 1. For attachment of wire backing support to posts:
    - a. Steel Posts: T-clips or ring wire fasteners, galvanized in accordance with ASTM A641.
    - b. Wood Posts: Staples with a minimum 3/4 inch wide crown and 1/2 inch long legs, galvanized as above.
    - c. Tie-wire may be used with either steel or wooden posts.
  - 2. For attachment of geotextile filter fabric to wire backing support:
    - a. Fabric ties recommended by geotextile fabric manufacturer.
    - b. Hog rings, galvanized in accordance with ASTM A641.

- c. Nylon cord may be used to attach filter fabric to top of wire backing.

**2.2 STABILIZED CONSTRUCTION ENTRANCE**

- A. Filter Fabric: Shall meet requirements specified in Paragraph 2.1.A. above. Physical properties shall meet those listed for "Stabilization/Reinforcement" application.
- B. Crushed Stone or Rock:
  - 1. Hard, clean, stone. Concrete rubble may be used provided it is free of reinforcing materials.
  - 2. Diameter: 3 to 5 inches, gradation per ASTM C136.
- C. Wash Rack (optional): If required, see Reference No. 4 (TxDOT) in Paragraph 1.2B. for specified materials.

**2.3 ROCK BERM**

- A. Rock: Shall meet requirements stated in Paragraph 2.2B. above with the following additions and exceptions:
  - 1. Angularity: Maximum length to width ratio of 3:1.
  - 2. Diameter: 4 to 8 inches if rock berm is to be placed in a flowing streambed. 3 to 5 inches for all other locations.
- B. Woven Wire Sheathing:
  - 1. Wire Size: 20 gauge minimum.
  - 2. Opening Size: 1 inch maximum.
  - 3. Galvanized in accordance with ASTM A641. PVC coating also allowable upon

**2.4 STONE DITCH CHECK**

- A. Well-graded crushed Stone, Rock or Recycled Material:
  - 1. Clean, hard, crushed stone or rock.
  - 2. Recycled, crushed concrete rubble may be used only if free of reinforcing steel, debris, cement fines, and other substances that may contribute to storm water pollution.
  - 3. Stone, Rock or Recycled Concrete: Diameter shall range from 1-1/2 inches through a maximum in inches equal to three times the width of the drainage channel bottom in feet.
  - 4. Diameter: 2 inches by 2 inches minimum for hardwood. Larger cross-sectional dimensions required if pine is used.

**2.5 PIPE INLET PROTECTION**

- A. Crushed Stone, Rock or Recycled Material:
  - 1. Clean, hard, crushed stone or rock.
  - 2. Recycled, crushed concrete rubble may be used only if free of reinforcing steel, debris, cement fines and other substances that could contribute to storm water pollution.
  - 3. Stone Riprap: Diameter shall be nominal 6 inches.
  - 4. Filter Stone: Diameter shall be 1-1 /2 or 2 inches.

**2.6 INLET PROTECTION**

- A. Provide inlet protection in accordance with NCTCOG - "Storm Water Quality Best Management Practices for Construction Activities". Four variations of applications for inlet protection are listed including Filter Barrier Protection, Block and Gravel Protection, Wire Mesh and Gravel Protection, and Excavated Impoundment Protection shown on S-4 in Specification Section M, with Detail ID 2120-2150. Inlet protection improperly used on a slope will cause inlet to be bypassed, forcing flows to continue the slope, and overloading inlets below. Provide protection inlets on slopes by means shown in SWP3; typically provide BMPs upstream of inlets.

**2.7 EROSION CONTROL MATTING**

- A. Jute Mats:
  - 1. Jute mats shall be composed of a woven jute yarn, free of any dyes.
  - 2. Unit weight: Minimum 2.7 pounds per square yard per ASTM D3776.
- B. Fiber Mats:
  - 1. Fiber mats shall be composed of wood or coconut husk (coir) fibers and may be encased in netting made of nylon, cotton, or other suitable materials.
  - 2. Unit weight: Minimum 1.2 pounds per square yard per ASTM D3776.
  - 3. Tensile strength: Minimum 40 pounds per ASTM D4632.

- 4. Elongation: Maximum 35 percent per ASTM D4632.

C. Synthetic Mats:

- 1. Synthetic mats shall be made of non-woven polyvinyl chloride or polypropylene monofilaments that are bonded together into a three-dimensional web-like material designed to serve as an erosion control and revegetation mat.
- 2. Porosity: Minimum 85 percent.
- 3. Unit weight: Minimum 11 ounces per square yard per ASTM D3776.
- 4. Tensile strength: Minimum 25 pounds in all directions, as measured by ASTM D5735.

D. Staples: For use in anchoring down matting material.

- 1. Size: Minimum 10 gauge wire.
- 2. Length: 6 to 10 inches.
- 3. Shall be galvanized or zinc coated to inhibit corrosion.

**2.8 TEMPORARY SEEDING**

Temporary Seed Mix: Avena spp (oats) at 20 lbs./acre (no mulch required) or as otherwise specified within the Project Technical Specifications.

**PART 3 - EXECUTION**

**3.1 PRE-CONSTRUCTION INSPECTION**

- A. Prior to the commencement of any on-site activities, the Contractor shall schedule and conduct a pre-construction inspection.
- B. In conjunction with the Contracting Officer's Representative and the Authority's Environmental Compliance Section, conduct a pre-construction inspection of existing facilities, structures, and environmentally sensitive areas in the vicinity of the Worksite. This inspection shall document the pre-construction condition of vegetation, streets, creeks, storm drainage, etc, that may be affected by the project. Document the inspection with photographs, sketches, and narratives and assemble into a pre-construction inspection report. Photographic documentation shall include vegetation densities. Photographs shall comply with Section 01345, "Construction Photographs".
- C. The pre-construction inspection shall include the MS4 located within and adjacent to the Worksite. Note: The purpose of this inspection is to



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document pre-existing drainage issues/problems that could later result in a fine or penalty being awarded by the Jurisdictional Entity. Contractor shall note the following:

1. Storm drains, culverts, swales and other components of the MS4 shall be inspected to verify that they are free of floatable trash, silt, debris, and functioning as originally intended.
2. Storm drains or culverts that do not function or appear not to function as originally intended.
3. Siltation of culverts, concrete swales, and other components of the MS4.
4. The presence of construction on adjacent, up-gradient, or down-gradient properties. If construction on other properties is noted, the Contractor shall photographically document the general condition of these properties and their compliance with storm water regulations.
5. Pre-existing off-site tracking from the Worksite or surrounding properties.
6. Potential pre-existing contamination (i.e. any areas of soil discoloration or distressed vegetation).
7. Any other pre-existing condition that, by its nature, could be construed as a violation of the CGP.

### 3.2 BMPs (STRUCTURAL CONTROL MEASURES)

- A. Examine the site conditions in areas where soil erosion and sediment structural control measures are to be installed. BMPs, as defined in the SWP3, shall be implemented prior to the commencement of any soil disturbing activity. Correct unsatisfactory site conditions as necessary to install BMPs.
- B. The CGP requires sediment basins at common drainage locations, where feasible, serving areas with 10 or more acres disturbed at one time within a common drainage basin. Contractor shall install sediment basins as required by the CGP or note site conditions that make basin construction infeasible.
- C. The installation of stabilized construction entrances may require minor grading and site preparation. If a wash rack is also required, it shall be installed in accordance

with the provisions stated in TxDOT *Storm Water Management Guidelines for Construction Activities*.

- D. Manufactured erosion and sediment control products such as straw wattles, check dams, and a variety of storm sewer inlet protection devices, are now commercially available. In the event Contractor chooses an "off-the-shelf" product, it shall be responsible for ensuring that it adequately protects the quality of storm water discharged from the site.
- E. Inlet protection devices shall incorporate an overflow weir in their design and installation. Note: Erosion bales (straw or hay bales) shall not be used as a structural control measure for inlet protection.

### 3.3 STABILIZATION PRACTICES

- A. Undertake temporary or permanent stabilization practices in order to maintain cover over site soils or to establish cover as soon as practicable in disturbed areas. In meeting this requirement, the Contractor shall minimize the amount of existing vegetated area that is disturbed or denuded, especially those areas outside the immediate zone of construction activity. Prior to its disturbance, the Contractor shall document existing vegetation cover through photography or video.
- B. Complete stabilization practices, including temporary or permanent seeding, mulching, hydro-mulching, sodding, and other practices shown in the SWP3 or otherwise on the plans, as stated in Section 02931, "Seeding and Sodding - Non-Irrigated Areas". Seed/grass shall be watered as necessary for germination.
- C. As required under the CGP, erosion control and stabilization measures shall be initiated immediately in portions of the site where construction activities have temporarily ceased and will not resume for a period exceeding 14 calendar days. Stabilization measures that provide a protective cover shall be initiated immediately in portions of the site where construction activities have permanently ceased. TCEQ defines "immediately" to be "... as soon as practicable, but no later than the end of the next work day, following the day when the earth-disturbing activities temporarily or permanently ceased." Stabilization measures shall be completed within the timeframe required by the CGP.
- D. Close-out and final acceptance: Close-out of the project shall not be accepted by the Authority until the requirements of the CGP and applicable Jurisdictional Entities have been fulfilled.

### 3.4 PROTECTION AND MAINTENANCE

- A. In addition to the specific protection and procedures stated or referenced in the Baseline SWP3, the following provisions shall apply:
  1. Contractor shall only allow those off-site discharges specifically identified in the CGP.

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2. Once installed, BMPs shall be repaired or replaced at the expense of the Contractor and shall function as necessary to protect the quality of storm water discharged from the site.
  3. Locations on the site adjacent to surface waterways, wetlands, or other environmentally sensitive areas, or off-site areas subject to vehicle tracking of sediments, shall receive the highest maintenance priority, followed by the protection of drainageways and storm sewer inlets and outfalls.
  4. Stockpiles used for the temporary storage of topsoil, fill soil, rock, or related construction materials shall be protected by perimeter BMPs and/or covered to prevent exposure to storm water. Temporary seeding of stockpiles may also be acceptable. Stockpiles include materials located off-site which may be maintained for the project. Excess spoil and other materials shall be promptly removed from the site.
  5. Fugitive dust, including dust generated from soil stabilization operations or vehicle tracking, shall be controlled at all times by using water or special purpose products commercially manufactured for this use. If water is used to control dust generation, any excess or runoff must first be routed to a sediment trapping device before being allowed to leave the site. See Section 01560, "Environmental Protection" for more information on dust control requirements.
  6. Contractor shall implement appropriate BMPs as necessary to minimize offsite tracking of soil, sediment, and debris. BMPs may include construction entrance stabilization measures, frequent adjacent street cleaning, and vehicle and equipment wash rack areas. Additional or alternate BMPs may be necessary to control the generation of fugitive dust related to off-site tracking. Contractor is responsible for clean up of any eroded or tracked sediment from streets, storm sewers and adjacent properties at no expense to the Authority.
  7. Construction staging areas, haul roads, jobsite office trailer locations, and vehicle and equipment parking areas that have more than 25 vehicle trips per day shall be graveled, as well as monitored for vehicle tracking and fugitive dust generation.
  8. During project construction, Contractor shall clean out, remove, and properly disposal of any sediment deposits or debris which may accumulate in the storm sewer inlets, manholes or in other areas of the site storm sewer system up to the point of system outfall or connection with the MS4.
- ### 3.5 INSPECTION REQUIREMENTS
- A. Contractor shall conduct inspections at least once every 7 days. The inspection shall occur on a specifically defined day. Contractor shall comply with any revision in inspection frequency required by applicable Jurisdictional Entities at no additional cost to the Authority.
  - B. Inspections shall include disturbed areas of the site, stockpiles and material storage locations, areas where temporary and permanent soil stabilization practices have been implemented, BMPs, and storm water discharge locations.
  - C. The ECM shall be responsible for overseeing and documenting the results of each inspection. Refer to Paragraph 1.4.D entitled "Environmental Compliance Manager" for inspection report requirements.
  - D. Contractor shall provide, install, maintain, and monitor a rain gauge approved by the Contracting Officer's Representative. Said rain gauge shall be located where it will collect a representative amount of rainfall received by the site.
  - E. Contractor shall immediately address any deficiencies in implementation and adherence to the provisions of the CGP and SWP3 as determined during site inspections. BMPs shall be repaired as required by the CGP. Alternative BMPs shall be implemented when, as determined by the ECM, a particular control measure has failed repeatedly or become ineffective in protecting the quality of storm water discharged from the site.
  - F. Periodic site audits, performed by the Authority, do not relieve the Contractor of the responsibility to perform regular inspection and maintenance activities for the BMPs employed on the site. The Authority's audits also do not relieve the Contractor of the duty to comply with the terms and conditions of the SWP3, the CGP, the Municipal Storm Water Discharge Permit of the Jurisdictional Entity, or any other local erosion and sediment control or storm water management regulations or ordinances.
- ## PART 4 - MEASUREMENT AND PAYMENT
- ### 4.1 GENERAL
- A. BMPs, soil erosion and sediment structural control measures and stabilization practices required under this section shall be measured, and paid at the lump sum for "Soil Erosion and Sediment Control" as installed in accordance with the relevant detail drawing and

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accompanying notes shown in the plan, and shall include maintenance through the period of the work, and removal and proper disposal of surplus material at the completion of construction and final stabilization of the site, or as required by the Contracting Officer.

make appropriate modifications to the SWP3 and site BMPs, as necessary. Changes to either the SWP3 or site BMPs resulting from changes to the work shall be considered incidental to the Contract.

- B. Rock Filter Dams. Rock filter dams shall be measured by the linear foot along the centerline of the top of the dam.
- C. Pipe Inlet Protection shall be measured by the cubic yard.
- D. Inlet Protection shall be measured by the each.
- E. Construction Exits shall be measured by the square yard of surface area.
- F. Temporary Sediment-Control Fence shall be measured by the linear foot.
- G. Erosion Control Matting. Erosion control matting will be measured by the square yard of surface area
- H. No separate measurement or payment shall be made for the relocation or maintenance of structural control measures for the Contractor's convenience or due to intermediate stages in the construction sequence.
- I. No separate measurement or payment will be made for alternate BMPs installed when BMPs prove ineffective.
- J. Temporary seeding and associated maintenance, if required, shall not be separately measured and shall be considered as incidental to the Contract, except as otherwise specified. Permanent seeding shall be paid as outlined under Section 02930, "Seeding and Sodding - Irrigated Areas", or Section 02931, "Seeding and Sodding - Non-Irrigated Areas", as applicable.
- K. There shall be no separate measurement for payment under this Section for the installation, protection, or maintenance of BMPs, or for performing final stabilization, at off-site locations where materials or equipment are stored for this project.

### 4.2 CHANGES IN PROJECT SCOPE

- A. Refer to General Provisions Paragraph, "Changes". In the event the Authority makes changes to the work such that additional BMPs are required or specific BMPs are rendered unnecessary, the Contractor shall

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**TABLE 01562-1**

Physical Properties	Temporary Silt Fence	APPLICATION Stabilization/ Reinforcement	Erosion Protectio n*
1) Grab Tensile Strength, ASTM D4632, tbs.			
(a) Principal Direction	125	350	350
(b) Cross Direction	105	n/a	n/a
2) Grab Tensile Elongation, ASTM D4632, percent	50	20	20 max
3) Sewn Seam Strength, ASTM D4632, lbs.	n/a	285	285
4) Trapezoidal Tear Strength, ASTM D4533, lbs.	n/a	150	150
5) Puncture Strength, ASTM D4833, lbs.	n/a	185	185
6) Mullen Burst Strength, ASTM D3786, lbs.	n/a	620	620
7) Permittivity, ASTM D4491, 1/sec.	0.05	0.02	0.2
8) Apparent Opening Size, ASTM D4751,	30	70	70
9) U.S. Standard Sieve Size No Ultraviolet Stability, ASTM D4355, percent	70	50	50
10) Weight, oz/sq yd	3-7	12	12
11) Thickness, mils	50	120	120

\*Note: Erosion protection here refers to use in permanent erosion control applications; for example, as an underlayment for riprap.

END OF SECTION 01562

TABLE 01562-1

Physical Properties	APPLICATION		
	Temporary Silt Fence	Stabilization/ Reinforcement	Erosion Protection*
1) Grab Tensile Strength, ASTM D4632, lbs.			
(a) Principal Direction	125	350	350
(b) Cross Direction	105	n/a	n/a
2) Grab Tensile Elongation, ASTM D4632, percent	50	20	20 max
3) Sewn Seam Strength, ASTM D4632, lbs.	n/a	285	285
4) Trapezoidal Tear Strength, ASTM D4533, lbs.	n/a	190	150
5) Puncture Strength, ASTM D4833, lbs.	n/a	185	185
6) Mullen Burst Strength, ASTM D3786, lbs.	n/a	620	620
7) Permittivity, ASTM D4491, 1/sec.	0.05	0.02	0.2
8) Apparent Opening Size, ASTM D4751, U.S. Standard Sieve Size No	30	70	70
9) Ultraviolet Stability, ASTM D4355, percent	70	50	50
10) Weight, oz/sq yd	3-7	12	12
11) Thickness, mils	50	120	120

\*Note: Erosion protection here refers to use in permanent erosion control applications; for example, as an underlayment for riprap.

END OF SECTION 01562

**SECTION 01570  
MAINTENANCE AND CONTROL OF TRAFFIC**

**PART 1 - GENERAL**

Coordinate this submittal with those required in other sections of Specifications.

**1.1 DESCRIPTION**

- A. This Section includes specifications for maintaining an orderly flow of vehicular and pedestrian traffic through and around the areas affected by the Contractor's construction activity and protecting the public from incurring injury or property damage as a result of the Contract's construction operations.
- B. For any occasion or event requiring special traffic control measures, the Contracting Officer will notify the Contractor in advance and the Contractor shall promptly comply and adopt necessary measures to ensure safe movement of vehicular and pedestrian traffic through work areas.
- C. Details not shown on the Contract Documents and the approved Traffic Control Plans shall conform to the Texas Manual on Uniform Traffic Control Devices and the regulations of the jurisdictional authority.
- D. Coordinate the Work in this Contract requiring traffic maintenance with traffic control procedures, requirements, and conditions for other contracts listed in the Contract Documents and as directed by the Contracting Officer.
- E. Temporary decking over excavated areas is specified in Section 01533, "Temporary Decking".

- 3. Details of nonstandard signs, including size of sign, letter size, type, and message.
- 4. Arrangements for access to buildings within and immediately adjacent to the construction site.
- 5. Arrangements for emergency exiting from buildings within and immediately adjacent to the construction site.
- 6. Anticipated traffic, bus zone, and driveway blockage resulting from construction operations. Include the anticipated loss of bus, passenger, and truck loading zones.
- 7. Locations where on-street parking will be permitted within the immediate vicinity of the site.
- 8. Arrangements for temporary passenger and commercial loading and unloading zones, and temporary bus stop zones, where existing zones will be blocked by construction activity.
- 9. Routing and projected volume of construction trucks.
- 10. Areas for material delivery and Contractor's staging areas access and egress points.
- 11. Locations of historic properties.

**1.2 REFERENCE STANDARDS**

- A. Texas Manual on Uniform Traffic Control Devices (TMUTCD).
- B. US Department of Transportation, Federal Highway Administration (FHWA), Standard Alphabets for Highway Signs and Pavement Markings.

- B. Draw the Traffic Control Plan to a scale of one inch equals 40 feet, and details in a larger scale, as necessary for clear understanding.
- C. Submit with the Traffic Control Plan a list of telephone numbers and contact persons for those departments of the jurisdictional authority and others who shall be notified three days prior to scheduled street closure and as soon as possible prior to emergency access closure. Refer to Article entitled "Notifications" herein for more information.

**1.3 TRAFFIC CONTROL PLAN**

- A. The Vehicular and Pedestrian Traffic Control Plan or Plans (referred to herein as Traffic Control Plan) shall include the following information. Submit multiple plans as required to depict traffic control throughout each stage of construction. Refer to Article entitled "Submittals" herein for submittal requirements.
  - 1. Vehicular including bicycles and pedestrian traffic routing, including detours.
  - 2. Proposed location of barricades, lighting, signage, pavement markings, markers, signals, and other traffic control devices.

- D. If the Contract Drawings include suggested Construction Sequencing/Temporary Traffic Control Plans, the following provisions apply:
  - 1. Upon review and acceptance by the Contractor, Contractor may use any suggested Construction Sequencing/Temporary Traffic Control Plans included in the Contract Drawings in obtaining the necessary approvals and permits from the jurisdictional authority.

## MAINTENANCE AND CONTROL OF TRAFFIC

2. If the Contractor desires to carry out construction activities differently than as designated in the Contract Drawings, he shall either submit copies of the appropriate Construction Sequencing/ Temporary Traffic Control Plan drawings from the Contract Drawings, showing on the drawings, any modifications he wishes to incorporate; or submit new drawings, showing alternate plans for sequencing construction activities and handling traffic, in accordance with the Traffic Control Plan submittal requirements described herein.

### 1.4 SUBMITTALS

- A. Submit the proposed Traffic Control Plans described herein to the jurisdictional authority and Contracting Officer.
- B. Schedule submittals of Traffic Control Plans which include the following closures or changes to traffic patterns sufficiently in advance of and obtain approval from the appropriate jurisdictional agency at least 30 calendar days prior to the time such closures and changes are scheduled to be made.
  1. Any full closure of a street proposed to be closed to all but construction activity and emergency traffic.
  2. Partial street closures for an extended period of time. "Extended period of time" is defined as overnight, weekends, holidays, or periods of inclement weather.
  3. Temporary closing to traffic of part of any street, sidewalk or other access, or other changes to traffic patterns
- C. Do not cause traffic, sidewalk, or bus zone disruptions before receiving approval of the Traffic Control Plan from the Contracting Officer, and applicable jurisdictional authorities.
- D. Submit notice of intent to permanently close existing street to the jurisdictional authority, with copy to Contracting Officer, a minimum of 30 days in advance of each closing. Refer to Article entitled "Notifications" herein for detailed requirements.

### 1.5 GENERAL MAINTENANCE OF TRAFFIC REQUIREMENTS

- A. Keep the areas adjacent to the construction site in such condition that traffic will be accommodated safely. Provide and maintain traffic control devices and services both inside and outside the project limits as needed to facilitate traffic guidance. Traffic control devices and services shall conform

to the requirements set forth in the Contract Documents and in the TMUTCD.

- B. Traffic Control Devices: Provide, erect, place, maintain, and adjust traffic control devices necessary to alert and forewarn the public of construction activities and potential hazards associated with them at all times. Do not work on or adjacent to the roadway until all necessary traffic control devices are in place.
  1. Traffic control signs: Provide temporary traffic control signs as shown in the approved Traffic Control Plans and in compliance with TMUTCD standards which are standard signs of the jurisdictional authority. Adequately post each change in location of traffic with a minimum of two signs mounted on temporary or standard posts. Provide all signage in accordance with the requirements of TMUTCD.
  2. Pavement Markings and Markers: Provide necessary temporary pavement markings and markers required in connection with temporary street work. Remove or obliterate existing or temporary pavement markings whenever vehicular traffic is moved to newly available pavement areas or to different traffic patterns.
  3. Redirecting traffic: Directing, channeling, and shifting of traffic lanes as well as barricading of traffic in connection with this work will be subject to approval of the jurisdictional authority.
- C. Replace any devices provided under this Section that are lost, stolen, destroyed, or deemed unacceptable while their use is required on the Project without additional compensation. This includes services, foundations, utilities, and similar items that are disturbed, destroyed or otherwise rendered unusable during construction.
- D. During nonworking hours and following completion of a particular construction operation, signs, except those necessary for the safety of the public, shall be removed or entirely covered with plywood sheeting or other material approved by the Contracting Officer so that the sign panel will not be visible.
- E. Keep retroreflective sheeting clean on signs, drums, barricades, and other devices. Promptly correct scratches, rips, and tears in the sheeting.

## MAINTENANCE AND CONTROL OF TRAFFIC

- F. If a vehicular or pedestrian signal within the Work area goes dark or fails to function properly, the Contractor shall:
1. Immediately call Police for any required Police control of the intersection and provide temporary flaggers until Police arrives.
  2. Immediately notify the concerned office of the jurisdictional authority. (I.e., for the City of Dallas, "concerned office" is the Maintenance Division of Department of Transportation).
  3. Immediately notify the Contracting Officer.
  4. If signal failure is a result of the Contractor's Work, the Contractor shall be responsible for all costs incurred.
- H. Traffic signal systems shall remain in operation at all times except as approved by the Contracting Officer. Obtain Contracting Officer's and jurisdictional authority's approval of temporary traffic signals prior to use of temporary traffic signals. Temporary signals shall be in compliance with Section 02590, "Traffic Signals".
- I. Maintain existing street lighting wherever possible. Obtain approval from the local jurisdictional authority prior to disconnecting or relocating existing street lighting. If relocating existing street lighting is required or proposed to accommodate proposed construction, coordinate work with the Contracting Officer and jurisdictional authority to the satisfaction of both. Illuminate areas where street lighting is cut off by equipment, barriers, and similar obstructions.

### 1.6 TRAFFIC CONTROL SYSTEM REQUIREMENTS

- A. Schedule operations to minimize potential traffic backups. The Contracting Officer may suspend the performance of the work, either in whole or in part, should an inordinate traffic delay occur during a construction operation.
- B. Maintain vehicular traffic at all locations to the greatest extent possible and reduce and reroute traffic only for the shortest time possible consistent with effective construction operations.
- C. The required travel lanes shall not be blocked by the Contractor's activities, including trucks delivering materials.
- D. Maintain the existing directional operation of the street system at all times, unless specially designated otherwise in the Contract Documents.
- E. Make provisions to minimize disruptions to adjacent properties including construct of temporary facilities to allow business functions to be maintained.
- F. Temporary Street Closure Restrictions: No more than one complete street closure will be allowed at any particular time. Show proposed temporary closing to traffic of part of any street, sidewalk or other access, and other traffic pattern changes on the Traffic Control Plan.
- G. Material Delivery Areas and Staging Area Access and Egress: Material deliveries and other related trucking activities shall occur in the Contractor's protected work area. Refer to Section 01500, "Temporary Facilities and Services", for provisions regarding staging areas. Material delivery areas and access and egress points of staging area are subject to the approval of the Contracting Officer. Coordinate access and egress with the Contracting Officer.
- J. Work in or near Airports: Equipment type and heights, sign heights, hours of construction and sequencing, illumination and signal work in or near airports shall meet clearance and lighting restrictions of the Federal Aviation Administration and airport owner.
- K. Illuminate nighttime construction operations by use of a lighting system approved by the Contracting Officer and approved by the jurisdictional authority, if applicable. Position and operate the nighttime system to preclude glare to the approaching traveling public. Refer to Section 01010, "Summary of the Work", for work hour provisions.
- L. Flaggers: Provide flaggers where required by approved Traffic Control Plan. When necessary, provide flaggers for controlling movement of equipment and materials to the worksite.
1. Flaggers shall be physically and mentally qualified, trained in their duties, efficient, and courteous, as outlined in the TMUTCD. Identify each flagger on duty with appropriate and distinctive apparel, including orange retroreflective vest and hat. Equip each flagger on duty with a highly visible, retroreflective "Stop/Slow" hand sign conforming to TMUTCD. Flags will not be permitted unless approved by the Contracting Officer. Flaggers shall be fluent in English so that verbal instructions to motorists may be provided.
  2. Provide approved equipment for two-way radio communications between flaggers when they are not in plain view of each other, and make such equipment available



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to the Contracting Officer for use as may be necessary.

M. Traffic Pattern Changes: Prior to changing traffic patterns, provide the following:

1. Adequate personnel and equipment to remove and set up traffic control devices as approved by the Contracting Officer.
2. Acceptable two-way radio communications network other than citizen band units.
3. Remove paving equipment and related equipment from the travel lane.

N. Use Type A flashing warning lights only on "ROAD CONSTRUCTION AHEAD" signs, on barricades and drums (used singly), and on the first two barrier units or drums used in a series for delineation. Mount Type C steady burn warning lights on channelizing devices and use them in a series for delineation (except that the first two devices shall have Type A warning lights).

O. Deviations from Approved Traffic Control Plans: Deviations from approved Traffic Control Plans will be allowed for bona fide emergencies only and as approved by the jurisdictional authority and Contracting Officer.

### 1.7 MAINTENANCE OF ACCESS AND EGRESS

A. Maintain vehicular and pedestrian access to residences, businesses (including public buildings), and properties at all times. Where construction activities will require the temporary closures of building entrances, arrange access with the affected residents and establishments.

B. Maintain emergency access to and from buildings within and immediately adjacent to the construction site.

C. Maintain local access for emergency traffic such as police, fire, medical, and disaster units at all times. Maintain an emergency response route at all times which includes the following:

1. A 25 foot inside and 45 foot outside turn radius for Fire Department vehicles.
2. Provisions for emergency vehicles traveling two ways in any lane. Such provisions include:
  - a. Maintenance of a non-skid surface on steel plates on the roadway and on steel plates on both sides of cross-street approaches.

b. No stacking of steel plates.

c. Maintenance of smooth transitions between steel plates and the roadway surface.

d. Secure steel plates in position and re-secure immediately if steel plates become dislodged.

3. Provide smooth transitions between permanent paving, temporary decking, and temporary pavement to reduce jolts and bumps within the construction zone.

D. Maintain pedestrian movements through the construction areas as follows:

1. Unless noted otherwise, a minimum of three pedestrian crosswalks at each intersection at all times.

2. No residence or business shall be denied pedestrian access at any time (without owner's consent). Structures with multiple points of access (especially those with access from adjacent streets) may be subjected to restricted access with the prior written consent of the property owner (or building management if so empowered).

3. In areas where the removal of existing sidewalks is necessary, maintain access to adjacent businesses, entrances, and properties by temporary level or sloped walkways having a width of not less than 6 feet.

4. Include provisions for the safe movement of mobility and sight-impaired individuals, including temporary ramps.

5. Construct temporary walking surfaces of non-skid materials.

6. Provide fencing or similar confining barrier to prevent errant pedestrian entry into work areas, restricted areas, and vehicular traveled way.

### 1.8 SEQUENCING

A. Upon completion of a segment of work in the streets, restore traffic to a normal flow as soon as possible. The impact of work activities at intersections shall be kept to a minimum and restoration of cross-street traffic flow at intersections shall be a priority item.

B. Contractor's surface operations: Schedule surface operations so as not to be working intermittently

throughout the area. Carefully schedule excavation or construction activities and vigorously pursue to completion as required to permit opening of street areas to traffic as soon as possible without unnecessary delays.

- C. Pavement Reconstruction: Excavate and construct intersections in stages as shown on approved Traffic Control Plan. Phase construction so that the required number of traffic lanes on each street are provided at all times during these operations.

## 1.9 NOTIFICATIONS

### A. Coordination Notifications:

1. Notify the Authority and adjacent property owners and business establishments a minimum of 3 working days prior to work which will disrupt normal traffic and pedestrian flow patterns in their immediate areas.
2. Refer to Section 01010, "Summary of Work" for work sequence and constraints as supplementary requirements.

### B. Street Closures Notifications:

1. Permanent Closures: Authorization for permanent closure of streets indicated on the Contract Drawings will be obtained by the Agency in the process of final plan approval by the jurisdictional authority and related Governmental action. However, the Contractor shall submit separate notifications of intent to physically close each of these streets as specified under the Article entitled "Submittals," herein.
2. Temporary Closures: Three (3) working days prior to any street closure, partial street closure, or, as soon as known, for temporary emergency access closure, notify the jurisdictional authority's applicable departments such as transportation, traffic, fire, police, sanitation, and ambulance service (if notification separate from fire department is required) and DART bus operations. Contract Specifications will list applicable departments and telephone numbers. Verify telephone numbers and determine the appropriate contact person for each department and include this information with its Traffic Control Plan submittal. Contact DART bus operations at (214) 828-6838.

## PART 2 - PRODUCTS

### 2.1 TRAFFIC CONTROL DEVICES

- A. Traffic control devices shall conform to the requirements set forth herein and as indicated elsewhere in the Contract Documents. Details not covered by the Contract Documents shall conform to the applicable provisions of the TMUTCD.
- B. Retroreflective Material: Sign panels, barricades, cones, drums, vertical panels, and flagger paddles shall have retroreflective sheeting meeting the minimum requirements for Type C retroreflective material, as described in TMUTCD.
- C. Sign Panels: Construction warning sign panels shall be orange with black legend unless otherwise indicated in the TMUTCD. Regulatory signs used during construction operations shall be fabricated in the colors specified in the TMUTCD.
  1. Sign panels: Fabricate sign panels from 0.75-inch thick plywood or other material acceptable to the Contracting Officer with retroreflective sheeting on the face side. Panels shall be true, square, and free from warping, bending, blemishes, and punching. Drill holes prior to final surface preparation and application of retroreflective sheeting.
  2. Sign Legends: Text on temporary traffic control signs shall be 4 inches series D or larger, as specified in FHWA Standard Alphabets for Highway Signs and Pavement Markings.
- D. Sign Posts: Fabricate sign posts from untreated soft wood, or other materials acceptable to the Contracting Officer.
- E. Barricades: Construct Type II and III barricades of wood or plastic. The Type II barricades shall collapse when tipped over. Barricade markings shall conform to TMUTCD.
- F. Cones: Cones shall be a minimum of 18 inches in height with a broadened base and shall be capable of withstanding impact without damage to the cones or vehicles. Cones shall be orange colored and highly visible both in daylight and darkness. Cones shall be capable of remaining upright during normal traffic flow and wind conditions in the area where they are used. Retroreflection requirements shall be in accordance with TMUTCD.
- G. Vertical Panels: Construct vertical panels of wood or other material acceptable to the Contracting Officer.

## MAINTENANCE AND CONTROL OF TRAFFIC

- H. Drums: Drums shall be plastic and shall be approximately 36 inches in height and have a minimum diameter of 18 inches. Drum markings shall conform to TMUTCD.
  - I. Temporary Guardrail: Temporary guardrail shall conform to TMUTCD . Used guardrail material will be permitted, subject to the approval of the Contracting Officer.
  - J. Temporary Concrete Barriers: Temporary concrete barriers shall conform to the requirements of TMUTCD. The barrier shall have white or yellow reflector units as applicable, approximately 1 inch by 3 inches in size, firmly mounted to the top of each barrier, at ten-foot centers.
  - K. Warning Lights (flashing or steady burn): Warning lights shall be Type A (low intensity flashing) or Type C (steady burn), as specified in the plans and meeting the requirements of the TMUTCD .
  - L. Provide temporary pavement markings and markers in conformance with Section 02580, "Pavement Markings and Delineators".
  - M. Provide the temporary pavement composition and patching and related aggregate base conforming to the requirements of the jurisdictional authority.
- D. Equipment Storage: During non-work hours, park equipment either in the staging areas, or at least 30 feet from the edge of lanes open to the public. Where due to land features or right-of-way, it is not feasible to meet these restrictions, and work is expected to resume within 24 hours, park equipment (except rubber-tire equipment) a minimum of 10 feet from the edge of open lanes, as approved by the Contracting Officer. Place three or four Type II barricades, with Type A warning lights, on the pavement side of the equipment. Park rubber-tire equipment a minimum of 30 feet from traffic lanes open to the public or store at approved staging areas.
  - E. Temporary pavement and patching: Construct, maintain and remove temporary pavement, patching, and aggregate bases required to safely and expeditiously handle vehicular and pedestrian traffic within or adjacent to the Worksite.
  - F. Upon completion of the Work, unless directed otherwise, remove temporary construction and installations specified in this Section, clean up, and restore area. Include restoration of facilities to their original condition or better.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Execute Traffic Control Plans and comply with other traffic maintenance requirements as specified herein.
- B. Prior to the start of construction operations, install pavement markings and markers and erect signs, barricades, and other traffic control devices as required by the Contract Documents and approved Traffic Control Plans. Operate traffic control devices only when they are needed, and only those devices that apply to conditions actually in existence shall be used. Cover existing signs to the satisfaction of the Contracting Officer, whether signs are permanent or temporary, that conflict with the traffic operations proposed for the current stage of construction. Uncover signs as soon as traffic conditions warrant their use.
- C. Remove existing pavement markings which conflict with proposed pavement markings for a particular phase of construction. Perform removal by sand blasting or other approved method that does not materially damage the surface or texture of the pavement. Make the removal pattern in an uneven shape that does not perpetuate the outline of the removed markings. Repair damage to the surface at the Contractor's expense using

### PART 4 - MEASUREMENT AND PAYMENT

#### 4.1 GENERAL

- A. The work described in this Section will be paid for on a lump sum basis for "Maintenance and Control of Traffic" wherein no measurement will be made.
- B. Warning devices, flaggers, signs and lights, barricades, and other precautionary measures in regard to installation of temporary decking, water distribution systems, storm sewer systems, sanitary sewer systems, and traffic signal systems will be considered included in lump sum and unit prices paid for temporary decking and the respective utility system.
- C. Temporary pavement markings and temporary reflectorized traffic buttons will not be paid for separately, but will be considered subsidiary to the work of this Section.
- D. Asphaltic concrete pavement and aggregate bases for temporary pavement will not be measured for payment, but will be considered subsidiary to work of this Section.

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- E. Temporary decking specified under Section 01533, "Temporary Decking", required for maintenance of traffic will be paid for under Section 01533, "Temporary Decking".
- F. Temporary traffic signals will be paid for in accordance with Section 02590, "Traffic Signals".

END OF SECTION 01570

**SECTION 01580  
PROJECT SIGNS**

The provisions of the DART Standard Specification Section 01580, "PROJECT SIGNS", shall apply to the Work as modified herein.

**PART 1 - GENERAL**

**1.1. DESCRIPTION:** Add Paragraph D:

- D. Contractor shall display NOI information, in addition to the standard documents to be displayed on the project sign.

**END OF SECTION 01580**

**SECTION 01580  
PROJECT SIGNS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Work specified in this section includes providing, displaying, and subsequently removing project signs; and supplements the Addendum to General Provisions Paragraph, "PROJECT SIGNS".
  - 1. Project signs displayed at the Worksite shall be as specified herein and shown on the Contract Drawings and as directed by the Contracting Officer.
- B. Maintain the project signs and supports, keep clean, repair deterioration and damage throughout the duration of the Contract.
- C. The following shall not be displayed at the Worksite:
  - 1. Separate Contractor's, subcontractor's, or supplier's signs or advertisements.
  - 2. Signs which flash, blink, rotate, or otherwise draw unusual attention, except where required by safety regulations.

**1.2 SUBMITTALS**

- A. Submit shop drawings showing size of sign, complete layout, lettering and size, and colors.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Project signs shall be fabricated from the following materials:
  - 1. Plywood face: High-density overlay type, with overlay each side, 3/4 inch nominal plywood thickness.
  - 2. Paint: Exterior, gloss, alkyd enamel. Provide two coats on sign faces, backs, and edges, and one coat on posts.
  - 3. Wood posts: Douglas fir, S4S, nominal four inches by four inches, length as required. Paint the entire post. Provide posts in sizes and depths of embedment as specified.
  - 4. Sign may be mounted otherwise if approved by the Contracting Officer.

- B. Lettering shall conform to the following requirements:

- 1. Type: Lettering shall be of the "Futura" typeface (refer to the Contract Drawings for requirements).
- 2. Letter size: Proportioned as shown in the Contract Drawings.
- 3. Colors: As indicated in the Contract Drawings and approved.
- 4. Symbols: Use only those symbols shown in the Contract Drawings.

**2.2 FABRICATION AND INSTALLATION**

- A. Sign panel: Cuts and edges shall be square, clean, with defects patched before painting.
- B. Image: Symbol or type may be screened or hand painted. No screen patterning, paint build-up, bleed-thru, or drips and runs will be allowed. Hand-made patterns must be carefully cut and true to the symbols provided therein. Only clear, crisp sign painting is acceptable. Hand-painted typography shall be true to the font design.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Posts: Sign posts shall be embedded in compacted earth three feet minimum.
- B. Locate project sign at the direction of the Contracting Officer.
- C. Provide and install project signs as shown on the Contract Drawings and as directed, within 30 days after Notice to Proceed (NTP).

**3.2 REMOVAL**

- A. Remove sign, framing supports, and foundation at completion of Project and restore the area.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements".

**END OF SECTION 01580**

**SECTION 01600  
PRODUCT REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section includes administrative and procedural requirements for the selection of products for use in the Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Administrative procedures for handling requests for substitutions made after award of Contract are included in Section 01630, "Product Substitution Procedures".
- C. Procedures for receiving and installing products furnished by the Authority are included in Section 01640, "Authority-Furnished Materials and Equipment".

**1.2 DEFINITIONS**

- A. Products: Items purchased for incorporating into the work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of the date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through the submittal process, or where indicated as a product substitution to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of the specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Refer to Section 01630, "Product Substitution Procedures".

- C. Basis-of-Design Product Specification: A specific manufacturer's product named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
- D. Manufacturer's Warranty: Preprinted written warranty published by the individual manufacturer for a particular product and specifically endorsed by the manufacturer to the Authority.
- E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend the time limit provided by the manufacturer's warranty or to provide more rights for the Authority.

**1.3 QUALITY ASSURANCE**

- A. Compatibility of Options: If the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

**1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with the manufacturer's written instructions.
  - 1. Schedule delivery to minimize long-term storage at the Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to the Project site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

## PRODUCT REQUIREMENTS

5. Store products to allow for inspection and measurement of quantity or counting of units.
  6. Store materials in a manner that will not endanger Project structure.
  7. Store products that are subject to damage by the elements under cover in a weather tight enclosure above ground, with ventilation adequate to prevent condensation.
  8. Comply with the product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  9. Protect stored products from damage.
- C. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
    1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
    2. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
  - D. Submittal Time: Comply with requirements in Section 01770, "Contract Closeout".

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTIONS

- 1.5 ASBESTOS**
- A. The asbestos restrictions and documentation requirements found in TX Regulation 25 TAC 295.34(i) and (j). shall apply to work of the Contract including those areas of the work classified as public buildings and areas not classified as public buildings. The additional restriction shall apply: Asbestos containing materials or parts shall not be incorporated in the work except when there is no alternative material or part.
  - B. When use of asbestos containing material is incorporated in the work, the following documentation provision shall apply in addition to the requirements of TX Regulation 25 TAD 295.34(i) and (j): Contractor shall submit documentation, satisfactory to the Contracting Officer, showing that there is no alternative material or part.
- 1.6 PRODUCT WARRANTIES**
- A. Warranties specified in other Sections shall be in addition to, and run concurrently with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of obligations under requirements of the Contract Documents.
  - B. General Warranty: Special warranties specified in each section shall not deprive the Authority of other rights the Authority may have under other provisions of the Contract Documents and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.
- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
    1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
    2. If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
    3. The Authority reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
    4. Where products are accompanied by the term "as selected," the Contracting Officer will make the selection.
    5. Where products are accompanied by the term "match sample," the sample to be matched will be made available by the Contracting Officer'. The product match shall be subject to the approval of the Contracting Officer.
  - B. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.



## PRODUCT REQUIREMENTS

C. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and that are recommended by the manufacturer for the application indicated. Where the product is specified for a specific application, general overall performance is also required.

1. Manufacturer's recommendations may be contained in published product literature or by the manufacturer's certification of performance.

D. Compliance with Standards, Codes and Regulations: Where Specifications only require compliance with imposed code, standard or regulation, select product that complies with standards, codes or regulations specified.

E. Visual Matching Specification: Where Specifications require matching an established sample, select a product (and manufacturer) that complies with requirements and matches the Contracting Officer's sample. The Contracting Officer's decision will be final on whether a proposed product matches satisfactorily.

1. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.

F. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with the specified requirements.

1. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Contracting Officer will select the color, pattern, or texture from the manufacturer's product line that does not include premium items.
2. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, the Contracting Officer will select the color, pattern, or texture from the manufacturer's product line that includes both standard and premium items.

## 2.2 PRODUCT OPTIONS

A. For Products specified by naming a minimum of three manufacturers with brand names or model numbers, select one of products and manufacturers named, which complies with Contract Documents.

1. Requests for manufacturer's products not listed must be submitted as Substitutions.

B. For Products specified by naming only one Product or manufacturer, Contractor must submit a request for substitution for a Product or manufacturer not specifically named.

C. For Products specified by naming only one Product and manufacturer and indicated as "no substitute", there is no option.

D. For Products specified only by reference standard, select a product meeting that standard.

E. For Products specified as Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product offered by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with the provisions in the "Comparable Products" Paragraph under the Article entitled "Definitions" to obtain approval for use of an unnamed product.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION PROVISIONS

A. Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in the Contract Documents.

B. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and/or defective items.

C. Provide attachment and connection devices, and methods necessary for securing work. Secure work true to line and level. Allow for expansion and building movement.

D. Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to the Contracting Officer for final decision.

## PRODUCT REQUIREMENTS

- E. Recheck measurements and dimensions before starting each installation.
- F. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
- G. Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry, including ADA, for the particular application indicated. Refer questionable mounting height decisions to the Contracting Officer for final decision.
- H. Handle, install, connect, clean, condition and adjust products in accordance with manufacturer's instructions and in conformity with specified requirements.
  - 1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with the Contracting Officer for clarifications.
  - 2. Do not proceed with work without clear instructions.
- I. Perform work in accordance with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by the Contract Documents.
- J. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.1 GENERAL

- A. Separate measurement or payment will not be made for work required under this Section. All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

END OF SECTION 01600

**SECTION 01630**  
**PRODUCT SUBSTITUTION PROCEDURES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies administrative and procedural requirements for handling requests for substitutions made after award of the contract.

**1.2 DEFINITIONS**

- A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.
- B. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the contract are considered requests for substitutions. The following are not considered substitutions:
1. Revisions to Contract Documents requested by the Authority or the Contracting Officer.
  2. Specified options for products and construction methods included in the Contract Documents.
  3. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.
  4. Value engineering change proposals. Refer to the General Provisions Paragraph, "VALUE ENGINEERING".

**1.3 SUBMITTALS**

- A. Submit three copies of each request for product substitution complete with a properly executed form and all supporting data.
- B. Substitution Requests: Identify product or fabrication or installation method to be replaced. Include the applicable Specification Section number and title, and drawing numbers and titles.
1. Substitution Request Form: Use form provided at end of this Section.
  2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why the specified material or product cannot be provided.
    - b. Coordination information, including a list of the changes or modifications needed to other parts of the work and to the construction performed by Authority and separate contractors that will be

necessary to accommodate the proposed substitution.

- c. Detailed comparison of significant variances created by the proposed substitution with those of the work specified. Significant variances may include attributes such as performance, weight, size, durability, visual effect, or other specific features and requirements indicated.
- d. Product Data, including drawings and descriptions of products, and fabrication and installation procedures.
- e. Samples, where applicable or requested.
- f. List of similar installations for completed projects with project names and addresses and names and addresses of architects/engineers and owners.
- g. Material test reports from a qualified testing laboratory indicating and interpreting test results for compliance with requirements indicated. Refer to Section 01450, "Quality Control", for requirements for Contractor's qualified testing laboratory.
- h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
- i. Detailed comparison of Contractor's Construction Schedule using the proposed substitution with products specified for the work, including its effect on the overall contract time. If specified product or method of construction cannot be provided within the contract time, include a letter from the manufacturer, on the manufacturer's letterhead, stating the lack of availability or delays in delivery.
- j. Cost information, including a proposal for the change, if any, in the contract sum.
- k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for the applications indicated.
- l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of

PRODUCT SUBSTITUTION PROCEDURES

the proposed substitution to produce indicated results.

10. If requested substitution involves more than one contractor, requested substitution has been coordinated with the other contractors, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

**PART 2 - PRODUCTS**

**2.1 SUBSTITUTIONS**

- A. Bids shall be based upon providing materials and products, identified in these Specifications or indicated on the Drawings.
- B. Contractor's submittal and the Contracting Officer's acceptance of shop drawings, product data or samples for construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.
- C. Timing: The Contracting Officer will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at the discretion of the Contracting Officer.
- D. Conditions: The Contracting Officer will consider a Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, the Contracting Officer will return requests without action, except to record noncompliance with these requirements:
  - 1. The requested substitution offers the Authority a substantial advantage in cost, time, energy conservation, or other considerations, after deducting any additional costs or responsibilities the Authority must assume. The Authority's additional responsibilities may include redesign and evaluation services, increased cost of other construction to the Authority, and similar considerations.
  - 2. Requested substitution does not require extensive revisions to the Contract Documents.
  - 3. Requested substitution is consistent with the Contract Documents and will produce the indicated results.
  - 4. Substitution request is fully documented and properly submitted.
  - 5. Requested substitution will not adversely affect the Contractor's Construction Schedule.
  - 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - 7. Requested substitution is compatible with other portions of the work.
  - 8. Requested substitution has been coordinated with other portions of the work.
  - 9. Requested substitution provides the specified warranty.

- E. Burden of proof of equality rests with the Contractor.
- F. By making request for substitution, the Contractor:
  - 1. Represents and warrants that the Contractor has personally investigated the proposed substitution product and determined that it is equal to or superior in all respects to the one specified;
  - 2. Represents and warrants that Contractor will provide the same warranties or bonds for the substitute that the Contractor would have provided for the one specified.
  - 3. Certifies that cost data presented is complete and includes all related costs under this Contract, except for Contracting Officer's redesign cost, and waives all claims for additional costs related to the substitution which may subsequently become apparent; and
  - 4. Will coordinate installation of the accepted substitute, making such other changes as may be required to make the work complete in all respects.
- G. The Contracting Officer will review requests for substitutions with reasonable promptness, and notify the Contractor, in writing, of decision to accept or reject the requested substitution.
- H. The Contracting Officer reserves the right to accept or reject proposed substitutions. Each request shall state the amount of savings, if applicable, to the Authority, if the substitution is accepted.
- I. Cost of testing required for analysis of the proposed substitution shall be paid for by the Contractor at a testing agency selected and approved by the Contracting Officer.
- J. Should the substitution be accepted, the Contractor shall be responsible for making the necessary adjustments to the Work which may be affected as result of the substitution at no additional cost to the Authority.
- K. Contractor warrants that the substituted material or system will perform the same as the originally specified material or system would have performed. Should the accepted substitution fail to perform as required, the Contractor shall replace the substitute material or system with the one specified and bear the costs incurred thereby.

**PART 3 - EXECUTION**

Not Used.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. Separate measurement or payment will not be made for work required under this Section. All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

END OF SECTION 01630



# SUBSTITUTION REQUEST

Project: \_\_\_\_\_

Substitution Request Number: \_\_\_\_\_

To: \_\_\_\_\_

From: \_\_\_\_\_

Re: \_\_\_\_\_

Date: \_\_\_\_\_

Contract For: \_\_\_\_\_

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

Description: \_\_\_\_\_

Section: \_\_\_\_\_ Page: \_\_\_\_\_

Article/Paragraph: \_\_\_\_\_

Proposed Substitution: \_\_\_\_\_

Manufacturer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone: \_\_\_\_\_

Trade Name: \_\_\_\_\_ Model No.: \_\_\_\_\_

Installer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone: \_\_\_\_\_

History:  New product  2-5 years old  5-10 yrs old  More than 10 years old

Differences between the proposed substitute and the specified product: \_\_\_\_\_

Point-by-point comparative data attached.

Reason for not providing the specified item: \_\_\_\_\_

Similar Installation:

Project: \_\_\_\_\_ Designer: \_\_\_\_\_

Address: \_\_\_\_\_ Owner: \_\_\_\_\_

Date Installed: \_\_\_\_\_

Proposed substitution affects other parts of the work:  No  Yes; explain \_\_\_\_\_

Savings to Authority for accepting the substitution: \_\_\_\_\_ (\$ \_\_\_\_\_).

Proposed substitution changes to contract time:  No  Yes [Add] [Deduct] \_\_\_\_\_ days.

Supporting Data Attached:  Drawings  Product Data  Samples  Tests  Reports  \_\_\_\_\_

**SUBSTITUTION  
REQUEST  
(Continued)**

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The Undersigned certifies:

- Proposed substitution has been fully investigated and is determined to be equal or superior in all respects to the specified product.
  - Same warranty will be furnished for the proposed substitute as for the specified product.
  - Same maintenance service and source of replacement parts, as applicable, is available.
  - Proposed substitution will have no adverse effect on other trades and will not affect or delay scheduled progress.
  - Cost data as stated above is complete. Claims for additional costs related to accepted substitution, which may subsequently become apparent are to be waived.
  - Proposed substitution does not affect dimensions and functional clearances.
  - Payment will be made for changes to design, including A/E design, detailing, and construction costs caused by the substitution.
  - Coordination, installation, and changes in the work as necessary for the accepted substitution will be completed in all respects.
- 

Submitted by: \_\_\_\_\_

Signed by: \_\_\_\_\_

Firm: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone: \_\_\_\_\_

Attachments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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**CONTRACTING OFFICER'S REVIEW AND ACTION**

- Substitution approved - Make submittals in accordance with Specification Section 01330.
- Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
- Substitution rejected - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

Additional Comments:     Contractor     Subcontractor     Supplier     Manufacturer     Contracting Officer

\_\_\_\_\_

\_\_\_\_\_

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\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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**SECTION 01640**  
**AUTHORITY-FURNISHED MATERIALS AND EQUIPMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section includes specifications for the acceptance, pick up, loading, transporting, unloading, handling, storage, protection, and utilization of materials and equipment furnished by the Authority for installation by the Contractor, including installation supervisors.
- B. Refer to Section 01600, "Product Requirements", for handling, storage, and other pertinent requirements.

**1.2 ABBREVIATIONS**

- A. Authority-furnished materials may be referred to herein and in other Sections of the Specifications, where applicable, by the abbreviation AFM.
- B. Authority-furnished equipment may be referred to herein and in other Sections of the Specifications, where applicable, by the abbreviation AFE.

**1.3 AUTHORITY-FURNISHED MATERIALS AND EQUIPMENT**

- A. The materials and equipment to be furnished by the Authority for installation by the Contractor are specified in the Contract Specifications, Section 01640, "Authority-Furnished Materials and Equipment".

**1.4 CONTRACTOR'S RESPONSIBILITIES**

- A. Requirements: The Contractor shall assume custody of, and provide protection for, all Authority-furnished materials and equipment from pick up or delivery, as applicable, and acceptance by the Contractor until Substantial Completion of the Work and the return of any excess materials and equipment.
- B. Protection: Protect all Authority-furnished materials and equipment while in custody from theft, vandalism, loss, and damage during unloading, storing, handling, distributing, and installing the materials and equipment. Lost or damaged materials and equipment, as documented by the Authority, shall be replaced by the Contractor at no additional cost to the Authority.
- C. The Contractor shall provide all labor, equipment, and materials necessary to pick up, load, transport, unload, handle, stockpile, and store Authority-furnished materials and equipment. Handling shall be in accordance with the respective manufacturer's recommendations as furnished by the Contracting Officer.

- D. Storage Plan: Prepare a storage plan for each storage area where Authority-furnished materials and equipment are proposed to be stored or stockpiled. The plan shall be in sufficient detail to demonstrate that efficient handling and security provisions have been provided, that supporting soils will not be overloaded, and that materials will not be overstressed due to bending or shear. A running inventory of the materials on hand shall be provided and kept, and the Contractor shall notify the Contracting Officer at least 30 days in advance of any anticipated shortages.

- E. AFM and AFE Acceptance: Inspect Authority-furnished materials and equipment at time of pick up (or delivery if delivery of the specific AFM or AFE to the Contractor by others is specified), and submit certification to the Contracting Officer showing the quantity of accepted materials and equipment. Set aside all damaged materials and equipment, and immediately notify the Contracting Officer in writing of the damage and circumstances of discovery. If delivery of AFM or AFE is, Contractor shall inspect Authority-furnished materials and equipment

- F. Inventory Records: Prepare and maintain perpetual inventory records of Authority-furnished materials and equipment, and assign stock number, date of receipt from the Authority, and approximate date of construction placement. All checkout and returns of Authority-furnished materials and equipment or other transfer of materials and equipment between the Contractor and the Authority shall be accompanied by an inventory record form.

- G. Excess Materials: Upon Substantial Completion of the Work, the Contractor shall transport, unload, and stockpile, all excess Authority-furnished materials and equipment to a delivery location within a 50 mile radius of the jobsite, as determined by the Contracting Officer.

**1.5 INSTALLATION FACILITIES, TOOLS, AND MATERIALS**

- A. The Contractor shall furnish all facilities, tools, equipment, materials, and services needed to complete the installation of Authority-furnished materials and equipment, and such other tools, equipment, materials, and services as required to complete the Work.

- B. Authority-furnished materials and equipment shall be installed accurately and efficiently to avoid waste, such as that due to incorrect or inaccurate installations. Wasted materials and equipment, as documented by the Contracting Officer, shall be



## AUTHORITY-FURNISHED MATERIALS AND EQUIPMENT

replaced by the Contractor at no additional cost to the Authority.

### 1.6 INSTALLATION INSTRUCTIONS

- A. The Contracting Officer will provide the Contractor with installation instructions and drawings from the manufacturers of Authority-furnished equipment.

### PART 2 - PRODUCTS

Not Used.

### PART 3 - EXECUTION

Not Used.

### PART 4 - MEASUREMENT AND PAYMENT

#### 4.1 GENERAL

- A. Separate measurement or payment will not be made for work required under this Section. Costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

END OF SECTION 01640

**SECTION 01715  
PRE-CONSTRUCTION INSPECTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section includes specifications for pre-construction inspection.
- B. Contractor will be responsible for other surveys as required prior to commencement of the Work. Refer to Section 01722, "Field Engineering".
- C. Monitor existing structures for damage and movement as and where indicated in Section 02316, "Geotechnical Instrumentation".
- D. Where necessary to safeguard adjacent structures and property, provide underpinning and support in accordance with Section 02150, "Underpinning, Support, and Restoration of Structures".

**1.2 SUBMITTALS**

- A. Submit copies of the pre-construction inspection report to the Contracting Officer.

**1.3 AUTHORITY'S INSPECTION**

- A. Conditional inspection of buildings or structures in the vicinity of the Project, which may possibly be affected by the Work, will be performed by the Authority. These surveys will be conducted to:
  - 1. Define and document existing property conditions and
  - 2. Assist the Authority in resolving possible disputes over property conditions.

**1.4 PRE-CONSTRUCTION INSPECTION**

- A. In conjunction with the Contracting Officer and the Authority's designers, conduct a pre-construction inspection of existing facilities, structures, and environmentally sensitive areas in the vicinity of the Worksite. Document the inspection with photographs, sketches, and narratives and assemble into an inspection report submitted to the Contracting Officer. Photographic documentation shall include vegetation densities. Photographs shall comply with Section 01345, "Construction Photographs".

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements".

END OF SECTION 01715

**SECTION 01722**  
**FIELD ENGINEERING - SURVEYING**

The provisions of the DART Standard Specification Section 01722, "Field Engineering - Surveying", shall apply to the Work as modified herein.

**PART 1 - GENERAL**

**1.1. DESCRIPTION:** Change Paragraph 1.1/A and 1.1/B and 1.1/C to read as follows:

- A. See plans for survey control established for this construction project.
- B. Horizontal Datum: See plans for information related to horizontal datum for this construction project.
- C. Vertical Datum: See plans for information related to vertical datum for this construction project.

**END OF SECTION 01722**

**SECTION 01722**  
**FIELD ENGINEERING – SURVEYING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section includes specifications for survey services as required for layout and performance of the Work.
- B. The work includes providing field engineering services as required to verify lines, levels, grades, and elevations, and that the work was constructed and installed accurately within specified tolerances.
- C. The work includes maintaining Authority-provided monuments and bench marks and establishing and maintaining new temporary and permanent monuments and bench marks to facilitate the work of this Contract, work of adjacent and follow-on contracts, and for the Authority's on-going use. Refer to Section 02110, "Survey Markers and Monuments" for related requirements.
- D. The work includes verifying constructed work including verifying alignment and grades of structures, stations, and trackbed in preparation for turn-over to follow-on contracts.
- E. The work also includes survey services for obtaining field measurement of work quantities to be determined by survey.

**1.2 REFERENCED STANDARDS**

- A. The work of this Section shall be in accordance with the following referenced standards and manuals.
- B. DART Survey, Right-of-Way and Subsurface Utility Engineering Manual.
- C. Federal Geodetic Control Committee (FGCC):
  - 1. Standards and Specifications for Geodetic Control Networks, dated September, 1984.
  - 2. Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques, version 5.0 dated May 1988, reprinted August, 1989.
- D. Texas Board of Professional Land Surveyors (TBPLS):
  - 1. TBPLS - Rules, Regulations and "Minimum Standards of Practice"
- E. Texas Society of Professional Surveyors (TSPS):
  - 1. TSPS - Manual of Practice for Land Surveying in the State of Texas

**1.3 SUBMITTALS**

- A. Survey notes, drawings, and calculations shall be completed as the work progresses and one signed copy of each survey document shall be submitted to the Authority for record purposes. Surveys submitted shall include a dated certification signed and sealed by a Professional Land Surveyor registered in the State of Texas attesting to the survey's accuracy and purpose.
- B. Construction survey notes shall be provided to the Contracting Officer within 48 hours after completion of the Contractor's survey.
- C. As-Built Survey: Submit drawings showing all final centerline, station, and other Contractor-installed monumentation, properly prepared and submitted to the Contracting Officer for approval. Depict actual as-built conditions of the constructed improvements and said improvements relationship or conformance with the Contract Documents. Illustrate the horizontal and vertical (if appropriate) location of all improvements and indicate and clearly dimension all nonconformance or variations from the Contract Documents.
- D. Submit a survey plan for establishing, controlling, and checking the layout for all work.
- E. Submit monthly when the request for payment is submitted, a survey showing actual as-built conditions for all work indicating its conformance to the Contract Documents. Include survey data of actual conditions required by quantitative records of actual work; damage and settlement surveys; surveys of adjacent construction; and similar data as required by the Contracting Officer. Submit three copies.

**1.4 QUALIFIED SERVICES**

- A. Surveying services and field engineering services shall be performed under the direct supervision of a State of Texas Registered Professional Land Surveyor.

**1.5 SURVEY CONTROL**

- A. DART Coordinate System: The Authority has established the Texas Coordinate System of 1983 (NAD 1983), North Central Zone as the basis for its horizontal system and National Geodetic Vertical Datum of 1988 (NGVD 1988) as the basis for its vertical system. The official scale factor on DART Buildout II Projects is 1.000136506, to convert from grid to surface values. All coordinates and distances shall be published as surface values.

B. Horizontal Datum: The horizontal control for all alignments shall be based on survey control points established under the direction of the Authority. Coordinates for control points established for the system shall be located on NAD 83, Texas Coordinate System, North Central Zone (Lambert Grid), as established by the National Geodetic Survey (NGS).

1. The accuracy of the horizontal ground control and of supporting ground surveys as a minimum shall be Second Order, Class I, in accordance with the FGCC Standards and Specifications for Geodetic Control Networks.
2. GPS relative positioning accuracy as a minimum shall be Order C Class 2-I as defined in FGCC Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques.

C. Vertical Datum: The vertical control shall be based on the NGVD 1988 Datum, as defined by the NGS descriptions with the most recent adjustments.

1. The accuracy of the vertical ground control and of supporting ground surveys shall be as a minimum Second Order, Class I, as defined above.

#### 1.6 LINES AND GRADES

- A. Only such primary control lines, monuments, and bench marks will be set by the Authority as the Authority determines to be necessary to control establishment of the lines and grades required for completion of the Work. In general, these will consist of the primary horizontal and vertical control points indicated on the Contract Drawings. Contractor shall establish work points for all major structures, all track alignments, and all roadway alignments. Contractor shall set survey monuments at each end of station platforms to establish platform finish horizontal and vertical alignment based on the Authority control datum.
- B. Contractor shall carefully preserve primary control monuments set by the Authority. In case such monuments are destroyed or damaged, they will be replaced at the Authority's earliest convenience. Contractor will be charged for the cost of replacing or restoring monuments destroyed or damaged by the Contractor's operations. This charge will be deducted from any monies due or to become due the Contractor.
- C. Contractor shall temporarily suspend work at such points and for such reasonable times as the Authority may require for resetting monuments, and the Contractor will not be entitled to any additional compensation or extension of time therefore.
- D. All other stakes or markers required to establish the lines and grades required for the completion of the Work shall be the responsibility of the Contractor.

#### 1.7 SURVEYS FOR LAYOUT AND PERFORMANCE

- A. Surveying Requirements: Perform all surveys for layout and performance of the Work, reduce the field notes, and make all calculations and drawings necessary to carry out such work. Contractor shall check the relative positions of all Authority-provided primary monuments and bench marks to be used and shall report any damaged or out-of-position monuments to the Contracting Officer at once. Contractor shall check such relative positions each time the Contractor uses such monument or bench mark.
- B. Datum: Contractor shall be responsible for correctly locating all lines and grades and for performing all measuring as required for the construction and completion of the Work from established reference points and information is shown on the Contract Drawings.
- C. Equipment: Contractor's instruments and other survey equipment shall be accurate, suitable for the surveys required, and in proper condition and adjustment at all times, per manufacturer's instructions.
- D. Field Notes and Records: Furnish certified copy of all survey records to the Contracting Officer at intervals required by the Contracting Officer. Furnish each field notebook to the Contracting Officer when filled or completed.

1. Record deviations which are accepted by the Contracting Officer on the record drawings.
2. Furnish the Contracting Officer with a plan sheet showing the horizontal distance, azimuth, and angle from the control points indicated to the references indicated.
3. Electric or unprocessed field will be accepted. Additional "hard copies" plots, sketches, spread sheets or processed data are required in specific situations or even on a routine basis if deemed necessary for checking or archiving.

E. Use by the Contracting Officer: The Contracting Officer may at any time use line and grade points and markers established by the Contractor. Contractor's surveys are a part of the work and may be checked by the Contracting Officer at any time. Contractor shall be responsible for any lines, grades, or measurements which do not comply with specified or proper tolerances, or which are otherwise defective, and for any resultant defects in the work. Contractor shall conduct resurveys or check surveys to correct errors indicated by review of the field notebooks or by check surveys performed by the Contracting Officer.

#### 1.8 SURVEYING ACCURACY AND TOLERANCES IN SETTING SURVEY STAKES

- A. Surveying Accuracy: Control traverse field surveys and computations, including surveys of control lines to determine horizontal and vertical alignment of major structure components, shall meet the accuracy requirements for Second Order, Class I Surveys as

specified by the FGCC. Staking for construction or equipment installations shall meet the accuracy requirements for Second Order, Class II Surveys as specified by FGCC.

- B. Tolerances: The tolerances generally applicable in setting survey stakes shall be as set forth in Paragraph 1.8.A above. Such tolerances shall not supersede stricter tolerances required by the Contract Drawings or Specifications, and shall not otherwise relieve the Contractor of responsibility for measurements in compliance therewith.

**1.9 MONUMENTATION**

- A. In accordance with Paragraph 1.6A. herein, monuments will be provided by the Authority to establish the centerlines of tracks.
- B. The Contracting Officer will furnish the Contractor with horizontal coordinate values to 1/100 of a foot and vertical values to 1/100 of a foot for all existing baseline monuments.
- C. Do not use controls for surveys other than the monumentation described above unless otherwise approved by the Contracting Officer.

**1.10 TRACKWORK SURVEYING REQUIREMENTS**

- A. The following trackwork surveying requirements apply to preparation for trackwork construction.
  - 1. Verify layout information shown in relation to the existing Authority provided monuments and existing structures before proceeding with layout of the actual work. As the work proceeds, check every major element of work for line. Bring discrepancies in location of structures to the attention of the Contracting Officer before starting trackwork. Maintain an accurate surveyor's field book of such checks, make available for the Contracting Officer's reference.
  - 2. Verify the actual grade line and the profile of the top of the subballast. Variations from the design grade line and profile of less than plus or minus 1/2 inch to be compensated for by the quantity of ballast or the thickness of concrete slab at no additional cost to the Authority. Variations more than plus or minus 1/2 inch shall be reported to the Contracting Officer for direction.

**1.11 FINAL ALIGNMENT AND TRACK INSPECTION**

- A. Survey of the track to verify that the horizontal alignment, vertical alignment, and superelevation are within the tolerances specified for each type of track construction.
- B. Areas found to exceed the tolerances shall be resurveyed after deficiencies are corrected.

- C. Alignment Control Monuments: Prior to final acceptance of the guideway construction, the Contractor shall reestablish the centerline of the northbound track. Upon the acceptance of the alignment by the Contracting Officer, the Contractor shall install the permanent Alignment Control Monuments at the locations shown on the contract drawings and in accordance with Section 02110, "Survey Markers and Monuments".

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements".

END OF SECTION 01722

**SECTION 01731  
CUTTING AND PATCHING**

**PART 1 - GENERAL**

Protection", and various other sections of the Specification as applicable.

**1.1 DEFINITION**

- A. This section specifies the cutting and patching of nominally completed and/or previously existing work in order to accommodate the coordination of work, to install other work, to uncover other work for access or inspection, to obtain samples for testing, or for similar purposes; and excludes integral cutting and patching during the manufacturing, fabricating, erecting, and installing of individual units of work.
1. Demolition is a related category of work, which may require cutting and patching as specified in this section.
  2. Excavation and the associated operations of dewatering, bracing, backfilling, and surface restoration, are separate categories of work.
- B. Refer to other sections of the Specifications for specific cutting and patching requirements and limitations applicable to individual units of work.
1. Refer to Division 15 and 16 of these Specifications for additional requirements and limitations pertaining to the cutting and patching of mechanical and electrical work, respectively.
  2. Comply with NFPA 51B standard for fire prevention in use of cutting and welding processes.

**1.2 SUBMITTALS**

- A. Prior to the performance of cutting and patching work on existing structures which affect appearance, structural, operational, or safety related components; submit to the Contracting Officer for approval, a description of the method and manner in which the Work is to be accomplished. As a minimum, the description is to include the methods of performance, working drawings showing structural element reinforcing, products to be used, firms and tradesmen to perform the Work, approximate dates of the Work, and anticipated results in terms of variations from the Work as previously existing. Include calculations with the submittal for cutting and patching of structural work.

**1.3 ENVIRONMENTAL**

- A. Perform cutting and patching and all operations in connection therewith conforming to the requirements of Section 01560, "Environmental

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Refer to individual material sections contained in subsequent sections of these Specifications.
- B. Where required patch materials are not specified, use materials which will result in equal or better work than work being cut and patched in terms of performance characteristics and visual effects.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Notify the Contracting Officer at least twenty four (24) hours in advance of starting any cutting or patching.
- B. Temporary Support: Provide temporary support for work to be cut to prevent failure. Do not endanger other work.
- C. Protection:
  1. Provide protection of other work during cutting and patching.
  2. Provide protection of the Work from adverse weather exposure.

**3.2 INSTALLATION**

- A. Structural Work: Do not cut and patch structural work in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio.
- B. Operational and Safety Related Components: Do not cut and patch operational elements and safety-related components in a manner resulting in a reduction of capacities to perform in the manner intended or resulting in decreased operational life, increased maintenance, or decreased safety.
- C. Visual Requirements: Restore or refinish work which has been cut or patched as near as possible to its original condition, using new materials. Restore or repair continuous surfaces to the nearest intersections and refinish entire assemblies.
- D. Do not proceed with cutting and patching for which submittals are required until such submittals have been approved by the Contracting Officer.

**3.3 CUTTING**

- A. Cut work by methods least likely to damage work to be retained and adjoining work.
  - 1. In general, where mechanical cutting is required, cut work with saws or rotary tools, not with impact tools. Core drill openings larger than 1-1/2 inch diameter through concrete work.
  - 2. Comply with the requirements of applicable sections of Division 2 of these Specifications where cutting and patching requires excavating and backfilling.
- B. Fittings: Cut products as required for fitting and adjusting to provide for finished installation complying with specified tolerances and finishes.

**3.4 PATCHING**

- A. Patch with seams which are durable. Comply with specified tolerances for the work. Where feasible, inspect and test patched areas to demonstrate integrity of work.
- B. Restore exposed finishes of patched areas; and, where necessary, extend finish restoration onto retained work adjoining in a manner which will minimize evidence of patching.

**3.5 INSPECTION**

- A. Request Contracting Officer's inspection of cutting and patching and obtain his approval prior to any further action with or about the cut and patched product.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 MEASUREMENT**

- A. Cutting and Patching is incidental to the work being performed and will not be measured separately.

**4.2 PAYMENT**

- A. Cutting and Patching is incidental to the work being performed. No separate payment will be made.

END OF SECTION 01731



**SECTION 01740  
CLEANING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section includes specifications for performing operations necessary for, and properly incidental to, site cleanup during construction and final cleaning of the facilities and the site prior to acceptance of the Work by the Authority as specified herein and in other sections when specified.

**1.2 CLEANING AND CLEANUP DURING CONSTRUCTION**

- A. The entire site of the Work, including the Contractor's work and storage areas, shall be kept in a neat, clean, and orderly condition at all times during the course of this Contract. The Contracting Officer may, at any time during construction, order a general cleanup of the site as a part of the Work, and there shall be no additional cost to the Authority. The Contractor shall provide general daily clean up and disposal service for removal of waste, rubbish, trash, and debris away from the jobsite.
- B. Perform cleaning of facilities and ancillary buildings as required during construction to prevent accumulations of dust, dirt, soil, trash, and debris, so that a clean and safe working environment will be present at all times.
- C. Walkways or designated pathways for authorized visitors shall be kept broom clean at all times. Walkways over exposed earth surfaces shall also be kept neat and free of pebbles and other obstacles to walking comfortably, equivalent to broom clean of paved surfaces.

**1.3 DUST CONTROL**

- A. Clean interior spaces prior to the start of finish painting and the application of other finishes, and continue cleaning as required until such work is completed.
- B. Schedule operations to prevent dust and other contaminants, resulting from cleaning operations, from adhering to set or newly finished surfaces.

**1.4 DISPOSAL OF DEBRIS**

- A. Dispose of waste, trash, and debris in a safe, acceptable manner, in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction. Bury no waste material and debris on the site. Burning of trash and debris on the site will not be permitted.

- B. Location of disposal site for trash and debris and length of haul are the Contractor's responsibility.

**1.5 FINAL CLEANING OF STATION FACILITIES AND ANCILLARY BUILDINGS**

- A. Prior to final inspection by the Authority, and after construction work is essentially complete, thoroughly clean station facilities and ancillary buildings and structures, utilizing professional building cleaners where appropriate.
- B. Items to be cleaned include glass, doors, hardware, opening frames, grilles, trim, exposed metal surfaces, plastics, concrete, pavers, floor coverings, light fixtures and plates, plumbing fixtures and trim, and finish surfaces throughout the construction.
- C. Vacuum-clean where appropriate and remove spots, smears, dust, debris, hand prints, and defacements of every sort, including those of vandals. Use commercial cleaning compounds where necessary.
- D. Follow the recommendations of the manufacturers of the materials and items to be cleaned for cleaning, polishing, and treatment such as waxing or sealing. Polish stainless steel and other non-ferrous metal surfaces.
- E. Clean permanent filters of the air-conditioning system and replace disposable filters of units operated during construction. Clean ducts, blowers, and coils if units were operated without filters during construction.

**1.6 FINAL SITE CLEANUP**

- A. Prior to final inspection, thoroughly clean the entire site and put it into a clean and neat, acceptable condition. Remove from the site construction waste and unused materials, dunnage, loose rock and stones, excess earth, and debris of any description resulting from the Work.
- B. Hose down and scrub clean where necessary pavement and paved walks. Remove oil and grease stains.
- C. Thoroughly remove mortar droppings from concrete slabs and pavement where they occur. Hose down and scrub clean concrete flatwork and exposed vertical surfaces of concrete and masonry.
- D. Free and clear new and existing drainage systems.
- E. Clean and protect conduit openings.

**PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements"

END OF SECTION 01740

**SECTION 01770  
CONTRACT CLOSEOUT**

The provisions of the DART Standard Specification Section 01770, "Contract Closeout", shall apply to the Work as modified herein.

**PART 1 - GENERAL**

**1.5. SUBSTANTIAL COMPLETION INSPECTION (SCI):** Change Paragraph 1.5/A to read as follows:

- A. Substantial Completion Inspection (SCI): Substantial Completion is determined by a series of inspections of the projects features, including the Stormwater Pollution Prevention Plan. The Contracting Officer will establish the dates of these inspections based on the Contractor's readiness for the inspection. The Contractor shall cooperate with the Contracting Officer in the coordination of attendees. The makeup of the inspection team will depend upon the nature of the work being inspected, but normally will include the Contractor, the Contracting Officer, representative of other FWTA/TRE divisions, and outside agencies as deemed appropriate. The Contractor shall be represented by its principal superintendent and such Subcontractors and Suppliers as may be necessary to answer the questions of the Contracting Officer's inspection team.

**1.6. SUBSTANTIAL COMPLETION INSPECTION FOR EQUIPMENT:** Change Paragraph 1.6/A/1 and 1.6/A/2 and 1.6/A/4 to read as follows:

- A.
1. The FWTA/TRE representative will accept the equipment.
  2. FWTA/TRE will maintain the equipment after acceptance.
  4. The Contracting Officer will retain authority to provide access to other contractors required to work in the facilities containing the equipment and by the FWTA/TRE personnel who will maintain the equipment.

**END OF SECTION 01770**

**SECTION 01770  
CONTRACT CLOSEOUT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section includes specifications for performing all operations necessary for and incidental to closing out the Contract work and assisting in the Contracting Officer's final inspection.
- B. Refer to General Provisions Paragraphs, "USE AND POSSESSION PRIOR TO COMPLETION" and "FINAL ACCEPTANCE".

**1.2 BENEFICIAL OCCUPANCY**

- A. Refer to General Provisions Paragraph, "USE AND POSSESSION PRIOR TO COMPLETION". The Authority may take possession or use any completed or partially completed part of the work under construction. Such occupancy neither relieves the Contractor of the responsibility for completing the work in accordance with the contract, nor removes contractual warranties or guarantees of construction.
- B. Beneficial Occupancy is preceded by inspections of the work areas to be possessed by the Authority and other agencies. Such inspections will usually result in a work list being developed. Reference procedures established in Article entitled "Substantial Completion Inspection", utilizing the work list in lieu of the punch list.
- C. The Contracting Officer will make arrangements for maintenance, heat, utilities, and insurance prior to Beneficial Occupancy.
- D. The Contractor shall sign and return the Certificate of Beneficial Occupancy prepared by the Contracting Officer. This Certificate establishes a Beneficial Occupancy Date (BOD) as the Authority takes occupancy.

**1.3 SUBSTANTIAL COMPLETION - GENERAL**

- A. Substantial Completion (when recognized by the contract) is defined as the point at which all work is sufficiently completed to allow full use of the contracted items for their intended purpose. Intended purpose is defined to mean useable from an operational and safety standpoint. This includes the ability for follow-on contractors to perform their tasks without the Authority incurring any liability for additional costs or delays as a result of incomplete work.
- B. Substantial Completion Requirements: To be considered substantially complete, the following items shall be addressed (as applicable).
  - 1. Physical completion
  - 2. Successful testing of the work

- 3. Submittal of permits, certificates of occupancy and other certificates, as required.
- 4. Submittal and approval of required submittals
- 5. Inspection Tags: Mount "green" inspection tags on 8-1/2 x 11 paper, identify as to item that was inspected, and submit.
- 6. Operating instructions for equipment shall be properly mounted and posted as specified in Section 01786, "Operation and Maintenance Instructions".
- 7. Required operations and maintenance manuals shall be submitted as specified in Section 01786, "Operation and Maintenance Instructions".
- 8. Guaranties and warranties shall be submitted to the Contracting Officer, as specified in the General Provisions and various sections of the Specifications.
- 9. Submittal of spare parts, maintenance materials, keys, special tools, testing equipment, and required surplus material.
- 10. Submittal of a list of subcontractors and vendors with contact names, phone numbers, addresses and description of work performed.
- 11. Temporary facilities, except as may be required for punch list work, shall be removed from the site.
- 12. The site and applicable appurtenances and improvements shall be cleaned as specified in Section 01740, "Cleaning".
- 13. Non-Conformance Reports, Audit Finding Reports, and Corrective Action Reports have been addressed and closed.

- C. When the Contractor believes that the work required by any designated part of the contract has been substantially completed in accordance with the contract, the Contractor shall make a written request to the Contracting Officer for an inspection.

**1.4 PRE-SUBSTANTIAL COMPLETION INSPECTION (PRE-SCI)**

- A. Prior to the scheduled date of a Substantial Completion Inspection, the Contractor shall request that the Contracting Officer make arrangements for inspections with the Authority, end user, the Authority's designer, and other agencies as required. The intent of these inspections is to review current work list items in manageable sized groups and to determine if the work is ready for a Substantial Completion Inspection. Items documented during Pre-SCI's will be provided to the Contractor so that these items may be completed prior to the Substantial Completion Inspection.

- 1.5 **SUBSTANTIAL COMPLETION INSPECTION (SCI)**
- A. Substantial Completion Inspection (SCI): Substantial Completion is determined by a series of inspections of the project features, including the Storm Water Pollution Prevention Plan. The Contracting Officer will establish the dates of these inspections based on the Contractor's readiness for the inspection. The Contractor shall cooperate with the Contracting Officer in the coordination of attendees. The makeup of the inspection team will depend upon the nature of the work being inspected, but normally will include the Contractor, the Contracting Officer, representatives of other DART divisions, and outside agencies as deemed appropriate. The Contractor shall be represented by its principal superintendent and such Subcontractors and Suppliers as may be necessary to answer the questions of the Contracting Officer's inspection team.
  - B. The Contracting Officer will organize, schedule, and guide the inspection teams. Following inspections, the Contracting Officer will prepare a "first draft" punch list and distribute within 72 hours to all members of the inspection group. The Contractor shall review the draft list for completeness and accuracy, adding additional information as necessary. Draft lists, with supporting references, shall be returned to the Contracting Officer within 72 hours of receipt.
  - C. If the inspection team concurs that the work is substantially complete, the Contracting Officer will complete the "Certificate of Substantial Completion". The Contracting Officer will retain the certificate and a copy will be given to the Contractor. If the inspection team does not find the work substantially complete, the SCI will be treated as a Pre-SCI and a new SCI will be scheduled.
  - D. Punch list: Punch list items will be entered and tracked by the Contracting Officer.
  - E. Following preparation, punch lists will be formally transmitted to the Contractor for immediate action. Once a list is forwarded to the Contractor, no new items will be added or deleted. New items will be addressed as latent defects or warranties.
  - F. The Contractor shall return a copy of the punch list within one week after receipt indicating the forecast completion date. Obtain the Contracting Officer's sign-off of individual items as they are completed.
  - G. Certificate of Substantial Completion: A Substantial Completion (SC) Certificate will be issued for each area that has been contractually designated as having a specified completion date, as well as for overall contract completion. The date of inspection resulting in issuance of the Certificate is the date of Substantial Completion. Each SC Certificate issued prior to the final certificate shall be marked "Partial". The final SC Certificate shall be marked "Final".
- H. The Substantial Completion Certificate, if necessary, will contain the following documents:
- 1. Punch list.
  - 2. A list of outstanding Change Orders, problem statement, and claims.
  - 3. A list of outstanding operation and maintenance manuals, warranties, guarantees, and permits.
  - 4. A list of outstanding test results.
  - 5. A list of spare parts, maintenance materials, keys, special tools, testing equipment, and required surplus material.
  - 6. A list of outstanding QC documentation.
- I. Post-Substantial Completion Inspection and Turnover: Following a completed SCI, record documentation and deliverables shall be transferred to the Contracting Officer within the time deemed appropriate by the Contracting Officer.
- 1.6 **SUBSTANTIAL COMPLETION INSPECTION FOR EQUIPMENT**
- A. The following procedures apply to a Substantial Completion Inspection for the purpose of accepting possession of equipment prior to final completion of the facility housing the equipment:
    - 1. The DART representative will accept the equipment.
    - 2. DART operations will maintain the equipment after acceptance.
    - 3. The Contracting Officer will control the keys to the facilities containing the equipment on behalf of the Authority.
    - 4. The Contracting Officer will retain authority to provide access by other contractors required to work in the facilities containing the equipment and by the DART Operations personnel who will maintain the equipment.
- 1.7 **FINAL INSPECTION**
- A. Final Inspection: When all requirements of the previously prepared punch lists have been completed, the Contractor shall request final inspection for full completion. Prior to scheduling the final inspection, the Contracting Officer will verify full completion. When satisfied, the Contracting Officer will arrange for and conduct the final inspection accompanied by the Contractor and other participants of previous inspections.

CONTRACT CLOSEOUT

B. Final Inspection/Acceptance by Third Parties:

1. The Contractor shall request in writing to the Contracting Officer final inspection by third parties of work of performed on their facilities.
2. Prior to making such request for final inspection, the Contractor shall have successfully completed testing of subject facilities, documented the testing, completed all punch list items in regarding to the facilities, completed related as-built drawings, and performed cleaning of facilities, as applicable.

9. If performance bond is in place, letter from bonding company regarding warranty provision (if required by contract).

10. Final payroll documents and certifications.

11. Completed Storm Water Pollution Prevention Plan (including Notice of Termination).

D. Claims and Changes: Before the final contract amount can be determined and the final payment made, all changes shall be negotiated and finalized by contract modification. All outstanding claims shall be identified.

1.8 FISCAL COMPLETION

A. Variations in Quantities: The final payment estimate cannot be prepared until the Contracting Officer and the Contractor have reached final agreement on all quantities of unit price items. All variations between individual contract quantities, as adjusted by contract modifications, and the final measured or calculated quantities may be subject to the General Provisions Paragraph "VARIATIONS IN ESTIMATED QUANTITIES".

B. A contract modification is not necessary for any variation in an estimated quantity when the Contractor and the Contracting Officer agree that the actual quantity is equitably paid by application of the contract unit price and there is no change in contract time. However, a modification summing-up all overruns and under-runs is required before final payment.

C. Deliverables: The final payment cannot be issued until the Contracting Officer is satisfied that the following contract deliverables have been received in full compliance with the contract:

1. Record documents submitted as specified in Section 01785, "Project Record Documents". Including required certification of Record (As-Built) Drawings and Specifications.
2. Tabulation of Tests, test reports, and other QC documents.
3. Final as-built progress schedule (if required by contract).
4. Operation and Maintenance Manuals and Training.
5. Warranties and guarantees.
6. Certificates of inspection and acceptance of relocation, modifications, and new work performed have been obtained from utility companies, public agencies, and others.
7. Spare parts, maintenance materials, keys, special tools, testing equipment, and required surplus material.
8. Certificate and Release of Claims.

1.9 FINAL ACCEPTANCE

A. Recommendation for Final Acceptance: Refer to General Provisions Paragraph "FINAL ACCEPTANCE". When the Contractor considers that all portions of the contract are in complete conformance with contract requirements, Contractor shall request that the Contracting Officer prepare a letter to the Authority recommending final acceptance and payment.

B. Closeout Package: The following items will be transmitted to the Contractor. The Contractor shall complete applicable items and return to the Contracting Officer.

1. Final Acceptance Letter
2. Contractor's Affidavit of Payment of Debts and Claims
3. Contractor's Affidavit of Release of Liens
4. Contractor's Release Form
5. Consent of Surety Company to Final Payment

C. Contractor's Releases: In accordance with the contract, the Contractor shall submit an affidavit that all applicable bills have been paid, thereby releasing the Authority from all claims arising by virtue of the contract, other than any claims specifically stated on the Contractor Release Form. Fiscal close-out of the contract will not necessarily be delayed pending decision on claims that are before the Authority.

D. Final Payment: After completion of the foregoing requirements, the Contractor shall prepare the final pay application.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

PART 4 - MEASUREMENT AND PAYMENT

4.1 GENERAL

- A. In accordance with Section 01001, "General Requirements"

END OF SECTION 01770

**SECTION 01785  
PROJECT RECORD DOCUMENTS**

The provisions of the DART Standard Specification Section 01785, "PROJECT RECORD DOCUMENTS", shall apply to the Work as modified herein.

**PART 1 - GENERAL**

**1.2. REFERENCED STANDARDS:**

- B. Removed
  - 1. Removed

**1.5. RECORD (AS-BUILT) DRAWING SET**

- C. Contractor shall use prints of the full-size drawings for its Working (As-Built) Drawing set and shall transfer the information from the Working (As-Built) Drawing set to the **half**-size Record (As-Built) Drawing set for final delivery to the Contracting Officer.
- I. Contractor shall submit Record (As-Built\_Drawings to the Authority as electronic files.
- 5. Contractor shall provide electronic file for as-built survey and an electronic PDF copy of the 11x17 construction redlines.

**END OF SECTION 01785**



**SECTION 01785  
PROJECT RECORD DOCUMENTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section includes specifications for preparation, maintenance, completion, and submission of project "as-built" drawings, specifications, and related documents for record purposes as required.

**1.2 REFERENCED STANDARDS**

- A. Institute for Electrical and Electronic Engineers (IEEE)
  - 1. IEEE 1016 – IEEE Standard for Information Technology – Systems Design – Software Design Description
- B. Dallas Area Rapid Transit (DART)
  - 1. DART Light Rail Project Design Criteria Manual – Volume III: Drafting (CADD) Standards (DART CADD Standards)

**1.3 SUBMITTALS**

- A. Contractor shall submit the following sets for approval by the Contracting Officer prior to final payment for the contract.
  - 1. Working (As-Built) Drawings: original markup set.
  - 2. Working (As-Built) Specifications: original markup.
  - 3. Record (As-Built) Drawings: original vellum set.
  - 4. Record (As-Built) Specifications: original markup.
  - 5. Record Shop Drawings Including Product Data.
  - 6. As-Built Survey.
- B. Submit the following record documents prior to substantial completion:
  - 1. Record Sample Submittal.
  - 2. Miscellaneous Record Submittals.

**1.4 MAINTENANCE OF RECORD DOCUMENTS**

- A. Maintain at the jobsite 1 copy of the following documents for record purposes:
  - 1. Conformed Contract Documents. One set of prints and specifications (Working (As-Built) Drawings and Specifications) shall be maintained for recording "as-built" revisions and special features.
  - 2. Changes.
  - 3. Approved Shop Drawings including product data.
  - 4. Clarifications or Explanatory Details and Specifications.
  - 5. Inspection Reports.
  - 6. Laboratory Test Records.
  - 7. Field Test Reports and Records.
  - 8. Inspection Tags: Mount "green" inspection tags on 8-1/2 inch by 11 inch paper, identify as to item that was inspected, and submit a copy as they are received in the field.
- B. Store documents used for record purposes in the Contractor's field office or other approved location, apart from documents used for construction. Do not use record documents for construction purposes. Protect from deterioration in a secure fire and heat-resistive location.
- C. Provide files and racks for storage of documents.
- D. Maintain documents in clean, dry, legible condition.
- E. Label each document "as-built" or "Record Documents" as appropriate.
- F. Provide access to Working (As-Built) Drawings and Specifications for the Contracting Officer's inspection during normal working hours

**1.5 WORKING (AS-BUILT) DRAWING SET**

- A. Maintain at the job site, a current working (blueline or blackline) set of as-built drawings, reflecting any and all changes, revisions, clarifications, and actual field conditions to date. The Authority will accept in-progress drawings based on redlines or CADD electronic files for review and certification of ongoing preparation and maintenance of as-built documents.

- B. Contractor shall maintain an index to the drawing set which shall be manually updated upon receipt of revised drawings. This index shall show, at a minimum, the drawing number, revision number, sheet number, and any drawings deleted. Revised drawings shall be inserted into the working set immediately. The working set shall be maintained in current construction status as the project progresses.
- C. For preparation and maintenance of the working set, the Contractor shall physically and legibly draw or mark on the most recent design-issued drawing revision with dark pencil to fully and accurately record the permanent construction as actually made and shall include to the following specific items.
1. Transfer all construction identification information, dimensions, and materials from RFI's, clarifications, field adjustments, and revisions.
  2. Include only those RFI's that change locations or dimensions of the work on the working and record as-built sets. Clarification RFI's which do not change what is indicated on the plans shall not be noted on the drawings.
  3. Field changes of facility dimension and detail not otherwise recorded by contract change or modification drawings.
  4. Give particular attention to concealed work that would be difficult to measure and record at a later date. No work shall be permanently concealed until the required information has been recorded and verified by the Contracting Officer.
  5. Show underground utilities by station and offset, not real world coordinates. Reference buried and concealed piping underground services and utilities to permanent construction or permanent surface control points. Record concurrent with actual installation complete plan and profile information (including layout geometry adequate to reestablish the locations and depths of the new and existing man-made improvements, list of fittings, material types and sizes) of utilities. Include changes of direction and elevations of utilities.
  6. Dimension locations of all concealed appurtenances from visible accessible features of structures.
  7. Show as-built information for each utility on the contract drawings for that particular utility only. As-built conditions for a utility shall not be shown on other utility drawings. In other words, as-built conditions for water lines will be shown on water line drawings, but shall not also be duplicated on electrical or communications drawings where the waterline might also be shown. Utility composite drawings shall not be marked with as-built conditions. These drawings shall be annotated to refer to specific utility drawings for as-built conditions for a particular utility.
8. Where the Contract Drawings are not of sufficient size, scale, or detail, the Contractor shall furnish its own drawings for incorporation of details and dimensions.
  9. Nomenclature and labels shall correspond to actual labels on installed equipment.
  10. Each connection to each piece of equipment, junction box, or terminal block shall be identified by function and color code.
  11. Dimensions, physical details, connections, and other information pertinent to system diagnostics, maintenance, or troubleshooting shall be shown.
- D. Incorporate Request for Information (RFI's) responses when a design-issued drawing revision has not been received, is not required or is not appropriate at the time of receipt of the RFI response:
1. If an RFI affects a drawing, the information shall be transferred to the Working (As-Built) Drawing set.
  2. If an RFI response is too extensive to be drawn on the face of the drawing:
    - a. The area affected by the change shall be clouded and reference made to the specific RFI on the face of the drawing.
    - b. This shall be supported by a legible copy of the RFI, with the RFI number clearly shown, copied onto a full-size (22 inches by 34 inches) sheet of paper. This copy will be inserted directly behind the affected drawing, followed by sequential character, (i.e., 250a, 250b) until all inserted pages affecting the specific drawing are included.
  3. If an RFI affects more than one drawing, the change shall be drawn on the face of each drawing affected or a legible copy of the RFI shall be inserted behind each drawing so affected. The copies will bear the appropriate page number(s).
  4. The information changed by the RFI response may appear in a later design-

- issued drawing revision, if appropriate. Until that time, the Contractor will continue to carry the RFI response information forward on later revision(s) of the drawing.
- d. PDF's of the drawings shall be included and all PDF's, electronic CADD files and hard copies shall match one another.
- E. Sketches: Incorporate a sketch provided with an approved and issued contract change in the following manner:
1. The information changed by the use of the sketch will be included in the next revision of the specific drawing issued by the Authority.
  2. In all other respects, sketches shall be incorporated into the as-built drawing in the same manner as RFI response specified above. The only difference being that the contract change number shall be referenced on the face of the drawing, instead of the RFI number.
  3. If a copy of the sketch is attached, it shall be legible and shall show the originating change number.
- F. When a design-revised drawing is received, the Contractor shall verify that it is complete and accurate to date for design changes, including RFI and sketches used during construction.
- G. Upon approval of the contents of the as-built set by the Contracting Officer, the Contractor shall transfer the as-built information to the record vellum copy as provided in Article entitled "Record (As-Built) Drawing Set" herein.
- H. Contractor shall submit current original Working (As-Built) Drawings to the Authority as electronic files.
1. The files shall be digital electronic Computer Aided Design and Drafting (CADD) files created by Bentley Systems, Inc., use most current version of MicroStation software.
  2. Digital electronic CADD files shall be created in compliance with the most current version of the Authority's CADD Standards.
  3. Digital electronic CADD files shall be provided to the Authority on CD ROM disk or DVD and each CD ROM or DVD shall:
    - a. Be provided in a protective cover.
    - b. Have an exterior label.
    - c. Contain an index of the CD ROM OR DVD's contents that lists each file name along with a file description.
4. The electronic files shall be named using the accepted naming convention specified in the current DART CADD Standards.
- 1.6 RECORD (AS-BUILT) DRAWING SET**
- A. At Notice to Proceed (NTP), the Authority will provide a vellum set of drawings for the Contractor's use for reproduction, as well as for final submittal of Record (As-Built) Drawing deliverable. As contract changes occur and drawings are revised, the Authority's Configuration Management Section (through the Contracting Officer) will provide vellum copies of the associated drawings to the Contractor for placement in the vellum set. The superseded vellum shall be pulled from the set and retained for record purposes.
- B. Contractor shall maintain a full size vellum set of Contract Drawings in clean, undamaged condition.
- C. Contractor shall use prints of the full-size drawings for its Working (As-Built) Drawing set and shall transfer the information from the Working (As-Built) Drawing set to the full-size Record (As-Built) Drawing set (vellum) for final delivery to the Contracting Officer.
- D. Contractor shall mark with black ink (preferred) or dark pencil to show actual installations which vary from the work as shown on the latest design-issued revision, clouding the area(s) affected and assigning the next sequential revision number for each drawing to identify it as the record (as-built) submittal. The revision number shall appear in three places on a drawing:
  1. In the revision description block, lower left-hand corner, by assigning the next sequential number for the specific drawing. In the description area, indicate "Record (As-Built) Submittal" and enter the appropriate date.
  2. In the revision number block, lower right-hand corner, by lining through the current revision number and entering the same number on each drawing as entered in Paragraph 1. above.
  3. On the face of the drawing, by each cloud or connected to each cloud by leader lines.
- E. Contractor shall update the index to reflect the actual contents of the Record (As-Built) Drawing set to accurately reflect the contents therein, by drawing number, revision number, and sheet number. Any drawings that have been deleted shall be so indicated on the index.

- F. Each cover sheet, index sheet and drawing sheet in the Record (As-Built) Drawing set shall be stamped with a Contractor-provided certification stamp worded exactly as in Figure 01785-1 and sealed and signed by a Professional Engineer registered in the State of Texas.
- G. The cover and index sheets shall be signed by an officer of the Contractor's organization, certifying compliance with the as-built conditions.
- H. Organize record (as-built) drawing sheets into manageable sets; bind with durable paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
- I. Contractor shall submit Record (As-Built\_ Drawings to the Authority as electronic files.
  - 1. The files shall be digital electronic Computer Aided Design and Drafting (CADD) files created by Bentley Systems, Inc., use most current version of MicroStation software
  - 2. Digital electronic CADD files shall be created in compliance with the Authority's CADD Standards.
  - 3. Digital electronic CADD files shall be provided to the Authority on CD ROM OR DVD and each CD ROM OR DVD shall;
    - a. Be provided in a protective cover.
    - b. Have an exterior label.
    - c. Contain an index of the CD ROM OR DVD's contents that lists each file name along with a file description.
    - d. PDF's of the drawings shall be included and all PFR's , electronic CADD files and hard copies shall match one another.
  - 4. The electronic files shall be named using the accepted naming convention specified in the current DART CADD Standards.
  - 5. Contractor shall provide 1 set of electronic files for sheet files (drawings) and 1 set of electronic files for reference files. The electronic, MicroStation files must match the hard copy submitted to the Authority. Multiple versions of the same electronic file will not be accepted. PDF's of the drawings and specifications will also be submitted with the electronic CADD files.
  - 6. During the progress of the Work, maintain 1 electronic copy and 1 hard copy of the latest annotated source code of software and application.

## 1.7 WORKING (AS-BUILT) SPECIFICATIONS

- A. During the progress of the work, maintain at the job site a current working copy of the Specifications reflecting current construction status for Contracting Officer's review, including Amendments Addendums, contract changes, and RFI's that affect the project and are not for clarification only and similar modifications issued in printed form during construction. Maintain Working (As-Built) Specifications in 1 or more large-ring, 3-ring binder or binders.
- B. Contractor shall markup in dark pencil variations in the actual work in comparison with the text of Specifications and modifications, selection of option, and similar information on work where it is concealed or cannot otherwise be readily discerned at a later date by direct observation. Note, related working (as-built) drawing information where applicable.
- C. Record information, changes, and notes in the specifications in blank areas, such as page margins or the backs of opposite pages, or on separate sheets inserted in the binder.
- D. In applicable specification sections, record the manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually furnished and installed.
- E. The record specifications shall be complete and shall include all applicable Contract Documents other than drawings.
- F. Contract Changes:
  - 1. Contract Changes shall be incorporated into the front of the record specifications in reverse chronological order. Use appropriate page dividers to identify Contract Changes and to separate Contract Changes from the Specifications.
  - 2. In addition, changes to the Specifications effected by Contract Change shall be annotated on the affected page or pages of the Specifications or adjacent thereto.
- G. Upon completion, transfer the current information to the Record (As-Built) Specifications copy as directed in Article entitled "Record (As-Built) Specifications".

## 1.8 RECORD (AS-BUILT) SPECIFICATIONS

- A. Contractor shall use the Working (As-Built) Specifications and transfer the information to the Record (As-Built) Specifications, using black ink for final delivery to the Contracting Officer.
- B. Contractor shall update the table of contents to reflect the actual contents of the Record (As-Built) Specifications to accurately reflect the contents

therein by section number. Any sections that have been added or deleted shall be so indicated on the table of contents.

- C. The cover and table of contents pages shall be signed by an officer of the Contractor organization, certifying compliance with the as-built conditions.
- D. Organize Record (As-Built) Specifications into manageable binders; print suitable titles, dates, and other identification on the cover of each binder.

### 1.9 OTHER RECORD SUBMITTALS

- A. Record Shop Drawings Including Product Data: During the progress of the Work maintain 1 copy of each shop drawing and product data submittal, and mark-up variations in the actual Work in comparison with the submitted information. Submittals shall be clearly revised, completed, and brought up to date, showing permanent construction as actually made. Include both variations from the manufacturer's instructions and recommendations for installation. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned at a later date by direct observation. Note related Changes and mark-up of Record (As-Built) Drawings and Specifications. Upon completion of mark-up, submit complete set to Contracting Officer for record.
  - 1. One complete full-size set of approved Shop Drawings, including manufacturers' printed catalog cuts and data, shall be collected and maintained for record purposes. Maintain in clean, undamaged condition.
  - 2. All pages of catalog cuts shall be clear, legible, and permanent.
  - 3. Shop Drawings shall be filed and maintained separate from Contract Drawings. Shop Drawings shall be filed in 9 inch by 12 inch file folders to the greatest extent possible and shall be indexed in accordance with the Contract Specifications as herein before specified.
  - 4. Shop Drawings shall be delivered in new boxes as specified in Article entitled "Submission of Documents" herein.
- B. Record Sample Submittal: Immediately prior to the time(s) of substantial completion, the Contracting Officer and the Contractor will meet at the Site, and determine which of the submitted samples maintained by the Contractor during the progress of the Work shall be transmitted for record purposes.

- C. Miscellaneous Record Submittals: Immediately prior to the time(s) of substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Contracting Officer for record.
- D. As-Built Survey: Refer to Section 01722, "Field Engineering – Surveying", for requirements.

### 1.10 SUBMISSION OF DOCUMENTS

- A. At completion of the Work, and before requesting final inspection, deliver as-builts and record documents to the Contracting Officer.
- B. Record documents shall be delivered neatly and efficiently filed and packaged in appropriate file storage cabinets or boxes, 12 inches by 15 inches in size. Boxes shall be type manufactured for file folder storage, shall have covers and cutout handles, and shall be accurately identified as to the contents. Include a packing list of all boxes and their contents. As-built drawings shall be folded correctly, with title block clearly visible on top, to fit neatly in the 12-inch by 15-inch boxes. Record (As-built) Drawings shall not be folded.
- C. Submission of record documents shall be accompanied with a transmittal letter, in triplicate, containing the following information:
  - 1. Date of submission.
  - 2. Project title and number.
  - 3. Contractor's name and address.
  - 4. Title and number of each record document. (Shop Drawings may be grouped in basic categories or divisions of work and by box identification.)
  - 5. Certification that each document as submitted is complete and accurate.
  - 6. Signature of Contractor, or its authorized representative.

### 1.11 WORKING (AS-BUILT) SOFTWARE AND APPLICATION LOGIC

- A. During the progress of the Work, maintain 1 electronic copy and 1 hard copy of the latest annotated source code of software and application logic source code and listings for the Authority's review. The code and listings shall be kept on site at the Contractor's Field Office, in 3-ring binders. Code and logic for each process shall be kept in a separate notebook. Electronic copies corresponding to the listing shall be kept in pockets in each of the binders. The contractor shall discuss with DART the software to be used and shall be agreed upon by the Authority and the contractor.

**1.12 RECORD (AS-BUILT) SOFTWARE AND APPLICATION LOGIC**

CD ROM OR DVD shall be provided.

- A. Contractor shall use the approved Working (As-Built) Software and Application Logic and transfer the information to the Record (As-Built) Software and Application set for final delivery to the Contracting Officer.
- B. Contractor shall update the index to reflect the actual conditions of the Record (As-Built) Software and Application set by location name/ number and revision number.
- C. An officer of the Contractor's organization, certifying compliance with as-built conditions, shall sign the cover and index pages.

- c. Printed copy shall be bound in 1 or more 3-ring binders.
- d. A key to the specification method(s) and a table of contents shall be provided with each binder.

3. Software Listings Document:

- a. Software listings shall be organized consistent with the Software Version description Document and shall describe current inventories and history of all software revisions loaded onto a particular platform.
- b. The Software Listings Document shall be submitted in 8.5 inch by 11 inch in laser-quality printed format.
- c. Four laser-quality printed copies of the Software Listings Document and 1 electronic copy on CD ROM OR DVD shall be provided.
- d. Printed copy shall be bound in 1 or more 3-ring binders.
- e. A key to the specification method(s) and a table of contents shall be provided with each binder.

- 4. Software source code shall be provided in machine readable format, shall correspond to the software listings, and shall be organized consistent with the Software Version Description Document. Four laser-quality printed copies of the machine-readable software source code and 1 electronic copy on CD ROM OR DVD and all tools to view and/or modify the code shall be provided.

**PART 2 - RODUCTS**

Not Used.

**PART 3 - EXECUTION**

Not Used.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. In accordance with Section 01001, "General Requirements"
- B. Refer to Section 01220, "Measurement and Payment", for submittal of as-built certification with each pay request.

**1.13 RECORD SET**

- A. The following As-Built Software Documentation shall be provided for any software item supplied under this Contract:

1. A Software Design Description (SDD) document:

- a. Contractor shall provide a traditional SDD document in accordance with IEEE 1016.
  - 1) The Authority may consider a Contractor alternative SDD submittal if the Contractor's SDD Submittal provides the IEEE 1016 Standard SDD technical content.
  - 2) The Authority retains the unilateral right to approve or disapprove any Contractor alternate SDD submittal.

- b. The Software Design description shall be submitted in 8.5 inch by 11 inch laser quality printed format in 1 or more 3-ring binders. A key to the specification method(s) shall be provided with each binder. A table of contents shall be included. Four laser-quality printed copies of the Software Design Description and 2 electronic copies on CD ROM OR DVD shall be provided.

2. Software Version Description Document:

- a. The Software Version Description Document shall be submitted in 8.5 inch by 11 inch laser-quality printed format.
- b. Four laser-quality printed copies of the software Version Description Document and 1 electronic copy on

**FIGURE NO. 01785-1**

**Record (As-Built) Certification Stamp**<sup>1</sup>

To be used by the Construction Contractor

Record (As-built) Certification

"Having checked this submission, we certify that it conforms to the requirements of the contract in all respects, except as otherwise indicated."

Company Name: \_\_\_\_\_

Officer of Firm Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Officer of Firm Name (typed): \_\_\_\_\_

Title of Officer (typed): \_\_\_\_\_

Seal of Professional Engineer of Construction Contractor, including signature and date, thereby sealing record (as-built) drawings for accuracy of as-built condition reflected herein, must be placed below:

<sup>1</sup> Stamp size shall be 2" x 4" for full-size drawings and 1-1/2" x 3" for half-size (11" x 17") drawings. The title of the stamp, company name, and statement regarding sealing shall be font size 12; all else shall be font size 10.

END OF SECTION 01785

**SECTION 01786**  
**OPERATION AND MAINTENANCE INSTRUCTIONS**

The provisions of the DART Standard Specification Section 01786, "OPERATION AND MAINTENANCE INSTRUCTIONS", shall apply to the Work as modified herein.

**PART 1 - GENERAL**

**1.2. SUBMITTALS**

A. Manuals

2. "6 complete bound sets of instructions" shall be replaced with "one electronic PDF copy of the instructions."

**END OF SECTION 01786**



**SECTION 01786  
OPERATION AND MAINTANCE INSTRUCTIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. Operation and Maintenance Manuals and training provided under this Section shall provide the Authority's personnel with the knowledge to operate, maintain, troubleshoot, and repair the installed equipment and systems provided by these Specifications.

B. Provide the following for each make and model of equipment and system installed or modified under this contract:

1. Posted operating and maintenance instructions for installed equipment and systems.
2. Preparation and submission of an Operation and Maintenance Manual(s) for installed equipment and systems hereinafter referred to as the O&M Manual.
3. Operation and maintenance training.

C. Manuals

1. General and specific content requirements for equipment and system manuals required under this Contract can be found in these Specifications.
2. Information to be provided shall include all required information required for the operation, maintenance, troubleshooting, repair, and restore of the equipment and systems.
3. Provide where directed, printed sheets under framed clear acrylic plastic, giving brief, concise operating and maintenance instructions for all items of mechanical and electrical equipment and similar equipment and specialty items, as applicable, at their respective locations.

D. Training Program

1. The Authority will assign supervisory, maintenance, and other personnel to the Contractor's training classes as required, at an Authority location with adequate seating and required lighting.
2. Each training course shall be held on consecutive days, excluding weekends and holidays. Each day's training shall be for 8 hours, unless otherwise specified. Training schedule shall accommodate all personnel on all shifts. Specific training days and availability shall be coordinated with the Authority at least 2 weeks prior to

commencement. Instructors present at the class location shall conduct training.

3. Courses shall include hands-on training. The Authority will provide transportation to the field locations to allow for hands-on training if required.
4. Course instructors shall be certified professional instructors and shall have performed training in similar systems before, and shall be adept in the use of the training and test equipment employed in the training program.
5. The Authority reserves the right unto itself to videotape all training sessions for its own use. Video taped training material will become the property of the Authority and shall not be subject to Contractor copyright protection.
6. In addition to the personnel specified to receive training herein, up to 2 additional personnel may observe and participate on any or all training classes, including hands-on training.

**1.2 SUBMITTALS**

A. Manuals

1. Refer to Section 01330, "Submittals", for submittal requirements and procedures, "minimum 21 days" to "minimum 30 days" for review.
2. A minimum of 60 days prior to the Contractor's request for final inspection in accordance with Section 01770, "Contract Closeout", submit to the Contracting Officer 6 complete bound sets of instructions for each equipment and its component parts, including manufacturers' certificates, warranty slips, parts lists, descriptive brochures, and maintenance and operating instructions, printed on 20-pound bond white paper, for all equipment and systems installed, tabbed and identified for easy reference. Preprinted material, photo copies not acceptable, provided by the manufacturer may be used as provided if approved by the Contracting Officer. All copies of manuals shall be legible with no portions of the text obscured or deleted.
3. Even though the O&M Manual is referred to herein in the singular, provide the Manual in as many volumes as necessary to accommodate all the information needed to complete the Manual. It may be more appropriate to submit certain items

OPERATION AND MAINTENANCE INSTRUCTIONS

of equipment, such as elevators and escalators, in separate volumes.

4. Defects discovered on review will be indicated in the O&M Manual or otherwise communicated to the Contractor in writing upon return of the O&M Manual set.
  5. Within 30 days after receipt of an O&M Manual marked "Approved as Noted – Correct and Resubmit" or "Disapproved", revise the Manual in accordance with the directions for revision and resubmit 6 sets of the revised Manual for review. The Contracting Officer will review and return the resubmitted O&M Manual in the same manner and time as specified above for the original submittal.
  6. Within 30 days after receipt of the O&M Manual marked "Approved" or "Approved as Noted - Confirm", revise the Manual in accordance with revisions noted, if any, and furnish 6 sets of the O&M Manual in final form. The original 6-set submittal shall not be considered included in the 8 sets of the Manual in final form. Equipment will not be accepted until the final O&M Manuals are submitted.
  7. Final copies of all manuals shall be submitted for Authority approval. Contractor developed manuals shall be provided in an Authority approved machine-readable format, suitable for microfilming. When available, manufacturer manuals and technical data shall be provided in an Authority approved machine-readable format. Final copies of all manuals shall also be provided electronically, in both their native software format and PDF format, complete with any associated appendices.
- B. Format: O&M Manual(s) shall include title page, table of contents, and frontispiece; information covering description, installation, operation, preventive maintenance, corrective maintenance, overhaul, parts list, and list of recommended spare parts; and an appendix. Each separate volume shall have a title page, contents page, frontispiece, and other information specified herein
1. Title Page: Include the name and function of the equipment, manufacturer's identification number, and the Contract Specifications number and title.
  2. Table of Contents: List sections and subsection titles of the O&M Manual with reference to the page on which each starts and a list of included drawings.
  3. Frontispiece: A Recognition illustration of the equipment described in the Manual.
4. Print Operation for O&M Manuals: Print O&M Manuals on high quality gloss paper, oil resistant with mylar reinforced binding. Pages shall be 8-1/2 inches by 11 inches in size or folded to that size, and placed in a 3-ring binder. Reduce drawings included with manuals to 11 inches by 17 inches and fold to open cut clear of the main text. Each binder shall not be filled more than 2/3 of its capacity. Bind each manual of each set in a heavy-duty 2 inch, 3-ring vinyl-covered binder and include pocket folders for folded sheet information. Mark identification on both the front and spine of each binder. Photo copies not acceptable
- C. Training Plan: Contractor shall submit 6 copies of the complete training plan, at least 60 days prior to the scheduled start of the course for Authority approval. The training plan shall include the following information:
1. Proposed schedule for each course, including syllabus for training and lesson plan
  2. Resumes of personnel proposed to be instructors for each course
  3. Statement of the purpose of the training
  4. Overview of the subjects to be covered in each course
  5. Overview of the hands-on experience to be included as part of each course
  6. List of the manuals, As-Built Documentation, and other printed materials to be utilized as training aides
  7. Description of the pre-requisite knowledge for each course
- D. Training Course Program: Contractor shall submit 6 copies of the complete program for each course, at least 60 days prior to the scheduled start of the course for Authority approval. Each training program shall contain the following information:
1. Detailed outline of the material to be covered in the course and the duration in hours of the training for each topic
  2. Course scheduling plan to cover all shift personnel.
  3. Copies of all visual aides, manuals, As-Built Documentation, and other printed materials to be used during the course.
  4. Detailed descriptions of the procedures to be performed by students during hands-on

- training, including test equipment to be used
- 5. Specific pass/fail criteria for the course, including a sample test, and a statement of the knowledge and skills students should possess at the conclusion of the course
- 6. Instructor Evaluation Survey
- E. Training Materials: Contractor shall deliver all training materials to the Authority 5 days prior to the commencement of the associated training class
  - 1. Delivery location of associated materials shall be coordinated with the Authority personnel.
  - 2. Sufficient copies shall be provided to accommodate all class attendees as well as auditors.
  - 3. The Authority reserves the right to duplicate all training material to accommodate additional personnel.
  - 4. Additional personnel may be added to the attendance roster at no additional cost to the Authority.
- 4. Prior to final acceptance, Contractor shall obtain a letter addressed to the Authority from each manufacturer of major equipment and systems stating the Authority will be informed of manufacturer's revised operations and maintenance recommendations, call-backs, availability of new software, and similar items in regard to the equipment and systems provided under the Contract.
  - a. All manufacturers' revisions shall submitted no later than 60 days following such revision. Such revisions shall be issued by replacement pages to the final O&M Manual, or by reissue of the O&M Manual, at the Contractor's Option.
- 5. Safety Procedures and Precautions
  - a. Ensure safety procedures and precautions are included by using a standard highlighting method.
  - b. Include procedures and precautions required to prevent damage to equipment, injury to personnel, or unsafe operational conditions.

**PART 2 - PRODUCTS**

**2.1 MANUALS FOR INSTALLED EQUIPMENT AND SYSTEMS**

- A. Contractor shall provide new custom manuals for each piece of equipment and system provided under this Contract.
- B. General requirements in addition to those specified in other sections of this contract include:
  - 1. Manufacturer's standard O&M Manuals, documentation, and configuration software, as applicable, provided with each furnished equipment and system.
  - 2. Manufacturer's Contact Information
  - 3. Manufacturer's Basic Product Information, including;
    - a. Literature describing each piece of equipment, including drawings and diagrams, physical function description of the equipment, major assemblies and subassemblies, and giving manufacturer's model number and drawing number.
    - b. Catalogue cut sheets, illustrated parts list and parts breakdowns.

**2.2 O&M MANUALS GENERAL REQUIREMENTS**

- A. Organize O&M procedures in such a manner that all required preventive maintenance activities be accomplished without interference with operations. Emphasize in these procedures accessibility, ease of equipment or component removal and replacement, visual indications of component deterioration, and localization of failures.
- B. Identify O&M tasks including recommended periodic maintenance, precautions to be observed during maintenance work, degree of on-line repairs, numbers, qualifications and skills of personnel, special tools and test equipment, and estimates of maintenance time.
- C. Prepare O&M manuals providing detailed instruction for the operation of each installed equipment and system condition; maintenance and safety actions required to ensure the operational requirements of the systems or item of equipment. Identify any safety markings, tags or similar identifiers to be maintained on any equipment.
- D. Prepare O&M manuals with vendor instructions and data covering the O&M of individual equipment and system provided. Include all configuration and software documents or CD-ROM or DVD's supplied with the equipment. Use this data as the training material for the individuals tasked to operate the installed equipment and

## OPERATION AND MAINTENANCE INSTRUCTIONS

systems. Information of material or equipment not provided for or used in the work shall be deleted from the O&M Manual.

E. Include in the manuals system-level step-by-step O&M procedures to be performed by journeyman operators or technicians, and provide the following elements, as required:

1. **Equipment Description:** Complete description of all systems with shop drawings, data sheets, bill of materials, flow, emergency instructions, spare parts listing, warranties, guarantees, wiring diagrams, recommended turn-around cycles, control and electrical circuit and wiring diagrams.
2. **Installation Instructions:** Installation instructions shall cover pre-installation inspection, installation, testing, and calibration; and preparation for operation, both for initial installation and for installation after overhaul.
3. **Operation Information:** This information describes the system operation, including operating parameters, interfaces with other systems, major equipment, and their physical and operating characteristics. The information shall also include performance specifications and operating limitations.
4. **Pre-operation Checkout:** Include the required steps or tasks to completely check out the system and prepare it for operation following a shutdown condition.
5. **Operator's Instructions:** Operator's instructions shall cover startup, shutdown and all procedures required to ensure safe operation. Repeat these instructions in a durable printed notice and mount in the operator's area.
6. **Preventive Maintenance:** Describe all maintenance to be performed on a periodic basis, e.g., cleaning, lubrication, adjustments, inspection, calibration, voltages and amperage. Prepare scheduled maintenance checklists for each unique type of maintenance significant equipment. Submit the checklists to the Authority approval prior to implementation.
7. **Maintenance Information:** Describe all maintenance instructions, step-by-step, that can be performed on installed equipment, including adjustments, repair, overhaul, disassembly, reassembly, replacement, and repairs that can be performed. A list of special tools which are required for the maintenance shall be included with the maintenance information.

8. **System Restore:** Describe step-by-step procedures for complete system restore in case of a catastrophic failure. Identify any specific tools required for system restore. Provide details of all user configurable settings for each piece of equipment.

F. **Logistics Data:**

1. Provide a logistics plan of O&M, including the required data on requirements for O&M logistics, support and procedures. Logistics plan shall include the following:
  - a. Identification of the extent to which preventive maintenance is performed on installed equipment as opposed to corrective maintenance performed at a maintenance facility.
  - b. Identification of equipment requiring special handling or unique maintenance procedures.
  - c. Determination of procurement lead times based on total order and shipping time to site for critical equipment and spares, and minimum and maximum inventory requirements.
  - d. Identification of O&M personnel skills levels.
  - e. Identifications of training requirements.
  - f. Formulate and recommend operating rules for personnel.
2. **Vendor Data:** Submit the following types of data and incorporate in the O&M manuals:
  - a. Manufacturers' brochures, catalogs, charts, performance curves, service and parts bulletins
  - b. Complete vendor list for each system subassembly
  - c. **Installation:** Parts breakdowns, drawings and service instructions, removal and installation procedures
  - d. **Operations:** Standard and emergency operating procedures, hazards from unsafe operations, emergency release/stop functions
  - e. Preventive maintenance and inspection requirements and procedures including cleaning

## OPERATION AND MAINTENANCE INSTRUCTIONS

- instructions, special tools and test equipment
- f. Shop drawings and other special drawings such as wiring diagrams, system schematics, assembly drawings, and inter-connection wiring diagrams.
- g. Performance data, e.g., maximum, minimum, and recommended speeds, capacities, voltage, amperage, wattage, temperatures, and other related operating information.
- h. Disassembly and assembly procedures
- i. Calibration instructions, including points of application, frequency, method of calibration, and special tools required.
- j. Troubleshooting procedures.
- k. Repair and overhaul instructions.
- l. Include industry or generic part numbers with component parts.
- m. Special tools and test equipment.
3. Special Tools and Test Equipment: Provide a list of special tools and test equipment for each equipment item, including tools and equipment designated specifically for use with the item, or usual tools and equipment required for operation maintenance of the items but not normally available to maintenance journeyman. Include following data on the list for each item:
- a. Nomenclature
- b. Purpose
- c. Manufacturer's part number or drawing number
- d. Manufacturer's name and address
- e. Quantity recommended by manufacturer
- f. Unit price
- g. Recommended source of supply
- h. Estimated lead-time
4. Parts and Spare Parts List: Coordinating with the requirements of this section and requirements specified in Section 01790,
- "Spare Parts and Maintenance Materials", provide a complete parts list and a list of recommended spare parts. For each item include the following data:
- a. Manufacturer's parts numbers and catalog item numbers if applicable, for identifying parts.
- b. Contact information, name, address and telephone number(s), for both Manufacturer and local vendor of parts.
- c. Parts or assemblies obtained from another manufacturer shall be identified by the name of that manufacturer and its identifying part number.
- d. Size, capacity, and other characteristics of each part shall be provided as required for identification.
- e. Include prices for all recommended spare parts.

## PART 3 - EXECUTION

### 3.1 SUPERVISOR FAMILIARIZATION AND OPERATIONS TRAINING REQUIREMENTS

- A. Contractor shall develop and provide Familiarization and Operations Training thoroughly describing the installed equipment and systems under this contract.
- B. Personnel and Course Composition
1. Training shall consist of at least 2 classes, each class designed for 3 operational personnel supervisors, 3 maintenance personnel supervisors, and 2 auditors [16 total personnel]. Each class shall be at least 8 hours in length, unless otherwise Authority approved.
2. Auditors shall be provided the same class materials, handouts, and access to the instructor, hands-on activity or demonstration as class participants.
- C. Training Goals: The goal of the Initial Familiarization and Operations Training is to provide the Authority's O&M supervisors with a high-level understanding of the installed equipment and systems sufficient for the supervisors to perform the following functions:
1. Assign maintenance personnel required for routine maintenance and troubleshooting.

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- 2. Assist maintenance personnel with use of manuals and As-Built Documentation.
- 3. Evaluate actual system performance vs. intended system performance.
- 4. Coordinate with equipment manufacturers support personnel for obtaining warranty support and troubleshooting support.

**3.2 TECHNICIAN FAMILIARIZATION AND OPERATIONS TRAINING REQUIREMENTS**

- A. Contractor shall develop and provide Familiarization thoroughly describing the installed equipment and systems under this contract.
- B. Personnel and Course Composition
  - 1. Training shall consist of at least 2 classes, each class designed for 12 maintenance technician personnel and 2 auditors for a total of 28 total personnel. Each class shall be at least 16 hours in length, unless otherwise Authority approved.
  - 2. Auditors shall be provided the same class materials, handouts, and access to the instructor, hands-on activity or demonstration as class participants.
- C. Training Goals: Initial Familiarization and Operations Training goal shall be to provide the Authority's O&M technicians with a high-level understanding of the installed equipment and systems, sufficient to perform the following functions:
  - 1. Perform routine maintenance and troubleshooting.
  - 2. Identify single points of failure and restore the affected subsystem in case of a catastrophic failure or incident.
  - 3. Become familiar with the use of manuals and As-Built Documentation.
  - 4. Test and evaluate actual system performance vs. intended system performance.
  - 5. Coordinate with equipment manufacturers support personnel for obtaining warranty support and troubleshooting support.

**3.3 OTHER O&M TRAINING REQUIREMENTS**

- A. Personnel and Course Composition: Training shall consist of at least 2 classes, each class at least 16 hours in length, and shall support up to 12 technician personnel and 2 auditors in each class

- B. Course Goals: Each training course shall provide maintenance personnel with the knowledge and skills required to:

- 1. Gain a thorough understanding of the operation of the equipment.
- 2. Gain familiarity with the specific components and their role.
- 3. Gain familiarity with drawings and other design and installation documentation.
- 4. Gain familiarity with and use procedures in the corresponding maintenance manual.
- 5. Be adept at using all tools, test equipment and built-in diagnostics and monitors.
- 6. Be adept at performing preventative maintenance.
- 7. Be adept at identifying the root cause of a subsystem failure and restoring the affected subsystem in the event of a catastrophic failure or incident.
- 8. Gain familiarity with the equipment or systems safety procedures and the potential for creating unsafe conditions during operation or maintenance.

**PART 4 – MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. The Work specified in this Section will not be measured separately for payment.

**4.2 PAYMENT**

- A. All costs connected herewith shall be considered incidental to the Work specified under Section 01001, "General Requirements".

END OF SECTION 01786

**SECTION 01790  
SPARE PARTS AND MAINTENANCE MATERIALS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section includes specifications for the furnishing and delivering of the spare parts and maintenance materials specified in the various sections of these Specifications as necessary to maintain the equipment and provide for emergency repairs for two years after the date of Acceptance of the Work by the Authority.
- B. This Section also includes providing all keys, special tools, and test equipment required to access, start, operate, monitor, maintain, and repair the equipment.
- C. Various specific and detailed requirements for parts lists, spare parts lists, spare parts, maintenance materials, keys, special tools, and test equipment are specified in the individual Sections of these Specifications, as applicable, and in the Contract Specifications.
- D. Coordinate the work of this Section with the work specified in Section 01786, "Operation and Maintenance Instructions", for Spare Parts Lists.
- E. Keys for finish hardware are specified in Contract Specifications Section 08710, "Door Hardware".

**1.2 SUBMITTALS**

- A. General: Refer to Section 01330, "Submittals", for submittal requirements and procedures.
- B. Spare Parts Lists:
  - 1. Prepare a form listing of recommended spare parts on a Recommended Spare Parts List (RSPL) for each individual piece of equipment that is of a maintenance significant nature.
    - a. Examples of Spare Parts are:
      - 1) One each of every lamp used in each light fixture
      - 2) One each of every type of circuit breaker or fuse used in electrical panelboard or fusible disconnect switches
      - 3) Recharge kit for chemical ground rods
      - 4) Required tools for maintaining electrical equipment

- 5) Spare keys for unlocking electrical panels or cabinets
- b. The equipment that each spare part is associated with shall be clearly noted.
- 2. Evaluate parts listed on the RSPL and advise the Contracting Officer of the Spare Parts quantities (minimum/maximum) required for a 24 month operation period (this period starts at the date of final acceptance). Base the evaluation upon the schedules shown, vendor data, interchangeability between sets, remote location of the Worksite and Operations and Maintenance (O&M) analysis to support maintenance of systems. Show a zero requirement in the minimum/maximum columns when none is required for any listed item. Indicate manufacturing lead time required for major items in RSPL that are critical to operation. The schedules show minimum required spare parts. Incorporate these quantities into the RSPL submittal to the Contracting Officer.
- 3. Use the RSPL form in submitting other spares requirements such as consumables, furnishings, tools, and materials to the Contracting Officer for approval.
- 4. Purchase spare parts designated by the Contracting officer from the Spare Parts Allowance. Spare parts shall be billed at the invoiced cost from the supplier.
- 5. The Spare Parts List shall be organized in accordance with the Contract Specifications, by Section number and title.
  - a. The Spare Parts List shall include the part's generic name or description, its trade name, Contractor's part number, manufacturer's name, manufacturer's part number, retail price, quantity, and correlation with the pertinent Contract Specifications, Contract Drawings, and Maintenance Manuals specified in Section 01786, "Operation and Maintenance Instructions".
  - b. Spare parts shall be grouped by equipment category. Replacement parts common to more than one category shall be cross-referenced and indexed. Such common parts shall have only one part number.

## SPARE PARTS AND MAINTENANCE MATERIALS

### C. Maintenance Materials List:

1. Prepare and submit a complete list of maintenance materials as specified in the various individual Sections of these Specifications, and in the Contract Specifications.
2. The Maintenance Materials List shall be organized in accordance with the Contract Specifications, by Section number and title. Include the quantities to be furnished.
3. Where maintenance materials are specified as a percentage of the materials installed, such percentages shall be translated to actual quantities of materials in the Maintenance Materials List.

### D. Keys, Special Tools, and Test Equipment List:

1. Prepare and submit a complete list of the keys, special tools, and test equipment as specified in the various individual Sections of these Specifications, and in the Contract Specifications.
2. The Keys, Special Tools, and Test Equipment List shall be organized in accordance with the Contract Specifications, by Section number and title.

3. One-Time Limited Service: Provide spare parts which normally require replacement after performing their function one time, such as fuses.
4. Long Lead Time: Provide spare parts for components which are not readily available from distributors, such as for custom-fabricated components. Long lead time shall be understood to mean longer than six weeks from receipt of order to delivery.
5. Exchange Assemblies: Provide assemblies which will be exchanged with malfunctioning units for installed equipment, and which must be inventoried as complete assemblies.

- C. Spare parts can only be used for repairs during the warranty period with written authorization of Contracting Officer. Spare parts so used shall be replaced at Contractor's expense.

## 1.4 MAINTENANCE MATERIALS

### A. Requirements:

1. Provide maintenance materials as specified in the individual Sections of the Contract Specifications.
2. Maintenance materials shall be identical to the materials installed in the Work.

- B. Quantities: Provide quantities of materials as specified in the individual Sections of the Contract Specifications.

## 1.5 KEYS, SPECIAL TOOLS, AND TEST EQUIPMENT

- A. Requirements: Provide sufficient keys, special tools and wrenches, and special test equipment and gages as required to access, start, maintain, and repair all the installed equipment, appliances, systems, and assemblies as specified in the individual Sections of the Contract Specifications.

1. In addition to those tools specified, special tools shall include any tools not readily available from local tool supply vendors.

- B. Quantities: Provide quantities of keys, special tools, and test equipment as specified in the individual Sections of the Contract Specifications.

## 1.6 BAR CODE

- A. Spare parts with the manufacturer's or supplier's serial number or other identification shall also be identified with bar codes, coded in accordance with the Authority's Bar Coding System (AIAG Auto

## 1.3 SPARE PARTS

### A. Requirements:

1. Provide specific spare parts as specified in the individual Sections of the Contract Specifications.
2. Spare parts shall be identical to the parts installed in the Work.

- B. Quantities: Except when specific quantities are specified in the individual Sections of the Contract Specifications, provide quantities based on reliability requirements, replacement lead time, the Contractor's recommendations, and the following requirements:

1. Wear: Provide spare parts for components which may be expected to require regular replacement under normal maintenance schedules, such as mechanical parts subject to continuous operation.
2. Consumability: Provide spare parts for components with a life-expectancy of less than 5 years.



## SPARE PARTS AND MAINTENANCE MATERIALS

Industry Code 39) or equivalent. The System details will be provided by the Contracting Officer.

will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

### 1.7 PACKAGING

- A. Comply with applicable requirements of Section 01600, "Product Requirements". Spare parts, maintenance materials, keys, special tools, and test equipment shall be securely packaged in boxes, with the boxes clearly labeled as to the contents. Such labeling shall include: location and description of the equipment and the item, complete listing of all items in the box, and the quantity of each item included in the box.

- B. Spare parts purchased from the Recommended Spare Parts List will be paid for under the Spare Parts Allowance. Spare parts compensated for under the Spare Parts allowance will not include those specific spare parts specified in individual Sections of the Contract Specifications and subject to the provisions of Article 1.3, Spare Parts, herein. Items purchased under the Spare Parts Allowance will not include maintenance materials specified in individual Sections of the Contract specifications.

### 1.8 DELIVERY

#### END OF SECTION 01790

- A. Ensure that the spare parts ordered are delivered to the Worksite before final acceptance of the facility by the Contracting Officer.
- B. Deliver spare parts, maintenance materials, keys, special tools, and test equipment to the warehouse location or locations specified in the Contract Specifications. Provide unloading service at the designated storage location for delivered products.
- C. Prepare formal receipts for such delivered products, and have them signed by the authorized Authority Representative at the location. A copy of such receipts shall be submitted to the Contracting Officer for information and record.

### 1.9 STORAGE

- A. Spare parts, maintenance materials, keys, special tools, and test equipment may be stored temporarily at the site of the work in suitable storage facilities until time to deliver these products to the locations designated in the Contract Specifications. Such storage shall comply with the requirements specified in Section 01600, "Product Requirements".

## PART 2 - PRODUCTS

Not Used.

## PART 3 - EXECUTION

Not Used.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.1 GENERAL

- A. Separate measurement or payment will not be made for work required under this Section except as provided for under the Spare Parts Allowance. Costs in connection with the work specified herein

**SECTION 02780**  
**UNDERGROUND ELECTRICAL AND COMMUNICATIONS DISTRIBUTION SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the construction of new ducts, manholes, and handholes for underground electrical and communications facilities.

**1.2 REFERENCE STANDARDS**

- A. American National Standards Institute (ANSI):

1. ANSI A14.3 - Ladders - Fixed - Safety Requirements.
2. ANSI A14.5 - Ladders Portable Reinforced Plastic - Supplement to Safety Requirements.
3. ANSI C80.1 - Rigid Steel Conduit - Zinc Coated (GRC)
4. ANSI/UL 651 - Standard for Schedule 40 and 80 Rigid PVC Conduit

- B. ASTM International (Formerly known as American Society for Testing and Materials) (ASTM):

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel
2. ASTM A48/A48M - Standard Specification for Gray Iron Castings
3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. ASTM A320/A320M - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service
5. ASTM A536 - Standard Specification for Ductile Iron Castings
6. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
7. ASTM C33 - Standard Specification for Concrete Aggregates
8. ASTM C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
9. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete

10. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

11. ASTM D3917 - Standard Specification for Dimensional Tolerance of Thermosetting Glass-Reinforced Plastic Pultruded Shapes

12. ASTM D4385 - Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products

13. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

14. ASTM F512 - Standard Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation

15. ASTM D3786 - Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method

- C. National Electrical Manufacturers Association (NEMA):

1. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit
2. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
3. NEMA TC 6 and 8 - Polyvinyl Chloride (PVC) Plastic Utilities For Underground Installations
4. NEMA Bulletin No. TCB 2-2000 - NEMA Guidelines For The Selection And Installation Of Underground Nonmetallic Duct

- D. American Association of State Highway Transportation Officials, Inc. (AASHTO)

1. AASHTO HB17 - Standard Specifications for Highway Bridges

**1.3 DEFINITIONS**

- A. Conduit: Individual electrical raceway.
- B. Duct: Assembly of conduits in configurations shown, concrete encased, with reinforcement.

**1.4 SUBMITTALS**

**A. Shop Drawings:**

1. Prior to manufacturing the Contractor shall submit for approval drawings for each cast-in-place manhole.
2. Prior to manufacturing the Contractor shall submit for approval typical drawings for each size and configuration of precast manhole, handhole, systems elements boxes and junction box with details of fabrication, assembly, accessories and joints.
3. Prior to manufacturing the contractor shall submit for approval diagrams of each manhole, handhole, system elements box and junction box, showing dimensioned locations for openings and knockout panels for express trough, duct and stub-up penetrations of manhole walls.
4. Prior to proceeding with Directional bores, Core bores and Hydro-jetting for duct bank and stub-up crossings/locations, submit for approval working plans, materials and installation details sufficient to fully indicate the crossing installation.
5. Submit, 21 days prior to installation, Shop Drawings representing planned conduit and/or Ductbank Work for this Specification Section.
6. In case of the any changes to the Systems Elements due to the actual site condition and/or conflicts with existing or proposed utilities, before proceeding with installation submit working drawings and shop drawings showing plan and scheduling for performance of the Work.

**B. Documentation:** Prior to manufacturing the contractor shall submit for approval calculations to demonstrate compliance with required load-bearing capacity, certified by a Professional Engineer, registered in the State of Texas.

**C. Certification:** Submit certificates on furnished material from manufacturers of materials.

1. Product data or certification indicating compliance of all elements with the standards and requirements listed in this section.

**D. Samples:**

1. Submit for approval sample, specification data, and manufacturer's installation instructions for nonwoven filter fabric.

2. Submit for approval sample and specification data for security bolts.

**1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Receive, transport, and store until use, those materials supplied by utility companies.

**1.6 QUALITY ASSURANCE**

- A. Comply with codes and regulations of the jurisdictional authority.
- B. Ladders and steps shall comply with OSHA Standards.

**1.7 MAINTENANCE MATERIALS PROVIDED**

- A. Furnish and deliver to the Contracting Officer, ten sockets to fit security bolts provided.
- B. Furnish fiberglass extension ladders in quantity, length, and type as shown on Manhole Schedule drawings and deliver to the Authority as directed by the Contracting Officer.

**PART 2 - PRODUCTS**

**2.1 CONCRETE WORK**

- A. Concrete formwork: As specified in Section 03100, "Concrete Formwork".
- B. Reinforcing steel: As specified in Section 03200, "Concrete Reinforcement".
- C. Concrete:
  1. Cast-In-Place: As specified in Section 03305, "Portland Cement Concrete", Mix S-7. Mix design for a Utility Company manhole shall be as required by the Utility Company for its facilities. Encasement for Underground Ducts shall be Mix M-1. Mix design for a Utility Company ductbank shall be as required by the Utility Company for its facility.
  2. Precast: As specified in Section 03430, "Structural Precast Concrete", Mix S-3 as specified in Section 03305, "Portland Cement Concrete".
- D. Flowable fill: As specified in Section 02220, "Grading, Excavating, and Backfilling".
- E. High-density polymer concrete (HDPC) for handholes, junction boxes and pull boxes: Sized as shown on the Manhole Schedule drawings.
  1. HDPC or aggregates bound together with polyester resin and/or reinforced with continuous woven glass strands or glass

fiber. Precast concrete shall be fire resistant and electrically non-conductive.

2. Precast HDPC concrete mix shall have the following certified, tested minimum characteristics:
  - a. Compressive strength (28-day): 10,300 psi
  - b. Tensile strength: 1,800 psi
  - c. Flexural strength: 3,600 psi
  - d. Modulus of elasticity:  $1.83 \times 10^6$
  - e. Freeze/thaw resistance (2,500 cycles): No change
  - f. Fire resistance (Maximum): 10 when tested in accordance with ASTM E84; or maximum burning rate of 0.3 inches per minute for each 0.1 inch of thickness when tested in accordance with ASTM D635
  - g. Shear (Minimum): 6,000 psi
3. Concrete formwork: As specified in Section 03100, "Concrete Formwork".
4. Quality assurance: As specified in Section 03300, "Cast-In-Place Concrete".

**2.2 COATINGS**

Not used.

**2.3 CONDUIT AND FITTINGS**

- A. PVC conduit and fittings:
  1. Concrete encased: ANSI/UL 651 or NEMA TC2; Type-Schedule 40 PVC.
  2. Direct burial: ASTM F512, Type DB-120.
- B. Galvanized rigid steel conduit and fittings: ANSI C80.1.
- C. Galvanized rigid steel conduit and fittings with polyvinyl-chloride external coating: NEMA RN 1

**2.4 SPACERS**

- A. Conduit spacers shall be installed in duct banks at the rate of 3 spacers per 20 linear feet or the equivalent, maximum interval of 78 inch centers along the entire conduit run. Plastic conduit spacers provided shall be specified for use in duct banks and be standard factory preformed spacers.

**2.5 END BELLS**

- A. Flared, smooth-surfaced fittings of same material as conduit; if fittings are of different material, include adapter for connection to conduit.

**2.6 AGGREGATE**

- A. Aggregate for Subgrade Foundation where required: ASTM C33, coarse aggregate No. 4 or No. 67.

**2.7 CHANNEL INSERTS**

- A. Fiber-reinforced polymer (FRP) channel shall be of pultruded glass-reinforced polyester or vinyl ester resin: ASTM D3917 and ASTM D4385, length and minimum width and depth sizes as shown on drawings, heavy duty, surface-mounted, slotted back with mounting slots on a maximum of 8 inch centers, channel configuration to accommodate standard metal framing fasteners.

**2.8 CABLE PULLING IRON**

- A. Fabricated of plain steel reinforcement bar, ASTM A615, Grade 60; welded; size as shown. Hot-dip galvanized after fabrication, ASTM A123.

**2.9 MANHOLE AND HANDHOLE FRAMES AND COVERS**

- A. Handhole Frame and Cover: Steel, ASTM A36/A36M; size as shown, with the DART Logo cast in the cover.
- B. Manhole Frame and Cover:
  1. Authority manhole, rectangular access cover: Size as shown on drawings.
    - a. Covers shall be designed by a registered Civil Engineer licensed in Texas in accordance with AASHTO HS20 loading requirements and ASTM C857.
    - b. Each Access Door shall be provided with a zinc plated and chromate sealed torsion assist mechanism to reduce the lifting requirements and shall be able to open to a 90 and/or 180-degree position.
    - c. Frames and covers shall be hot dipped galvanized per ASTM A123 as last revised to reduce corrosion.
    - d. Each access door shall be manufactured with a minimum 1/4 inch steel floor plate.
    - e. Torsion Bars shall be removable or exchanged without removing the covers from the frame assembly.

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- f. Covers shall have the DART logo as shown on the Contract Drawings.
  - g. Covers shall be provided with recessed flush lift handles to assist opening covers.
  - h. Miscellaneous hardware shall be zinc plated and chromate sealed for corrosion resistance.
  - i. Countersink hole at bolt locations to prevent bolts from extending more than 1/8 inch above cover. The hole shall have a diameter that is large enough to accommodate the socket for the bolt heads.
2. Authority manhole, round access cover: Size as shown on drawings.
- a. Cast iron, ASTM A48, Class 30, with the DART logo cast in the cover.
  - b. Cast or drilled countersink hole at bolt locations to prevent bolts from extending more than 1/8 inch above cover. The hole shall have a diameter that is large enough to accommodate the socket for the bolt heads.
3. Utility Company manhole: Access cover furnished by the Utility.

C. Impedance Bond Box: Frame with Lid and Fabricated Metal Box:

- 1. Frame and lid shall adhere to the requirements of Section 05500, "Metal Fabrications". Fabricated metal box shall be constructed of either galvanized ASTM A36/A36M Carbon Steel; Cast Iron, ASTM A48, Class 40; or ductile iron, ASTM A536. DART logo shall be cast into cast and ductile iron lids.
- 2. Box elements shall be a minimum of 1/4 inch thick. Frame/lid assembly shall be connected to the fabricated metal box to form a monolithic item, resulting in a watertight case.

**2.10 MANHOLE STEPS**

- A. Unless otherwise shown: Fiberglass or rebar.
- B. As shown on Manhole Schedule drawings, provide at manhole steps a telescoping safety post as specified herein.

**2.11 HANDHOLES AND MANHOLES**

- A. Unless otherwise shown, Contractor's option of either cast-in-place or precast.

- 1. Cast-in-place concrete:
  - a. Size and configuration as shown on the detail drawings, the schedules, and as specified.
  - b. Manholes shall be designed for AASHTO HS20-44 truck loading.
  - c. Handholes shall be designed for AASHTO HS20-44 truck loading when indicated on the detail drawings and the schedules.
  - d. Manhole: Include lifting rings, manhole steps, pulling irons, sump, hole through floor for ground rod. Precast extensions included where required by Utility or by manhole schedule or detail drawings.
- 2. Precast concrete:
  - a. Size and configuration as shown on the detail drawings, the schedules, and as specified.
  - b. Designed for AASHTO HS20-44 truck loading.
  - c. Manhole: Include lifting rings, manhole steps, pulling irons, sump, hole through floor for ground rod, and seal or sealant for sealing joints between sections. Precast extensions included where required by Utility or by manhole schedule or detail drawings.

**2.12 GROUNDING**

- A. As specified in Section 16450, "Grounding and Bonding".

**2.13 WARNING TAPES**

- A. Polyethylene non-detectable tape for direct burial, extra stretch, minimum of 7 mil thick and a minimum of 6 inches wide for use in trenches. Approved manufacturers are Terra-Tape, Blackburn Manufacturing, Seton, or Authority approved equal.
- B. Provide printed warning label text. The text shall be placed on three foot centers with tape placed continuously over ducts and conduits. The tape shall be colored as follows:
  - 1. For communication and signal ducts: Orange tape with black printed labeling: "Caution-Communications Cable Buried Below" or "Warning - Communications Cable Buried Below", or Authority approved standard language. Communication ducts are those that run between Communications/Signal Manholes (CSMH),

or run from a CSMH to a Communication Facility, stub-up, stub-out, handhole, or junction box.

2. For electrical ducts or cable: Red tape with black printed labeling: "Caution – High Voltage Cable Buried Below" or "Warning – High Voltage Cable Buried Below", or Authority approved standard language. Electrical ducts are those that run between Utility Manholes (UTMH), between Traction Power Manholes (TPMH), between UTMH and TPMH and Traction Power Substations, or run from a UTMH or a TPMH to a stub-up.

**2.14 CONCRETE COLORING AGENT**

- A. Red Iron Oxide: ASTM C979
  1. Include in ductbank concrete encasement mix design, or apply and mix in top layer of ductbank concrete immediately following concrete placement, where indicated on drawings.

**2.15 SECURITY BOLTS**

- A. Two security bolts shall be required to lock down a manhole, handhole, junction box, or pull box cover in order to prevent unauthorized access. .
- B. Security bolt shall be fabricated to be a direct replacement of existing bolts, where applicable, and shall comply with the following physical specifications:
  1. Bolt shall be made from 304 Class 2 or equal stainless steel, conforming to ASTM A320/A320M.
  2. Bolt shall be made with a flat pentagonal 0.845 inch head (0.56 inch side), 0.3 inch minimum depth.
  3. Bolt shall be torqued by means of a matching tool steel socket, which fits a 1/2 inch drive wrench.
  4. Bolt lengths shall be as required to fully engage the threads and shall be held to plus or minus 0.1 inch.
  5. Bolt for junction boxes shall be 3/8 inch diameter, 16 threads per inch, class UNC-2A. Bolt for manholes, handholes, and pullboxes shall be 1/2 inch diameter, 13 threads per inch, class UNC-2A.
- C. Apply marine grade anti-seize calcium sulfonate lubricant or equal to bolt threads prior to final installation of security bolt.

**2.16 LADDERS**

- A. Authority manhole: Length and type of ladder as shown on Manhole Schedule drawings.
  1. Structural steel ladders shall conform to Specification Section 05500, "Metal Fabrications".
  2. Fiberglass ladders shall conform to the requirements of ANSI A14.5, Type 1A - Industrial - Extra Heavy Duty.
  3. Fiberglass extension ladders shall conform to the requirements of ANSI A14.5, Type 1A. - Industrial - Extra Heavy Duty.
  4. Fixed ladders shall conform to the requirements of ANSI A14.3.
- B. Utility Company manhole: Ladder as required by the Utility Company.
- C. As shown on Manhole Schedule drawings, provide at manhole ladders a telescoping safety post as specified herein.

**2.17 TELESCOPING SAFETY POST**

- A. As shown on Manhole Schedule drawings, provide on manhole steps and ladders an aluminum telescoping safety post with stainless steel hardware conforming to OSHA requirements extending not less than 36 inches above the top of the manhole ring or cover.

**2.18 NON-WOVEN FILTER FABRIC**

- A. Use non-woven material for subgrade separation/stabilization at locations indicated on the Contract Drawings.
- B. Shall adhere to the following requirements:

Unit Weight	8oz/sq yd
Tensile Strength	200 lbs
Elongation	20%
Mullen Burst Strength	250psi
Trapezoidal Tear Strength	80lbs
Puncture Strength	80lbs

**PART 3 - EXECUTION**

**3.1 EXCAVATING AND BACKFILLING**

- A. Excavating and backfilling: In accordance with Section 02220, "Grading, Excavating, and Backfilling". Refer to Section 02221, "Utility Excavation and Backfill", for support of excavation.
  1. Requirements for duct trench and manhole backfill material are modified to include native, excavated soil and similar borrow.

For duct banks, stub-ups and stub-outs, this only applies to backfill areas equivalent from the top of encasement to finished grade or stabilized base for track bed. All required level-up or other supporting materials shall remain as controlled flowable fill or select fill. Use of native, excavated soil for manholes and handholes/junction boxes shall be restricted to sidewalls and areas above the structural floor. Required level-up or support bedding material shall remain as indicated on the Contract Drawings or controlled flowable fill. Native excavated soil for backfill shall be free of roots, grass, trash and other organic material. The requirements for compaction and other items specified as Execution remain unchanged.

- B. Ducts and manholes installed on backfill over utilities or structures:
  - 1. Place and compact backfill up to grade shown for ducts and manholes; compact as specified in Section 02220, "Grading, Excavating, and Backfilling"; ensure the manhole sets level.
  - 2. Schedule completion of backfilling to allow sufficient time for installation of ducts and manholes.
- C. Where shown for subgrade foundation, use layers of coarse aggregate ASTM C33, No. 4 and No. 67 in combinations and proportions as determined by field conditions.
- D. Protect and maintain existing utility services in accordance with Section 02760, "Maintenance, Support, and Restoration of Existing Utility Facilities".

**3.2 PAVEMENTS, SIDEWALKS, CURBS, AND GUTTERS**

- A. Remove pavements, sidewalks, curbs, and gutters where necessitated by construction of ducts and manholes in accordance with Section 02050, "Demolition", as indicated on the drawings.
- B. Place temporary bituminous pavement in accordance with Section 02511, "Bituminous Pavement", when required by the sequence of operations.
- C. On completion of distribution systems construction, replace pavements, sidewalks, curbs, and gutters, in accordance with Section 02525, "Combined Curb and Gutters, Curb Ramps, and Walks", when required by the sequence of operations.
- D. Reconstruction of roadway or track slab necessary for the installation of new power switches, insulated joints and related systems elements shall be completed in accordance with Section 03300 "Cast-In-Place Concrete", when required by the sequence of operations.

- E. Upon completion of distribution system construction, replace and reset pavers in accordance with Section 02515, "Unit Pavers", when required by the sequence of operations. The requirements of Section 02515 for the preparation, installation, and finishing of new unit pavers shall also apply to the preparation, installation, and finishing of existing pavers that are to be reused.

**3.3 PLACING DUCTS**

- A. Depending on encasement necessary for duct formation, place conduits on spacers and, where required, construct concrete base prior to placing bottom tier of conduits.
- B. Minimum bend radius for raceways installed underground shall be as shown in Specification Section 16110, Table 3.1, except where otherwise indicated.
- C. Lay conduits for encased ductbanks and stub-ups/outs using preformed plastic spacers installed at maximum interval of 78 inch centers along the entire conduit run, to provide tier spacing as shown. For Utility Company facilities use spacers recommended by that Utility Company.
- D. Make tight conduit joints by complying with recommendations of conduit manufacturer, using coupling jointing compound or solvent cement.
- E. Use non-metallic conduit, unless otherwise shown.
- F. Where required, properly place and compact concrete around conduits in accordance with Section 03300, "Cast-In-Place Concrete". Where required, properly place and compact controlled flowable fill around conduits in accordance with Section 02220, "Grading, Excavating, and Backfilling". Placing of flowable fill around conduits shall be performed in a manner that prevents conduit floating. Conduits shall be sufficiently restrained to a point that the duct bank conduit configuration has not been changed from that designed and that clearance and encasement dimensions are satisfied along the entire length of duct bank or bundled stub-outs.
- G. Where shown, install reinforcing steel in encasement in accordance with Section 03200, "Concrete Reinforcement".
- H. If not already in concrete mix, immediately following concrete placement, substantially apply and mix concrete coloring agent in liquid form to fully saturate the entire top surface of encasement concrete and to provide a strong red color, where shown on drawings.
- I. Clear conduit by rod and pull an approved test mandrel from structure to structure.
- J. Install Authority approved nylon or polyester pull line in each conduit. Tag each pull line to identify the corresponding point of origin.

- K. Directional Bore: and walls of the core-borehole shall be filled with grout in accordance with Section 03305 "Portland Cement Concrete".
1. Where indicated, or used as an alternate means of construction, install conduit by directional bore. Excavation of the boring pits shall proceed in accordance with Section 02221 "Utility Excavation and Backfill".
  2. Where concrete casing is required for installation of the 4-inch communication conduits and duct banks, the borehole shall be a minimum of 10-inch diameter. Any voids that develop between communication conduits and walls of the borehole shall be filled with grout in accordance with Section 03305 "Portland Cement Concrete".
- L. Direct Burial:
1. Duct should be fully surrounded by a selected backfill to prevent more than the desired deflection and, in power ducts, to provide for heat dissipation. A separation of 1 inch both vertically and horizontally between ducts is a recommended minimum to provide room for heat dissipation and for good compaction of backfill. Other spacing may be required for different applications in which case the additional spacers manufacturing data shall be included in to submittal
  2. Duct formation may be built up layer by layer. After each layer is placed, the selected backfill should be placed over it to a minimum depth of 1-inches. This fill should be spread evenly and compacted to provide continuous support for the next tier of ducts. Any temporary spacers used should be removed from each layer of duct as soon as backfill is completed in that layer. To maintain clearance between ducts, joints for adjacent ducts should be offset about 6 inches both horizontally and vertically.
  3. If alternate methods and materials are deemed necessary due to site conditions and other RR limitations, contractor shall submit a work plan of methods and material selections to the Authority for approval. See Article 1.4, Submittals for requirements.
- M. Core-Bore:
1. Where indicated, or used as an alternate means of construction, install conduit by core-bore method.
  2. Where concrete casing is required for installation of the 4 inch and 2 inch communication conduits and duct banks, the core-borehole shall be a minimum of 10 inch diameter for 4 inch conduit, and 8 inch diameter for 2 inch conduit. Any voids that develop between communication conduits
- 3.4 INSTALLATION OF WARNING TAPES**
- A. After placing a minimum of 6 or a maximum of 12 inches of backfill over the ducts, place the appropriate warning tapes above and parallel to the centerline of the duct for the entire length of the duct trench.
- 3.5 CONSTRUCTION OF MANHOLES AND HANDHOLES**
- A. Cast-in-Place:
1. Provide drainage facilities for manholes where shown. If connection is made to existing line, install connection in accordance with Section 02700, "Storm Sewer Systems".
  2. After pit excavation, place filter fabric, gravel setting bed & compact prior to forming the MH floor and walls. Wrap filter fabric completely around gravel setting bed and overlap loose ends. Secure in-place by forming MH on the fabric wrapped setting bed to line and correct elevation as indicated on the plans
  3. Erect formwork in accordance with Section 03100, "Concrete Formwork".
  4. Place reinforcing in accordance with approved shop drawings.
  5. Provide for location of duct entrances and inserts in walls as shown.
  6. Place concrete as specified in Section 03300, "Cast-In-Place Concrete".
  7. Install conduits of material shown.
  8. Install end bells on conduits where ducts terminate in manhole and handholes.
  9. Build duct formations into walls of manholes and seal around openings.
  10. If location of manhole or handhole openings will be obstructed, inform the Contracting Officer immediately.
  11. Install frame and cover, adjust to finished grade by using precast neck extenders, grout and, if necessary, brick chimney as specified in Section 02700, "Storm Sewer Systems".
  12. Seal conduit openings with approved conduit plugs.



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| <p>13. Install ground rods where shown. If soil conditions prevent driving rod to required depth, install alternative grounding system as approved.</p> <p>14. Provide channel inserts along interior walls as shown. Perform pull-out test.</p> <p>15. Backfill in accordance with Section 02220, "Grading, Excavating, and Backfilling", except as modified herein regarding the use of excavated soil, in accordance with Paragraph 3.1A.1.</p> <p>16. Install ladder and telescoping safety post where required by Manhole Schedule drawings.</p> <p>17. Complete grounding of metal components in accordance with Section 16450, "Grounding and Bonding".</p> | <p>11. When installing sections of precast manholes, prevent damage to joints seals.</p> <p>12. Provide channel inserts along interior walls as shown. Perform pull-out test.</p> <p>13. Paint exterior of manhole, which is below grade, with two coats of epoxy coal tar, 18 mils minimum total dry film thickness.</p> <p>14. Backfill in accordance with Sec. 02220, "Grading, Excavating, and Backfilling", except as modified herein regarding the use of excavated soil, in accordance with Paragraph 3.1 A.1.</p> <p>15. Install ladder and telescoping safety post where required by Manhole Schedule drawings.</p> |
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B. Pre-cast:

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| <p>1. Provide drainage facilities for manholes where shown. If connection is made to existing line, install connection in accordance with Section 02700, "Storm Sewer Systems".</p> <p>2. After pit excavation, place filter fabric, gravel setting bed &amp; compact prior to setting the MH section. Wrap filter fabric completely around gravel setting bed and overlap loose ends. Secure in-place by setting MH section on the fabric wrapped setting bed to line and correct elevation as indicated on the plans</p> | <p>16. Complete grounding of metal components in accordance with Section 16450, "Grounding and Bonding".</p> |
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**3.6 CLEAN-UP**

- A. Remove debris from manholes and ensure complete installation is left in neat and finished condition.

**3.7 CONSTRUCTION TOLERANCES**

- A. Construct System Elements to the following tolerances:

	<u>Construction Type</u>	<u>Elevation</u>	<u>Station</u>	<u>Offset</u>	<u>Slope</u>
3. Install conduits of material shown.	Signals Stub-ups	+1" / -2"	+2" / -2"	+2" / -2"	N/A
4. Install end bells on conduits where ducts terminate in manhole and handholes.	OCS Stub-ups	+1" / -2"	+2" / -2"	+2" / -2"	N/A
5. Build duct formations into the bulkhead of manholes and seal around openings.	Cross bond/ Negative return Stub-ups	+1" / -2"	+2" / -2"	+2" / -2"	N/A
6. If location of manholes or handholes openings will be obstructed inform the Contracting Officer immediately.	Manhole in guide-way/ unpaved area	+1" / -2"	+2" / -2"	+2" / -2"	N/A
7. Install factory provided asphaltic/poly-silicone type joint sealing strips to wall joints. Place and secure MH top including the frame and cover, adjust to finished grade by using precast neck extenders, when required.	Manhole in Pavement	+1/4" / -1/4"	+2" / -2"	+2" / -2"	N/A
8. Seal conduit openings with approved conduit plugs.	Signals Foundation	+1" / -2"	distance to IJ +0" / -4"	+2" / -2"	N/A
9. Install cable pulling irons and steps as shown.	Ductbank	+0" / -12"	+6" / -6"	+6" / -6"	+any % / -0%
10. Install ground rods where shown. If soil conditions prevent driving rod to required	Channel in manhole	+2" / -2"	N/A	N/A	N/A

Tie spacing at Stub-ups      N/A      +1/2" / - 1/2"      N/A      N/A

G. Trench Support System for trenches exceeding a depth of 5 feet will be measured and paid for as specified under Section 02221, "Utility Excavation and Backfill".

**PART 4 - MEASUREMENT AND PAYMENT**

END OF SECTION 02780

**4.1 GENERAL**

- A. Duct banks for electrical and communications facilities will not be measured, but will be paid for at lump sum price for "Duct Banks".
- B. Concrete encased PVC, galvanized rigid steel (GRS) and flex metal conduit stub-ups and stub-outs will not be measured separately, but shall be considered subsidiary to the related Duct Bank item.
- C. Manholes will be measured by and paid for at the unit price for "Manholes" per each, for each type and size.
- D. Handholes will be measured by and paid for at the unit price for "Handholes" per each, for each type and size.
- E. Junction boxes, pullboxes, and systems elements boxes will be measured by and paid for at the unit price for "Junction Box", "Pullbox", "Impedance Bond Box", and "System Element Box" per each, for each type and size.
- F. No separate measurement or payment will be made for the following work required for work of this section. Such work will be considered subsidiary to the various bid items:
  - 1. Ladders, steps, telescoping safety post, and other accessories.
  - 2. Socket tools for access cover security bolts and fiberglass extension ladders.
  - 3. Concrete work, including reinforcing steel.
  - 4. Excavating, backfilling, jacking, boring, and tunneling, including concrete encasement, bedding material, and disposal of surplus material.
  - 5. Support of excavation for depths not exceeding 5 feet.
  - 6. Dewatering.
  - 7. Removal and replacement of existing bases, pavements, sidewalks, curbs, and gutters.
  - 8. Barricading and maintenance and control of traffic.
  - 9. Maintenance and support of existing utility facilities, except as otherwise indicated in Section 02760, "Maintenance, Support, and Restoration of Existing Utility Facilities".



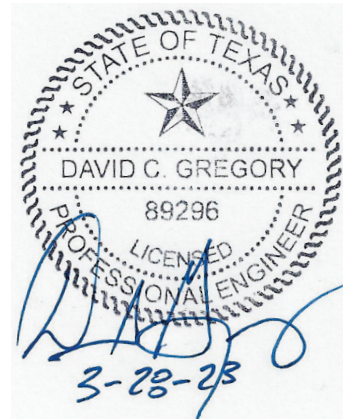
**TRINITY METRO<sup>SM</sup>**

**TRINITY RIVER EXPRESS (TRE)  
TRINITY LAKES PARKING LOT PROJECT  
PROJECT SPECIFICATIONS IFB**

I hereby certify that the following Specification(s) that contained herein were prepared under my direct supervision.

**DIVISION 2 – SITE CONSTRUCTION**

- 02060 – SOIL EROSION AND SEDIMENT CONTROL
- 02072 – REMOVAL AND RESTORATION OF MISCELLANEOUS EXISTING FACILITIES
- 02100 – SITE PREPARATION
- 02220 – GRADING, EXCAVATION, AND BACKFILLING
- 02221 – UTILITY EXCAVATION AND BACKFILL
- 02230 – BASE FOR PAVEMENTS
- 02244 – SOIL STABILIZATION LIME TREATMENT
- 02271 – DITCH LINING AND SLOPE PROTECTION
- 02525 – COMBINED CURB AND GUTTER, CURB RAMPS, AND WALKS
- 02550 – CONCRETE PAVEMENT
- 02560 – SITE IMPROVEMENTS
- 02580 – PAVEMENT MARKINGS AND DELINEATORS
- 02600 – MAINTENANCE AND CONTROL OF TRAFFIC
- 02700 – STORM SEWER SYSTEMS
- 02810 – PLANTING IRRIGATION
- 02831 - BOLLARDS
- 02845 – ALUMINUM SIGNS
- 02850 – TRAFFIC CONTROL
- 02910 – TOPSOIL AND FINISHED GRADING
- 02920 – LAWNS AND GRASSES
- 02930 - PLANTING
- 02931 – SEEDING AND SODDING – NON-IRRIGATED AREAS



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Engineering Firm Registration Number F-21947

CONTRACT NO.  
23-026

**IFB  
Submittal**

March  
2023



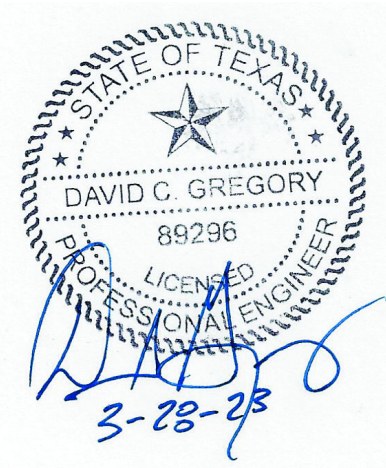
**TRINITY METRO<sup>SM</sup>**

**TRINITY RIVER EXPRESS (TRE)  
TRINITY LAKES PARKING LOT PROJECT  
PROJECT SPECIFICATIONS IFB**

I hereby certify that the following Specification(s) that contained herein were prepared under my direct supervision.

**DIVISION 3 – CONCRETE**

- 03100 – CONCRETE FORMWORK
- 03200 – CONCRETE REINFORCEMENT
- 03300 – CAST-IN-PLACE CONCRETE
- 03305 – PORTLAND CEMENT CONCRETE
- 03350 – CONCRETE FINISHING



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CONTRACT NO.  
23-026

**IFB  
Submittal**

March  
2023

**SECTION 02060**  
**SOIL EROSION AND SEDIMENT CONTROL**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies the measures necessary for the installation, maintenance and removal of soil erosion and sediment control devices related to water pollution prevention.

**1.2 RELATED WORK**

- A. None

**1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.

1. City of Fort Worth, Division 31 - Earthwork
  - a. 31 25 00, Erosion and Sediment Control
2. Texas Department of Transportation (TxDOT)
  - a. Item 164, Seeding and Erosion Control
  - b. Item 166, Fertilizer
  - c. Item 506, Temporary Erosion, Sedimentation and Environmental Controls
3. North Central Texas Council of Governments (NCTCOG)
  - a. Item 201, Temporary Erosion, Sedimentation, and Water Pollution Prevention and Control

**1.4 SUBMITTALS**

- A. No change from reference specifications.

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**SECTION 02060**  
**SOIL EROSION AND SEDIMENT CONTROL**

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the ~~TRE Rail~~ RE Rail contract.

**END OF SECTION 02060**

**SECTION 02072**  
**REMOVAL AND RESTORATION OF MISCELLANEOUS EXISTING FACILITIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies temporary and permanent paving repair; and sweeping and disposing of excess material.

**1.2 RELATED WORK**

- A. For roadway excavation and backfill, see Section 02220, "Grading, Excavating and Backfilling"
- B. For utility trench excavation, excavation and backfill, see Section 02221,"Utility Excavation and Backfill".
- C. For cement treated base courses, see Section 02242, "Soil Stabilization: Cement Treatment"
- D. For traffic control, see Section 02850, "Traffic Control"
- E. For concrete pavement, see Section 02550, "Concrete Pavement"
- F. For base course material, see Section 02230, "Base for Pavements"

**1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  - 1. City of Fort Worth Division 31, Earthwork
    - a. 32-01-17 Permanent Asphalt Paving Repair
    - b. 32-01-18 Temporary Asphalt Paving Repair

**1.4 SUBMITTALS**

- A. No change from reference specifications.

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**SECTION 02072**  
**REMOVAL AND RESTORATION OF MISCELLANEOUS EXISTING FACILITIES**

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02072**



## **SECTION 02100 SITE PREPARATION**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

- A. This Section specifies the preparation of right of way and other designated areas of construction operation by removing and disposing of all obstructions; and disposing of excess material.

#### **1.2 RELATED WORK**

- A. For roadway excavation and backfill, see Section 02220, "Grading, Excavating and Backfilling"
- B. For utility trench excavation, excavation and backfill, see Section 02221, "Utility Excavation and Backfill".
- C. For demolition, see Section 02050, "Demolition"
- D. For traffic control, see Section 02850, "Traffic Control"
- E. For erosion control and seeding, see Section 01562, "Soil Erosion and Sediment Control"
- F. For planting of trees and shrubs, see Section 023900, "Landscape Planting"

#### **1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  - 1. City of Fort Worth Division 31, Earthwork
    - a. 31-10-00 Site Clearing

#### **1.4 SUBMITTALS**

- A. No change from reference specifications.

#### **1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. No change from reference specifications.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. No change from reference specifications.

#### **3.2 TESTING**

- A. No change from reference specifications.

**SECTION 02100  
SITE PREPARATION**

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the ~~TEX Rail~~TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the ~~TEX Rail~~TRE Rail contract.

**END OF SECTION 02100**

**SECTION 02220**  
**GRADING, EXCAVATING AND BACKFILLING - FORT WORTH**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies grading, excavating, constructing embankments and backfilling for roadways, and structures; and disposing of excess excavated material.

**1.2 RELATED WORK**

- A. For utility excavation and backfill, see Section 02221, "Utility Excavation and Backfill".

**1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  - 1. City of Fort Worth Division 31, Earthwork
    - a. 31-23-16, Unclassified Excavation
    - b. 31-23-23, Borrow
    - c. 31-24-00, Embankments

**1.4 SUBMITTALS**

- A. No change from reference specifications

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**SECTION 02220**  
**GRADING, EXCAVATING AND BACKFILLING - FORT WORTH**

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02220**

## SECTION 02221 UTILITY EXCAVATION AND BACKFILL

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. This Section specifies excavation and backfill for pipeline utilities (storm sewer, water, sanitary sewer).

#### 1.2 RELATED WORK

- A. For Utility Removal/Abandonment, see Section 02050, "Demolition"
- B. For Roadway Excavation and Backfill, see Section 02220, "Grading, Excavating and Backfilling"
- C. For Trench Excavation Protection and Temporary Shoring, see Section 02222, "Grading, Excavating and Backfilling"
- D. For Flowable Backfill, see Section 02222, "Grading, Excavating and Backfilling"
- E. For Permanent Asphalt Pavement Repair, see Section 02072, "Removal and Restoration of Miscellaneous Existing Facilities"
- F. For Temporary Asphalt Paving Repair, see Section 02072, "Removal and Restoration of Miscellaneous Existing Facilities"
- G. For Concrete Paving Repair, see Section 03905, "Concrete repair and Restoration"
- H. For Concrete Curb, Gutter, Sidewalks, Driveways, Barrier Free Ramps, see Section 02525 "Combined Curb and Gutters, Curb Ramps, and Walks"
- I. For Cement Treated Base Courses, see Section 02242, "Soil Stabilization: Cement Treatment"
- J. For Flexible Base Courses, see Section 02230, "Base for Pavements"
- K. For Water Utility Installation, see Section 02260, "Water Distribution Systems"
- L. For Storm Sewer Installation, see Section 02700, "Storm Sewer Systems"
- M. For Sanitary Sewer Installation, see Section 02730, "Sanitary Sewer Systems"
- N. For Temporary Erosion, Sedimentation, and Environmental Controls, see Section 01562, "Soil Erosion and Sediment Control"
- O. For Seeding For Erosion Control, see Section 01562, "Soil Erosion and Sediment Control"
- P. For Topsoil Placement and Finishing of Parkways, See Section 02910, "Topsoil and Finished Grading"
- Q. Hydro-mulching, Seeding and Sodding, See Section 02931, "Seeding and Sodding-Non-Irrigated Areas"
- R. For Traffic Control, See Section 02845, "Traffic Control"
- S. For Barricades, Signs, and Traffic Handling, see Section 01570, "Maintenance and Control of Traffic"

#### 1.3 REFERENCES

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  - 1. North Central Texas Council of Governments (NCTCOG) Public Works Construction Standards, Division 500

**SECTION 02221**  
**UTILITY EXCAVATION AND BACKFILL**

- a. 504, Open Cut - Backfill
2. City of Fort Worth Division 33, Utilities
  - a. 33-05-10, Utility Trench Excavation, Embedment, and Backfill
  - b. 33-05-23, Hand Tunneling
3. City of Fort Worth Division 03, Concrete
  - a. 03-34-13, Controlled Low Strength Material (CLSM)
  - b. 03-34-16, Concrete Base Material for Trench Repair
4. City of Haltom City Standard Details
  - a. Standard Detail WM-014 - Backfill Ditch Width (Water)
  - b. Standard Detail SS-004 - Pipe Embedment (Sanitary Sewer)
  - c. Standard Detail SD-013 Pipe Embedment (Storm Drain)
5. City of North Richland Hills Public Works Design Manual
  - a. Standard Detail No. 3M - Trench Embedment and Backfill Details
6. City of Grapevine Construction Standards
  - a. Article II - Standard Specifications for Construction - Streets and Drainage
    - (1) Item 7 - Storm Drains (Sections 7.1, 7.2, 7.3, 7.4, 7.5, 7.9, 7.10.3)
  - b. Article III - Standard Specifications for Construction - Water Distribution System and Sanitary Sewer System
    - (1) Item 2 - Excavation, backfill, and pipe embedment
    - (2) Item 15 - Pipe embedment and backfill

**1.4 SUBMITTALS**

- A. No change from reference specifications.

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**SECTION 02221**  
**UTILITY EXCAVATION AND BACKFILL**

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02221**

**SECTION 02230**  
**BASE FOR PAVEMENTS - FORT WORTH**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies foundation course for surface course or for other base course composed of flexible base constructed in one or more courses in conformity with the typical section.

**1.2 RELATED WORK**

- A. n/a

**1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.

- 1. City of Fort Worth Division 32, Exterior Improvements
  - a. 32-11-23, Flexible Base Courses

**1.4 SUBMITTALS**

- A. No change from reference specifications.

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.



**SECTION 02230**  
**BASE FOR PAVEMENTS - FORT WORTH**

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02230**

**SECTION 02244**  
**SOIL STABILIZATION: LIME TREATMENT - FORT WORTH**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies treating subgrade, subbase and base courses by pulverization, addition of lime, mixing and compacting the mix material to the required density.

**1.2 RELATED WORK**

- A. For embankment, see Section 02220, "Grading, Excavating and Backfilling"
- B. For flexible base courses, see Section 02230, "Base for Pavements"

**1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  - 1. City of Fort Worth Division 32, Exterior Improvements
    - a. 32-11-29, Lime Treated Base Courses

**1.4 SUBMITTALS**

- A. No change from reference specifications.

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**SECTION 02244**  
**SOIL STABILIZATION: LIME TREATMENT - FORT WORTH**

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02244**

**SECTION 02271  
DITCH LINING AND SLOPE PROTECTION - FORT WORTH**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. This Section specifies furnishing and installing concrete, stone, cement-stabilized, or special riprap.

**1.2 RELATED WORK**

A. For seeding and erosion control, see Section 01562, "Soil Erosion and Sediment Control"

**1.3 REFERENCES**

A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.

1. City of Fort Worth Division 03, Concrete
  - a. 03-30-00, Cast-In-Place Concrete
2. City of Fort Worth Division 31, Earthwork
  - a. 31-37-00, Riprap

**1.4 SUBMITTALS**

A. No change from reference specifications.

**1.5 QUALITY ASSURANCE**

A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

A. No change from reference specifications.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. No change from reference specifications.

**3.2 TESTING**

A. No change from reference specifications.

**PART 4 - METHOD OF MEASUREMENT**

A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**SECTION 02271**  
**DITCH LINING AND SLOPE PROTECTION - FORT WORTH**

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02271**

**SECTION 02525**  
**COMBINED CURB AND GUTTERS, CURB RAMPS, AND WALKS - FORT WORTH**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies placement of concrete curbs and gutters, concrete valley gutters, barrier free ramps, concrete sidewalks and driveways.

**1.2 RELATED WORK**

- A. For selective site demolition, see Section 02050, "Demolition"
- B. For concrete paving and joint sealants, see Section 02550, "Concrete Pavement".

**1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  - 1. City of Fort Worth Division 32, Exterior Improvements
    - a. 32-13-20, Concrete Sidewalks, Driveways and Barrier Free Ramps
    - b. 32-16-13, Concrete Curb and Gutters and Valley Gutters

**1.4 SUBMITTALS**

- A. No change from reference specifications.

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**SECTION 02525**  
**COMBINED CURB AND GUTTERS, CURB RAMPS, AND WALKS - FORT WORTH**

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02525**

**SECTION 02550  
CONCRETE PAVEMENT - FORT WORTH**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies finished pavement constructed of Portland cement concrete including monolithically poured curb on the prepared subgrade or other base course and the specification for silicone joint sealing for concrete pavement and curbs.

**1.2 RELATED WORK**

- A. For concrete paving repair, see Section 03905, "Concrete Repair and Restoration"

**1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.

- 1. City of Fort Worth Division 32, Exterior Improvements
  - a. 32-13-13, Concrete Paving
  - b. 32-13-73, Concrete Paving Joint Sealants

**1.4 SUBMITTALS**

- A. No change from reference specifications.

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.



**SECTION 02550**  
**CONCRETE PAVEMENT - FORT WORTH**

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02550**

## **SECTION 02560 SITE IMPROVEMENTS**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

A. This Section includes site improvements: Benches, Trash Receptacles and Bike Racks.

#### **1.2 RELATED WORK**

A. Not Used.

#### **1.3 REFERENCES**

A. Not Used.

#### **1.4 SUBMITTALS**

A. Refer to Section 01330 - Submittals

B. Product Data: For each type of bench, trash receptacles and bike rack product indicated.

C. Shop Drawings: Show fabrication and installation details for each product, including attachment plates, anchors, finishes and colors.

1. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

D. Qualification Data: For the Installer.

E. Warranty: Manufacturer's standard warranty for a period of not less than two (2) years.

#### **1.5 QUALITY ASSURANCE**

A. Refer to section 01450 Quality Control and Quality Assurance.

B. Installer Qualifications: A firm experienced in installing site improvements similar in material, design, and extent indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Written installation procedures by the respective product manufacturer.

D. Welding Standards: Qualify welding procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01, Section 01312, Project Meetings.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

A. Deliver products to Project site in such quantities and at such times to ensure continuity of installation. Handle and store piles at Project site to prevent physical damage.

1. Protect finishes and coatings and touch up damage to coatings before final acceptance.

#### **1.7 PROJECT CONDITIONS**

A. Protect surfaces from possible damage during product installation.

## SECTION 02560 SITE IMPROVEMENTS

### PART 2- PRODUCTS

#### 2.1 BENCHES

- A. Rambas Backless Bench by Creative Pipe, Inc. [http://www.creativepipe.com/rambas\\_bench.com](http://www.creativepipe.com/rambas_bench.com) or prior approved equivalent products. At the Grapevine Station ONLY: provide Creative Pipe, Inc. style "Granada Backed Bench."
- B. Provide RMBLB 3 and RMBLB 4 seat pattern as indicated on the drawings. Provide "Granada per Grapevine Station drawings."
- C. Flange mounting: "SM."
- D. Seat Choice: "WC."
- E. Finish: "T" Thermoplastic Powder coated.
- F. Curbs for mounting: Refer to drawings for locations where curbs or leveling pads are to be used.
- G. Some locations may require a concrete pad or special forming for the bench base to maintain a level condition. Refer to the drawings.

#### 2.2 TRASH RECEPTACLES

- A. Creative Pipe, Inc. Style "Duomo DOT - PS-36-PSF-SS-LD-LSD-LCT, color: Stainless steel finish with the plastic 'open side liner' for security or a prior approved equivalent product. At the Grapevine Station ONLY: provide Creative Pipe, Inc. style "Banico" trash receptacles.

#### 2.3 BIKE RACKS

- A. Creative Pipe, Inc. or prior approved equivalent products. Style: "Cityscape" Splice Units; Provide bike capacities as indicated on the drawings.

#### 2.4 PAINT

- A. Thermoplastic powder coated, Finish designated as "T" finish.

#### 2.5 FABRICATION

- A. Welded construction.
- B. Fabricate and assemble units in shop to greatest extent possible.

### PART 3- EXECUTION

#### 3.1 EXAMINATION

- A. Site Conditions: Do not start installation of new benches or bike racks until authorized by the Owner.

#### 3.2 TOUCHUP PAINTING

- A. Clean field welds, splices, and abraded painted areas and field-apply paint according to SSPC-PA 1. Use same paint and apply same number of coats as specified for shop painting.

#### 3.3 DISPOSAL

- A. Remove packaging materials from site and legally dispose of them off Owner's property.

**SECTION 02560  
SITE IMPROVEMENTS**

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02560**

**SECTION 02580**  
**PAVEMENT MARKINGS AND DELINEATORS - FORT WORTH**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies placement of pavement markings, raised markers, work zone marking and for the removal of pavement markings and markers.

**1.2 RELATED WORK**

- A. N/A

**1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.

- 1. City of Fort Worth Division 32, Exterior Improvements
  - a. 32-17-23, Pavement Markings

**1.4 SUBMITTALS**

- A. No change from reference specifications.

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**SECTION 02580**  
**PAVEMENT MARKINGS AND DELINEATORS - FORT WORTH**

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02580**

**SECTION 02600**  
**MAINTENANCE AND CONTROL OF TRAFFIC**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies the measures necessary for the installation of traffic control devices and preparation of traffic control plans.

**1.2 RELATED WORK**

- A. None

**1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.

1. City of Fort Worth, Division 34 - Transportation
  - a. 34 71 13, Traffic Control
2. Texas Department of Transportation (TxDOT)
  - a. Item 502, Barricades, Signs, and Traffic Handling
  - b. Item 508, Constructing Detours
  - c. Item 512, Portable Traffic Barrier
  - d. Item 662, Work Zone Pavement Markings

**1.4 SUBMITTALS**

- A. No change from reference specifications.

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**SECTION 02600**  
**MAINTENANCE AND CONTROL OF TRAFFIC**

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02600**



**SECTION 02700**  
**STORM SEWER SYSTEMS – FORT WORTH**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. This Section Includes:

1. Minimum requirements for auger boring using 48-inch and smaller casing pipe with lengths less than 350 feet at the locations shown on the Drawings.
2. Furnishing and installing reinforced concrete storm drain pipe and culverts, including:
  - a. Pipe or box fittings
  - b. Connection of drain lines to curb inlets
  - c. All joints
  - d. All connections to new or existing pipe or headwalls, manholes, etc., to the lines and grades shown on the Drawings
3. Sanitary Sewer, Water Appurtenance, or Reclaimed Water Appurtenance Precast Concrete Manholes.
4. Requirements for the installation of carrier pipe into steel casing or tunnel liner plate at locations shown on the Drawings.
5. Construction of inlets, complete in place or to the stage detailed, including furnishing and installing frames, grates, rings and covers.
6. Cast-in-place manholes.
7. Concrete collars for manholes.
8. Frame, cover and grade rings used as access ports into water, sanitary sewer and storm drain structures such manholes or vaults.
9. Requirements for manufacturing, furnishing and transporting tunnel linear plate to be used for excavation support and steel casing support to be installed by open cut or by other than open cut at locations shown on the drawing.
10. Adjusting manholes, inlets, valve boxes, and other structures to grade.

**1.2 RELATED WORK**

A. N/A

**SECTION 02700**  
**STORM SEWER SYSTEMS – FORT WORTH**

**1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  - 1. City of Fort Worth Division 33, Utilities
    - a. 33-05-13, Frame, Cover and Grade Rings
    - b. 33-05-14, Adjusting Manholes, Inlets, Valve Boxes, and Other Structures to Grade
    - c. 33-05-17, Concrete Collars
    - d. 33-05-20, Auger Boring
    - e. 33-05-21, Tunnel Liner Plate
    - f. 33-05-22, Steel Casing Pipe
    - g. 33-05-24, Installation of Carrier Pipe in Casing or Tunnel Liner Plate
    - h. 33-39-10, Cast-in-Place Concrete Manholes
    - i. 33-39-20, Precast Concrete Manholes
    - j. 33-41-10, Reinforced Concrete Storm Sewer Pipe/Culverts
    - k. 33-49-20, Curb and Drop Inlets.

**1.4 SUBMITTALS**

- A. No change from reference specifications.

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**SECTION 02700**  
**STORM SEWER SYSTEMS – FORT WORTH**

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled “Measurement and Payment” are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled “Measurement and Payment” are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION**

## **SECTION 02810 PLANTING IRRIGATION**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

- A. This section specifies all of the irrigation equipment, piping, manual valves, pressure reducing valves, automatic control valves, automatic drain valves, transition fitting, miscellaneous piping specialties, sprinklers, quick couplers, drip irrigation specialties, controllers and boxes for automatic control valves and how do install all of the equipment.

#### **1.2 RELATED WORK**

- A. For landscape surface and sub-drainage see Section 02630, "Landscape Drainage & Sub-Drainage"
- B. For planting see Section 02930, "Planting"
- C. For turf and grasses see Section 02920, "Turf and Grasses"

#### **1.3 DEFINITIONS**

- A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.
- C. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

#### **1.2 PERFORMANCE REQUIREMENTS**

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.
- C. Minimum Working Pressures: Reference drawing notes.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. The following items shall be included in submittal but not limited to:
  - 1. Pipe
  - 2. Controller
  - 3. Electric control valves
  - 4. Freeze sensor
  - 5. Moisture sensor
  - 6. Spray nozzles
  - 7. Pop ups heads
  - 8. Rotary heads
  - 9. Gate valves

**SECTION 02810  
PLANTING IRRIGATION**

- 10. Backflow preventer
- 11. Wire
- 12. Flow sensor and master valve
- B. Qualification Data: For qualified Installer.
- C. Operation and Maintenance Data: For controllers and automatic control valves to include in operation and maintenance manuals.
  - 1. The O&M Manual shall include manufacturer's recommended instructions and maintenance schedule for the complete irrigation system.
  - 2. Provide a copy of the color-coded Controller Chart in the Manual
- D. As – Built Drawings
  - 1. Record drawing noting any variations from the Contract Documents. Submit one copy of record "As – Built" prints prior to expiration of the required maintenance period
  - 2. All valves and controller shall be GPS surveyed.
  - 3. All valves shall be numbered with a metal tag and reference to the "As – Built Drawing".
- E. Controller Chart: Provide a Controller Chart that is 8 ½ " x 11" and thematically sealed. Chart shall be legible and color – coded for each zone, keying stations of the Controller to valve locations and to irrigation heads served by the station. Place Chart inside door of Controller.
- F. Spray irrigation system audit test results. Turf areas 10,000 sf and larger shall be audited by an Irrigation Association certified auditor. The following efficiencies shall be minimal: Fixed spray – 60%, rotors – 70%.
- G. Backflow test results.
- H. Pressure test results of system pressure test for 1 hour at 100 psi.
- I. Installer Qualifications: Licensed in landscaping and irrigation systems with not less than five years experience in the type and scale of work required in this Section.

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Licensed in landscaping and irrigation systems with not less than five years experience in the type and scale of work required in this Section.
- B. All irrigation work shall be performed by a single firm specializing in this type of work and possessing the State of Texas Irrigation license. Contractor shall also provide for at least one on-site employee with an irrigation license.
- C. Irrigation System: Provide underground irrigation system as a complete unit, including sprinklers, bubblers, drip irrigation heads, controllers, and accessories – produced by acceptable manufacturers as specified herein.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

## **SECTION 02810 PLANTING IRRIGATION**

### **1.6 PROJECT CONDITIONS**

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Construction Manager and Owner no fewer than five 5 days in advance of proposed interruption of water service.
  - 2. Do not proceed with interruption of water service without Construction Manager's written permission.
- B. Existing Conditions:
  - 1. Take precaution to insure that equipment and vehicles do not disturb or damage existing site grading, walks, curbs, pavements, utilities, plants, tree protection zones, and other existing items and elements of the Site. Notify the Owner if rock layer(s) or other unanticipated conditions are encountered underground.
  - 2. Utilities: Verify the locations and sizes of stub-outs for water sources indicated on the Contract Drawings as the source of water supply to the underground irrigation system.
  - 3. Existing Utilities: Prior to excavation, determine the locations of all newly constructed and existing utilities. It is the Contractor's responsibility to obtain all necessary spotting services thru the Owner. Do not damage or disturb underground utilities. If a conflict exists between the location of underground utilities and the proposed work, notify the Owner and arrange for field and design adjustments.
  - 4. Unknown Utilities: In the event that uncharted or incorrectly charted utilities are encountered during excavation that conflicts with this work, all work on that part of the job shall cease until the Owner is contacted and resumption of work is authorized by the Owner.
  - 5. Existing Structures: Use extreme caution when working near existing structures. Do not damage existing features unless specifically indicated on the Contract Drawings. Contractor is responsible for incidental damage caused to existing site features and structures. Repairs shall be made at Contractor's expense.
  - 6. Contractor shall note if there is any existing irrigation within the site and if so cap water lines prior to construction commencing work. All damaged irrigation equipment from construction shall be repaired and replaced in the same material and be operational.
  - 7. Sequencing/Scheduling: Coordinate irrigation system with related work. Grade site within 1"-inch of finish grade prior to trenching. Install irrigation system prior to plant material installation.

### **1.7 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Spray Sprinklers: Equal to 1 percent of amount installed for each type and size indicated, but no fewer than 2 units.
  - 2. Bubblers: Equal to 2 percent of amount installed for each type indicated, but no fewer than 2 units.
  - 3. Emitters: Equal to 5 percent of amount installed for each type indicated, but no fewer than 5 units.
  - 4. Drip-Tube System Tubing: Equal to 5 percent of total length installed for each type and size indicated, but not less than 100 feet

## **SECTION 02810 PLANTING IRRIGATION**

### **1.8 WARRANTY**

- A. General: Warranty underground irrigation system through the specified warranty period of one twelve month calendar period against operational deficiencies due to inferior material or workmanship. Correct deficiencies immediately as directed by the Owner at no additional cost to owner, including damage caused by such defects. Repairs shall be completed within ten business days of notification from the Owner.
- B. Settlement: Warranty underground irrigation system through the specified warranty period of one twelve month calendar period against settlement damage. Adjust, restore, or replace pipes, valves, sprinkler heads, planting, paving, or other improvements or damages caused by settlement at no additional cost to the owner. These adjustments and restorations include damage caused to adjacent areas that are not part of the project. Damaged areas shall be restored to their original state.

### **PART 2 - PRODUCTS**

#### **2.1 PIPES, TUBES, AND FITTINGS**

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. PE Pipe with Controlled ID: ASTM F 771, PE 3408 compound; SDR 11.5 and SDR 15.
  - 1. Insert Fittings for PE Pipe: ASTM D 2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners.
- C. PE Pipe with Controlled OD: ASTM F 771, PE 3408 compound, SDR 11.
  - 1. PE Butt, Heat-Fusion Fittings: ASTM D 3261.
  - 2. PE Socket-Type Fittings: ASTM D 2683.
- D. Pipe and Pipe Fittings
  - 1. Polyvinyl Chloride Pipe (PVC).
    - a. Main and Lateral Lines: All plastic pipe which is 2-1/2 inches or smaller shall be Schedule 40 PVC and shall conform to ASTM D1785 – continuously and permanently marked with manufacturer's identification, type, class, nominal pipe size, schedule, and pressure rating [in psi] in accordance with the NSF standard.
    - b. Main Lines: All main line pipe which is larger than 2-1/2 inches in diameter shall be PVC 1120 or 1220 (SDR-PR) pipe, SDR-21 with a 200 psi pressure rating and conforming to ASTM D3139.
    - c. Provide pipes in 20 foot lengths, free of holes, blisters, wrinkles or dents. Note: Except for drip irrigation systems all systems are designed to 100 psi. Pressure shall be regulated at source connection to operate at manufacturers recommended pressure.
- E. Threaded Nipples: Schedule 80 machined PVC pipe, Type 1, Cell Classification 12454, complying with ASTM D2467.
- F. Line location tape: shall be detectable irrigation line marking tape- Thorbrand or equal. Location tape shall be used on all main and lateral lines.

#### **2.2 PIPING JOINING MATERIALS**

- A. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- B. Cleaner, Primer and Solvent Cements

## **SECTION 02810 PLANTING IRRIGATION**

1. Cleaner: Uni-Weld 7300 cleaner, ASTM F 656, or approved equal. Cleaner shall be NSF approved.
  2. Primer: Uni-Weld 8700, Hi-Etch purple primer, ASTM F656.
  3. Cleaner/Primer shall be any color other than clear.
  4. Solvent Cements: Uni-Weld 2200 clear, light viscosity type, for lateral lines, Uni-Weld 1700 gray, heavy duty viscosity type, for lateral lines larger than 2-1/2 inch diameter, and Uni-Weld 6700 clear, light viscosity type for Flex/PVC connections - ASTM D 2564. Solvent shall be NSF approved.
- C. Sealing Tapes and Pastes:
1. Threaded Connections between PVC and Metal Pipe: Rectorseal No. 100 virgin heavy duty sealing paste, Plasto-joint Stick as manufactured by Lake Chemical Company, or Teflon tape.
  2. Metal-to-Metal Connection: Rectorseal No.5 slow dry, soft set pipe thread compound.
  3. PVC-to-PVC Connections: Teflon tape.
  4. Plastic irrigation head or Plastic valve to pipe Connections: Teflon tape. Thread sealing compound shall not be used on thread connections between nipples and plastic valves.

### **2.3 BACKFLOW PREVENTION DEVICES**

- A. Per plan.
- B. Backflow Preventer shall be certified by licensed certified backflow preventer tester.

### **2.4 QUICK COUPLERS**

- A. Manufacturers: Subject to compliance with requirements, Provide products by one of the following :
- B. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
  1. Rainbird.
- C. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, Non- Potable rubber-covered cap.

### **2.5 MANUAL VALVES**

- A. Plastic Ball Valves:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. NIBCO INC.
  2. Description:
    - a. Standard: MSS SP-122.
    - b. Pressure Rating: 125 psig minimum 150 psig].
    - c. Body Material: PVC.
    - d. Type: Union.
    - e. End Connections: Socket or threaded.
    - f. Port: Full.



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- B. Bronze Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. NIBCO INC.
    - b. Powell Valves.
    - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  2. Description:
    - a. Standard: MSS SP-80, Type 2.
    - b. Class: 125.
    - c. CWP Rating: 200 psig.
    - d. Body Material: ASTM B 62 bronze with integral seat and screw-in bonnet.
    - e. Ends: Threaded or solder joint.
    - f. Stem: Bronze, nonrising.
    - g. Disc: Solid wedge; bronze.
    - h. Packing: Asbestos free.
    - i. Handwheel: Malleable iron, bronze, or aluminum.
- C. Operating Wrenches for Iron Gate Valve Casings:
1. Furnish two 2 steel, tee-handle operating wrench(es) with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut for Project.
    - a. NIBCO INC.
  2. Description:
    - a. Standard: MSS SP-70, Type I.
    - b. CWP Rating: 200 psig.
    - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
    - d. Ends: Flanged.
    - e. Trim: All bronze.
    - f. Disc: Solid wedge.
    - g. Packing and Gasket: Asbestos free.

**2.6 AUTOMATIC CONTROL VALVES**

- A. Plastic, Automatic Control Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
  2. Description: Molded-glass filled nylon body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-VAC solenoid. With captured plunger and 150 -200 psi rating. Slow closing with fabric reinforced diaphragm.

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PLANTING IRRIGATION**

**2.7 AUTOMATIC DRAIN VALVES**

- A. Description: Spring-loaded-ball type of corrosion-resistant construction and designed to open for drainage if line pressure drops below 2-1/2 to 3 psig.

**2.8 TRANSITION FITTINGS**

- A. General Requirements: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
  - a. Cascade Waterworks Manufacturing.
  - b. Dresser, Inc.; DMD Division.
  - c. Ford Meter Box Company, Inc. (The).
  - d. JCM Industries.
  - e. Smith-Blair, Inc; a Sensus company.
  - f. Viking Johnson.
2. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

C. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
  - a. Spears Manufacturing Company.
2. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-socket or threaded end.

D. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Spears Manufacturing Company.
2. Description: MSS SP-107, PVC four-part union. Include one brass or stainless-steel threaded end, one solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

**2.9 MISCELLANEOUS PIPING SPECIALTIES**

- A. Water Hammer Arresters: ASSE 1010 or PDI WH 201, with bellows or piston-type pressurized cushioning chamber and in sizes complying with PDI WH 201, Sizes A to F.
- B. Pressure Gages: ASME B40.1. Include 4-1/2-inch- diameter dial, dial range of two times system operating pressure, and bottom outlet.

**2.10 SPRINKLERS**

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- A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.
- B. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings
- C. Plastic, Surface Spray Sprinklers:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings
- D. Plastic, Pop-up Spray Sprinklers:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings

**2.11 CONTROLLERS**

- A. Reference irrigation plans for controller
- B. Wiring
  - 1. Provide #12 AWG [min. ga.], type UF, single conductor, solid copper wire, color-coded wiring to electric control valves from automatic controller. Wire shall be UL approved for direct underground burial. Exposed wiring leading to controller shall be in a rigid electrical metallic approved tubing. Multi-strand wire is not acceptable.
  - 2. Provide a single wire to each solenoid from controller and a common neutral wire to all solenoids from controller as power supply.
  - 3. Provide two extra zone wires and one extra common wire to furthest valve location with 36-inch loops in standard size valve box.
  - 4. Indicate wire path and size on Contract Drawings.
  - 5. Refer to the Facilities Design Manual for additional requirements.
- C. Dry Splice Connectors
  - 1. Rainbird Snap-Tite wire connectors or Spears DS-400 Dri-Splice connectors or approved equal.

**2.12 BOXES FOR AUTOMATIC CONTROL VALVES**

- A. Plastic Boxes:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following shall be black in color:
    - a. Ametek
- B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch minimum to 3 inches maximum.

**PART 3 - EXECUTION**

**3.1 EARTHWORK**

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

## SECTION 02810 PLANTING IRRIGATION

- B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.
- C. Provide minimum cover over top of underground piping according to the following:
  - 1. Irrigation Main Piping: Minimum depth of 18 inches below finished grade.
  - 2. Lateral Piping: 12 inches
  - 3. Sleeves: 24 inches.
- D. Trenching:
  - 1. Stake out all sprinkler head and valve locations prior to trenching for review and approval by the owner.
  - 2. Excavate trenches straight and true with bottom uniformly sloped to low points. Make excavations of sufficient depth and width to permit proper handling and installation of the pipe and fittings. Accurately trim trenches to provide a uniform bed, free from loose soil, rocks, debris, and other sharp edged objects before installing pipe and fittings. In areas where trees are present, adjust trench location beyond the drip line of the trees.
  - 3. Trench depths in rocky areas shall be 6" inches below required depth to allow for pipe bedding. Pipe installed in rocky soil shall be bedded in 6" inches of sand.
  - 4. Trench widths shall allow a minimum of 4" inches between pipes laid in the same trench.
  - 5. Provide a minimum of 24" inches and a maximum of 26" inches of cover for all constant pressure mainline. Provide a minimum of 18" inches and a maximum of 20" inches of cover for all mainline located downstream of the master valve. Provide a minimum of 18 inches and a maximum of 20" inches of cover for all lateral lines not under constant pressure. Provide a minimum of 6" inches of cover for all ½" inch distribution tubing.
  - 6. Keep bottom of trench or excavation free and clear of water.
  - 7. Where existing pavement must be cut to install landscape irrigation system, saw-cut smoothly to straight lines 6" inches wider than trench. Concrete sidewalks, curb & gutter, shall be removed to the nearest joint or saw-cut as directed by the owner.
    - a. Repair and replace pavement cuts, sidewalks, curb & gutter with equivalent materials and finishes – match existing. Refer to Section [2] and Standard Detail WU3001 for patching.

### 3.2 PREPARATION

- A. Installation
  - 1. General
    - a. Prior to installing irrigation heads, stake or otherwise locate trees and shrub planting areas. Avoid laying irrigation lines in root ball zone.
    - b. Install irrigation material and equipment and provide necessary hardware in accordance with the Contract Drawings.
    - c. All connections to the water distribution system must comply with Standard Specification Section 02665 – Underground Water Lines for Domestic & Fire Protection Systems.
  - 2. PVC Pipe
    - a. Main Line: Verify static water pressure at Point of Connection with pressure noted on Contract Drawings. Notify the Owner with any discrepancies prior to proceeding.

## SECTION 02810 PLANTING IRRIGATION

- b. Cut pipe square with the axis, using a fine-tooth hand saw, or ratcheting PVC cutter. Blade edge of cutter shall be straight and sharp to assure square burr-free cuts through PVC pipe. Cutter shall have a pipe supporting plate that adjusts to PVC size, and aids in eliminating pipe deformation and cracking. Remove all burrs prior to solvent welding.
- c. Inside of pipes shall be clean and free of dirt, debris, and any foreign matter.
- d. Apply cleaner and solvent in accordance with ASTM D 2855 and manufacturer's recommendations.
- e. All piping in planters is to rest on a gravel filtration layer and is to be placed prior to placement of soil.
- f. Cover and protect open pipe ends, fixtures and equipment from dirt, water, and chemical or mechanical damage during installation.
- g. Do not lay pipe in water or in trench when weather conditions are unsuitable for work or when temperature is 32 degrees F or below. Pump out or otherwise remove water encountered or accumulated in excavation to keep the bottom of the trench or excavation free and clear of water during installation.
- h. Compression or flow span couplings are not permitted.
- i. Avoid having irrigation pipe crossovers. When pipes cross there shall be a minimum vertical clearance of 4" inches between the pipes and trenching shall be adjusted accordingly to provide required cover.
- j. Vertical stacking of irrigation lines is not permitted. Where pipes are laid in the same trench there shall be a minimum horizontal separation of 4" inches between pipes.
- k. There shall be a minimum separation between fittings used on any single piece of pipe of 3" inches between fittings 1 ½" inches or less and 6" inches between fittings 2" inches and larger.
- l. Saddle taps are not permitted on lines greater than 2" inches.
- m. Drain entire system to a manual drain valve(s) placed at the low point(s) in the system. Drain valve shall be installed on lines of nominal pipe size of 1½" inches or less.
- n. Install drain valve in a standard-body plastic valve box with locking cover and sump pit. Drain-gravel backfill shall be 1-cubic foot of cleaned gravel or crushed stone, graded from ¾ inch min. to 1½"inch maximum.
- o. Thoroughly clean fixtures, exposed materials, and equipment.
- p. Install detectable Line Marking Tape on all main lines and lines > ¾"inch. Place tape 6 "inches above piping.

### 3.3 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.

## SECTION 02810 PLANTING IRRIGATION

- F. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.
- G. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 or larger pipe connection.
- H. Install underground thermoplastic piping according to ASTM D 2774.
- I. Install expansion loops in control-valve boxes for plastic piping.
- J. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- K. Install ductile-iron piping according to AWWA C600.
- L. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.
- M. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.
- N. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.
- O. Install piping in sleeves under parking lots, roadways, and sidewalks.
- P. Install sleeves made of Schedule 40 PVC pipe and socket fittings, and solvent-cemented joints.
- Q. Install transition fittings for plastic-to-metal pipe connections according to the following:
  - 1. Underground Piping:
    - a. NPS 1-1/2 and Smaller: Plastic-to-metal transition fittings.
    - b. NPS 2 and Larger: AWWA transition couplings.

### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.
- E. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End PE Pipe and Fittings: Use butt fusion.
  - 2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
- F. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

## **SECTION 02810 PLANTING IRRIGATION**

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
3. PVC Nonpressure Piping: Join according to ASTM D 2855.

### **3.5 VALVE INSTALLATION**

- A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.
- B. Aboveground Valves: Install as components of connected piping system.
- C. Pressure-Reducing Valves: Install in boxes for automatic control valves or aboveground between shutoff valves.
- D. Drain Valves: Install in underground piping in boxes for automatic control valves.
- E. Setting Valves:
  1. Do not locate valves beneath paved surfaces.
  2. Install valves in a level position.
  3. Install all valves, except backflow preventer, with minimum 24" inches cover. Refer to Section 15051, Piping Systems, for backflow preventer installation.
  4. Install an isolation valve at the PoC, and at loop or zone isolation points.
  5. Install an isolation valve upstream of each electric control valve. Isolation valve may be installed in same valve box with automatic valve.
  6. Manual Drain Valves: install at end and low points of the irrigation system. Additional manual drain valves must be installed if there are multiple low points along the system's run of pipe where water collection may occur.
  7. Install Reduced Pressure or Pressure Vacuum Breakers in accordance with Section 15051, Piping Systems.
- F. Install sprinklers after hydrostatic test is completed.
- G. Install sprinklers at manufacturer's recommended heights.
- H. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and 2 inches from other boundaries unless otherwise indicated.

### **3.6 SPRINKLER INSTALLATION**

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 6" inches from walls and other boundaries such as curbs and walks.
- D. Sprinkler Heads,
  1. Fully flush entire system prior to the installation of sprinkler and bubbler heads. Cap risers as deemed necessary to achieve adequate flushing.
- E. Bubblers:

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1. Bubblers shall be spaced 180 degrees apart and 12" inches from edge of root ball. On sloped surfaces – install bubbler on uphill side of plant material to be irrigated.

### **3.7 VALVE BOX INSTALLATION**

- A. Valve boxes shall be installed as shown on the detail drawings and located as shown on the drawings.
- B. Valve boxes shall be installed at and level with finish grade.
- C. Valve boxes shall be engraved or embossed on the top side of the lid with the contents of each valve box. Letters and numbers shall be no smaller than 1 inch and no larger than 1 ½" inches
  1. Control Valves – brand "Zone Valve" and the # of that valve into the lid.
  2. Quick coupling valve – Brand "Q C " into the lid
  3. Wire splices Brand "WS" into the lid.
  4. Isolation valves – "IV"
  5. Drain Valves – "DV".
  6. Air release – "AR"

### **3.8 CONNECTIONS**

- A. Comply with requirements for piping specified in Division 22 Section "Facility Water Distribution Piping" for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
- C. Connect wiring between controllers and automatic control valves.

### **3.9 IDENTIFICATION**

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."
- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
  1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Division 31 Section "Earth Moving" for warning tapes.

### **3.10 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.



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PLANTING IRRIGATION**

- C. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Any irrigation product will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

**3.11 ADJUSTING**

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.

**3.12 CLEANING**

- A. Flush dirt and debris from piping before installing sprinklers and other devices.

**3.13 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

**PART 4 - METHODS AND MEASUREMENTS**

**4.1 DESCRIPTION**

- A. The sub-sections entitled "Measurement and Payments" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

**5.1 DESCRIPTION**

- A. The sub-sections entitled "Measurement and Payments" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02810**

## **SECTION 02831 BOLLARDS**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

- A. This Section specifies the installation of flexible bollards including mounting hardware.

#### **1.2 RELATED WORK**

- A. None

#### **1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  1. ASTM S36 – Standard Specification for Carbon Structural Steel.
  2. ASTM A312 – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
  3. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  4. ASTM A536 – Standard Specification for Ductile Iron Castings.
  5. ASTM B26 – Standard Specification for Aluminum-Alloy Sand Castings.
  6. CE Mark – Manufacturer's declaration of compliance with European Union Low Voltage Directive 2006/95/EC.
  7. RoHS – Directive 2002/95/EC on the Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment. Tech Spec technical bulletins.

#### **1.4 SUBMITTALS**

- A. In accordance with Conditions of the Contract.
- B. Product Data: Provide for each type of bollard, component, finish, and accessory specified.
- C. Color Samples: Submit manufacturer's standard colors for selection. .
- D. Setting Drawings: Show embedded items and cutouts required for work specified in other Sections
- E. Maintenance Data: Submit manufacturer's field touch-up, cleaning, and maintenance instructions.

**SECTION 02831**  
**BOLLARDS**

1. Warranty Documentation: Submit sample of manufacturer's warranty.

**1.5 QUALITY ASSURANCE**

- A. Comply with Section 01450, "Quality Control".

**1.6 DELIVERY, STORAGE AND HANDLING**

- A. Protect bollards and accessories during delivery, storage, and handling.

**1.7 WARRANTY**

- A. Provide manufacturer's standard warranty against defects in materials and workmanship.

1. Warrant Period: Five years from date of invoice, except as otherwise indicated.
  - a. Coatings: Two years, against peeling, cracking, or significant color change,

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Acceptable Manufacturer: Reliance Foundry Co. Ltd., phone 604-592-4333 or 888-735-5680, fax 604-590-8875, website [www.reliance-foundry.com](http://www.reliance-foundry.com), email [info@reliance-foundry.com](mailto:info@reliance-foundry.com).
- B. Substitutions: Substitutions permitted with written approval from owner.

**2.2 FLEXIBLE BOLLARDS**

Note: Bollard Type, Color and Reflective Tape to be specified by owner prior to contractor procuring materials.

- A. Flexible Bollards, General:
  1. Material: Polyurethane.
    - a. Thermal stability: Good +/- 10 SHORE D.
    - b. Working Temperature: -40°C / + 60 °C.
    - c. Fire resistance: CLASS E. As per UNE-EN-ISO 11925-2:2002
  2. Performance Requirements:
    - a. Impact resistance: Test of 50 impacts, bending the bollard through 90°, simulating a 1500kg vehicles at 15km/h.
    - b. Fatigue resistance: Test of 500 impacts, bending the bollard through 45°, at intervals of 30 seconds.

**SECTION 02831**  
**BOLLARDS**

**B. Flexible Bollard:**

1. Model: Reliance Foundry; **R-8301**
2. Size:
  - a. 80 cm (31.5 in.) high above grade
  - b. 100.6 cm (39.4 in) high overall
  - c. 7.6 cm (3 in.) body dia.
3. Weight: 3.6 Kgs. (8 lbs)
4. Design: Cylindrical with ball top.
5. Country of Origin: Spain.
6. Color: Black, Traffic Green, Imitation Stainless Steel, Brown, Red, Grey.
7. Reflective Tape: Red, White, Yellow, None.
8. Installation:
  - a. Fixed, New Concrete, Embedded.



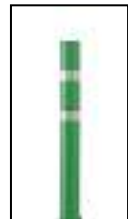
**C. Flexible Bollard:**

1. Model: Reliance Foundry; **R-8301-EX**.
2. Size:
  - a. 89.9 cm (35.4 in) high above grade
  - b. 110 cm (43.4 in.) high overall
  - c. 7.6 cm (3 in.) body dia.
3. Weight: 4.1 Kgs. (9 lbs)
4. Design: Cylindrical with ball top.
5. Country of Origin: Spain.
6. Color: Black, Traffic Green, Imitation Stainless Steel, Brown, Red, Grey.
7. Reflective Tape: Red, White, Yellow, None.
8. Installation:
  - a. Fixed, New Concrete, Embedded.



**D. Flexible Bollard:**

1. Model: Reliance Foundry; **R-8302**.
2. Size:
  - a. 99 cm (35.4 in.) high above grade
  - b. 110 cm (43.4 in.) high overall
  - c. 10 cm (3.9 in.) body dia.
3. Weight: 3.6 Kgs. (8 lbs)
4. Design: Cylindrical with flat top.
5. Country of Origin: Spain.
6. Color: Black, Traffic Green, Imitation Stainless Steel, Brown, Red, Grey.
7. Reflective Tape: Red, White, Yellow, None.
8. Installation:
  - a. Fixed, New Concrete, Embedded.



**SECTION 02831**  
**BOLLARDS**

E. Flexible Bollard:

1. Model: Reliance Foundry; **R-8302-FL (flanged)**.
2. Size:
  - a. 99 cm (35.4 in.) high above grade
  - b. 99 cm (35.4 in.) high overall
  - c. 10 cm (3.9 in.) body dia.
3. Weight: 3.6 Kgs. (8 lbs)
4. Design: Cylindrical with flat top.
5. Country of Origin: Spain.
6. Color: Black, Traffic Green, Imitation Stainless Steel, Brown, Red, Grey.
7. Reflective Tape: Red, White, Yellow, None.
8. Installation:
  - a. Fixed, Existing Concrete, Surface (Flanged) Mount.
  - b. Fixed, New Concrete, Surface (Flanged) Mount.



F. Flexible Bollard:

1. Model: Reliance Foundry; **R-8303**.
2. Size:
  - a. 80 cm (31.5 in.) high above grade
  - b. 100 cm (39.4 in.) high overall
  - c. 10 cm (3.9 in.) body dia.
3. Weight: 3.2 Kgs. (7 lbs)
4. Design: Cylindrical with flat top.
5. Country of Origin: Spain.
6. Color: Black, Traffic Green, Imitation Stainless Steel, Brown, Red, Grey.
7. Reflective Tape: Red, White, Yellow, None.
8. Installation:
  - a. Fixed, New Concrete, Embedded.



G. Flexible Bollard:

1. Model: Reliance Foundry; **R-8303-FL (flanged)**.
2. Size:
  - a. 80 cm (31.5 in.) high above grade
  - b. 10 cm (3.9 in.) body dia.
3. Weight: 3.2 Kgs. (7 lbs)
4. Design: Cylindrical with flat top.
5. Country of Origin: Spain.
6. Color: Black, Traffic Green, Imitation Stainless Steel, Brown, Red, Grey.
7. Reflective Tape: Red, White, Yellow, None.
8. Installation:
  - a. Fixed, New Concrete, Embedded.



## SECTION 02831 BOLLARDS

### H. Flexible Bollard:

1. Model: Reliance Foundry; **R-8303-EX**.
2. Size:
  - a. 99 cm (39 in.) high above grade
  - b. 131.5 cm (51.8 in.) high overall
  - c. 10 cm (3.9 in.) body dia.
3. Weight: 4.1 Kgs. (9 lbs)
4. Design: Cylindrical with flat top.
5. Country of Origin: Spain.
6. Color: Black, Traffic Green, Imitation Stainless Steel, Brown, Red, Grey.
7. Reflective Tape: Red, White, Yellow, None.
8. Installation:
  - a. Fixed, New Concrete, Embedded.



### I. Flexible Bollard:

1. Model: Reliance Foundry; **R-8351**.
2. Size:
  - a. 101.6 cm (40 in.) high above grade
  - b. 12.7 cm (5 in.) base dia.
3. Weight: 5.4 Kgs. (12 lbs)
4. Design: Cylindrical with domed top.
5. Country of Origin: England.
6. Color: Black, Blue, Green, Red, Yellow, Tan, White.
7. Reflective Tape: Yellow, White, Red, None.
8. Installation:
  - a. Fixed, New Concrete, Embedded.



### J. Flexible Bollard:

1. Model: Reliance Foundry; **R-8352**.
2. Size:
  - a. 101.6 cm (40 in.) high above grade
  - b. 15.2 cm (6 in.) body dia.
3. Weight: 7.7 Kgs. (17 lbs)
4. Design: Cylindrical with domed top.
5. Country of Origin: England.
6. Color: Black, Blue, Green, Red, Yellow, Tan, White.
7. Reflective Tape: Yellow, White, Red, None.
8. Installation: Fixed, New Concrete, Embedded



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine paving or other substrates for compliance with manufacturer's requirements for placement and location of embedded items, condition of substrate, and other conditions affecting installation of bollards.

**SECTION 02831**  
**BOLLARDS**

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. General: Comply with manufacturer's installation instructions and setting drawings.
- B. Damaged, cracked, chipped, deformed or marred bollards are not acceptable. Field touch-up minor imperfections in accordance with manufacturer's instructions.

**3.3 CLEANING & PROTECTION**

- A. Protect bollards against damage.
- B. Immediately prior to Substantial Completion, clean bollards in accordance with manufacturer's instructions to remove dust, dirt, adhesives, and other foreign materials.
- C. Touch up damaged finishes according to manufacturer's instructions.

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION**

## **SECTION 02845 ALUMINUM SIGNS**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

- A. This Section specifies removal of existing small and large roadside sign assemblies, relocation of existing small and large roadside sign assemblies, and furnish and fabricate material required for relocation, and installation of small and large roadside sign assemblies, and furnish, fabricate and erect new small sign assemblies and steel supports for large roadside signs, concrete foundations for small and large roadside signs, traffic signal controllers, pedestal poles, roadside flashing beacon assemblies, electrical services, and other small traffic control devices.

#### **1.2 RELATED WORK**

- A. For excavation and backfill, see Section 02222, "Grading, Excavating and Backfilling"
- B. For riprap, see Section 02272, "Ditch Lining and Slope Protection"
- C. For concrete reinforcement, see Section 03200, "Concrete Reinforcement"
- D. For concrete substructures, see Section 03300, "Cast-In-Place Concrete"

#### **1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  - 1. City of Fort Worth Division 34, Transportation
    - a 34 41 30, Aluminum Sign Assemblies
  - 2. Texas Department of Transportation (TxDOT)
    - a Item 644, Small Roadside Sign Assemblies
    - b Item 647, Large Roadside Sign Supports and Assemblies
    - c Item 656, Foundations For Traffic Control Devices

#### **1.4 SUBMITTALS**

- A. No change from reference specifications.

#### **1.5 QUALITY ASSURANCE**

- A. No change from reference specifications



**SECTION 02845  
ALUMINUM SIGNS**

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION**

## **SECTION 02850 TRAFFIC CONTROL**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

- A. This Section specifies the installation of Traffic Control Devices and preparation of Traffic Control Plans.

#### **1.2 RELATED WORK**

- A. None

#### **1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  - 1. City of Fort Worth Division 34, Transportation
    - a. 34 71 13, Traffic Control

#### **1.4 SUBMITTALS**

- A. No change from reference specifications.

#### **1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. No change from reference specifications.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. No change from reference specifications.

#### **3.2 TESTING**

- A. No change from reference specifications.

### **PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**SECTION 02850  
TRAFFIC CONTROL**

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION**

**SECTION 02910  
TOPSOIL AND FINISHED GRADING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Furnish and place topsoil to the depths and on the areas shown on the plans.

**1.2 RELATED WORK**

- A. For roadway excavation and backfill, see Section 02220, "Grading, Excavating and Backfilling"
- B. For utility trench excavation, excavation and backfill, see Section 02221,"Utility Excavation and Backfill".
- C. For cement treated base courses, see Section 02242, "Soil Stabilization: Cement Treatment"
- D. For water utility installation, see Section 02260, "Water Distribution Systems"
- E. For sanitary sewer utility installation, see Section 02730, "Sanitary Sewer Systems"
- F. For storm sewer installation, see Section 02700, "Storm Sewer Systems"
- G. For temporary asphalt repair, see Section 02072, "Removal and Restoration of Miscellaneous Existing Systems"
- H. For seeding and erosion control, see Section 01562, "Soil Erosion an Sediment Control"

**1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  - 1. City of Fort Worth Division 32, Exterior Improvement
    - a 32-91-19, Topsoil Placement and Finishing of Parkways.

**1.4 SUBMITTALS**

- A. No change from reference specifications.

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**SECTION 02910  
TOPSOIL AND FINISHED GRADING**

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION**

## **SECTION 02920 LAWNS AND GRASSES**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

- A. This section includes the installation of sod
- B. Related Requirements:
  - 1. Section 02230 "Site Clearing" for topsoil stripping and stockpiling.
  - 2. Section 02300 "Earth Work" for excavation, filling and backfilling, and rough grading.
  - 3. Section 02810 "Planting Irrigation" for turf irrigation.

#### **1.2 DEFINITIONS**

- A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
  - 1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
  - 1. Certification of each seed mixture for turf grass sod. Include identification of source and name and telephone number of supplier.
- C. Qualification Data: For qualified landscape Installer.

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**LAWNS AND GRASSES**

- D. Product Certificates: For soil amendments and fertilizers, from manufacturer.
- E. Material Test Reports: For standardized ASTM D 5268 topsoil, existing native surface topsoil, existing in-place surface soil, and imported or manufactured topsoil.
- F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required initial maintenance periods.

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
  - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
  - 2. Experience: Three years' experience in turf installation in addition to requirements in Division 01 Section "Quality Requirements."
  - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  - 4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
    - a. Certified Landscape Technician - Exterior, with installation specialty area(s), designated CLT-Exterior.
    - b. Certified Turfgrass Professional, designated CTP.
    - c. Certified Turfgrass Professional of Cool Season Lawns, designated CTP-CSL.
  - 5. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
  - 6. Pesticide Applicator: State licensed, commercial.
- B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.
  - 1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
  - 2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
  - 3. Report suitability of tested soil for turf growth.
    - a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.

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- b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Preinstallation Conference: Conduct conference at Project site.

**1.5 DELIVERY, STORAGE, AND HANDLING**

A. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

**1.6 PROJECT CONDITIONS**

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

**1.7 MAINTENANCE SERVICE**

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:

1. Sodded Turf: 30 days from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 TURFGRASS SOD**

A. Turfgrass Sod: Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects], complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Species: Bermudagrass (*Cynodon dactylon*).

C. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed.

**2.2 INORGANIC SOIL AMENDMENTS**

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:



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1. Class: T, with a minimum of 99 percent passing through No.8 sieve and a minimum of 75 percent passing through No. 60 sieve.
  2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
  3. Provide lime in form of ground dolomitic limestone.
- B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: Horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

### **2.3 ORGANIC SOIL AMENDMENTS**

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
1. Organic Matter Content: 50 to 60 percent of dry weight.
  2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- B. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.

### **2.4 FERTILIZERS**

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
  2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

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1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

**2.5 PLANTING SOILS**

- A. Planting Soil: ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 6 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth. Mix ASTM D 5268 topsoil with the following soil amendments in the following quantities to produce planting soil:
  1. Ratio of Loose Compost to Topsoil by Volume: 1:3.
  2. Ratio of Loose Wood Derivatives to Topsoil by Volume: 1:3
- B. Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
  1. Supplement with another specified planting soil when quantities are insufficient.
  2. Mix existing, native surface topsoil with the following soil amendments in the following quantities to produce planting soil:
    - a. Ratio of Loose Compost to Topsoil by Volume: 1:3.
    - b. Ratio of Loose Wood Derivatives to Topsoil by Volume: 1:3
- C. Planting Soil: Existing, in-place surface soil. Verify suitability of existing surface soil to produce viable planting soil. Remove stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix surface soil with the following soil amendments in the following quantities to produce planting soil:
  1. Ratio of Loose Compost to Surface Soil by Volume: 1:3.
  2. Ratio of Loose Wood Derivatives to Surface Soil by Volume: 1:3
- D. Planting Soil: Imported topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 2 inches deep; do not obtain from agricultural land, bogs or marshes.
  1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass; not infested with nematodes, grubs, other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled, pore-space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
  2. Mix imported topsoil or manufactured topsoil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

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- a. Ratio of Loose Compost to Topsoil by Volume: 1:3.
- b. Ratio of Loose Wood Derivatives to Topsoil by Volume: 1:3.

### **2.6 MULCHES**

- A. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
  - 1. Organic Matter Content: 50 to 60 percent of dry weight.
  - 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

### **2.7 PESTICIDES**

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
  - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  - 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

### **3.2 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
  - 1. Protect grade stakes set by others until directed to remove them.

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- B. Install 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.

**3.3 TURF AREA PREPARATION**

- A. Limit turf subgrade preparation to areas to be planted.
- B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
  - 1. Apply superphosphate fertilizer directly to subgrade before loosening.
  - 2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
    - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
    - b. Mix lime with dry soil before mixing fertilizer.
  - 3. Spread planting soil to a depth of 4 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
    - a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.
    - b. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
  - 1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
  - 2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches 6 inches of soil. Till soil to a homogeneous mixture of fine texture.
    - a. Apply superphosphate fertilizer directly to surface soil before loosening.
  - 3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
  - 4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- F. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

**3.4 SODDING**

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or

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sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.
  2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

### **3.5 TURF RENOVATION**

- A. Renovate existing turf.
- B. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
  1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
  2. Install new planting soil as required.
- C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- D. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- E. Mow, dethatch, core aerate, and rake existing turf.
- F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.
- H. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.
- I. Apply sod as required for new turf.
- J. Water newly planted areas and keep moist until new turf is established.

### **3.6 TURF MAINTENANCE**

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
  1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
  2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
  3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

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- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
  - 1. Schedule watering to prevent wilting, puddling, erosion, Lay out temporary watering system to avoid walking over muddy or newly planted areas.
  - 2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
  - 3. First week: Perform watering daily to keep soil on sod pads continuously moist and to maintain moist topsoil to a depth of at least 4 inches. Water to prevent wilting or as approved. Water may be needed more than once a day depending on weather conditions.
  - 4. Remaining weeks: Perform watering weekly or as needed to keep grass from wilting and to promote growth.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
  - 1. Mow Bermuda grass to a height of 1/2 inch to 1 inch or less.
- D. Turf Postfertilization: Apply fertilizer after initial mowing and when grass is dry.
  - 1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

### **3.7 SATISFACTORY TURF**

- A. Turf installations shall meet the following criteria as determined by Architect:
  - 1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

### **3.8 PESTICIDE APPLICATION**

- A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

### **3.9 CLEANUP AND PROTECTION**

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- C. Remove nondegradable erosion-control measures after grass establishment period.

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**PART 4 - METHODS AND MEASUREMENTS**

**4.1 DESCRIPTION**

- A. The sub-sections entitled "Measurement and Payments" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

**5.1 DESCRIPTION**

- A. The sub-sections entitled "Measurement and Payments" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02920**

## SECTION 02930 PLANTING

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. This section specifies landscape items, plants, planting soils, tree stabilization, mulch, and edging.

#### 1.2 RELATED WORK

- A. For landscape surface and sub-drainage see Section 02630, "Landscape Drainage & Sub-Drainage"
- B. For planting irrigation for trees, shrubs, ground cover, perennials, and pots see Section 02810 "Planting Irrigation".
- C. For turf and grasses see Section 02920, "Turf and Grasses"

#### 1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- C. Finish Grade: Elevation of finished surface of planting soil.
- D. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- F. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- G. Planting Area: Areas to be planted.
- H. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- I. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- J. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- K. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- L. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- M. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- N. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.



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### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated, including soils.
  - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
  - 2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.
  - 3. Plant Photographs: Include color photographs in digital 3-by 5inch print format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
- B. Samples for Verification: For each of the following:
  - 1. Mulch: 1 pint volume of each mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
  - 2. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
- C. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
  - 1. Manufacturer's certified analysis of standard products.
  - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- E. Material Test Reports: For standardized ASTM D 5268 topsoil and existing native surface topsoil and imported or manufactured topsoil.
- F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.
- G. Warranty: Sample of special warranty.

### **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.
  - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
  - 2. Experience: five years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
  - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

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4. Pesticide Applicator: State licensed, commercial.
- B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
  1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
  2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
  3. Report suitability of tested soil for plant growth.
    - a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.
- D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
- E. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
  1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
  2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- F. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
  1. Notify Architect of sources of planting materials seven days in advance of delivery to site.
- G. Preinstallation Conference: Conduct conference at Project site.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
- B. Bulk Materials:

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1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball.
- E. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
1. Do not remove container-grown stock from containers before time of planting.
  2. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

### **1.7 PROJECT CONDITIONS**

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
1. Notify Architect no fewer than two days in advance of proposed interruption of each service or utility.
  2. Do not proceed with interruption of services or utilities without Architect's written permission.
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

### **1.8 WARRANTY**

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
    - b. Structural failures including plantings falling or blowing over.
    - c. Faulty performance of tree stabilization, edgings.
    - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

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2. Warranty Periods from Date of Substantial Completion:
  - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
  - b. Ground Covers, Biennials, Perennials, and Other Plants: Three months.
3. Include the following remedial actions as a minimum:
  - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
  - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
  - c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
  - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

### **1.9 MAINTENANCE SERVICE**

- A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than the warranty period stated above.
- B. Initial Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than the warranty period stated above.

## **PART 2 - PRODUCTS**

### **2.1 PLANT MATERIAL**

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
  1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.
  2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus

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and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

- E. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

### 2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
  - 1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
  - 2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: Horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

### 2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
  - 1. Organic Matter Content: 50 to 60 percent of dry weight.
  - 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or granular texture, with a pH range of 3.4 to 4.8.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.
- D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

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1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.
- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

### 2.4 FERTILIZERS

- A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
  2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
  1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
  2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
  1. Size: 10-gram tablets.
  2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.
- F. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

### 2.5 PLANTING SOILS

- A. Planting Soil Planting Plan: Existing, in-place surface soil. Verify suitability of existing surface soil to produce viable planting soil. Remove stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
  1. Ratio of Loose Compost to Surface Soil by Volume: 1:3.
  2. Ratio of Loose Wood Derivatives to Surface Soil by Volume: 1:3.
  3. Weight of Sulphur coated fertilizer 15-5-10 with Micronutrients & Iron per 1000 Sq. Ft.: 20lbs

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4. Volume of Sand Plus 10 Percent Diatomaceous Earth per 1000 Sq. Ft.: 1:3.

### 2.6 MULCHES

- A. Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
  1. Type: Shredded hardwood.
  2. Size Range: 3 inches maximum, 1/2 inch minimum.
  3. Color: Natural.

### 2.7 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally-encountered chemicals, alkalis, and acids.
- B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd..

### 2.8 PESTICIDES

- A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

### 2.9 TREE STABILIZATION MATERIALS

- A. Per details on drawings.

### 2.10 LANDSCAPE EDGINGS

- A. Steel Edging: Standard commercial-steel edging, rolled edge, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings comparable product by one of the following or approved equal:
    - a. COL-MET  
1355 Pritchett Industrial Dr.  
Austell, Georgia 30168  
800. 829. 8225  
[www.colmet.com](http://www.colmet.com)
  3. Edging Size: 3/16 inch wide by 4 inches deep.
  4. Stakes: Tapered steel, a minimum of 15 inches long.

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5. Accessories: Standard tapered ends, corners, and splicers.
6. Finish: Standard paint.
7. Paint Color: Green.

### **2.11 MISCELLANEOUS PRODUCTS**

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Burlap: Non-synthetic, biodegradable.
- C. Planter Filter Fabric: Woven or Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.
- D. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
  1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
  3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

### **3.2 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. If structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants are damaged, they shall be replaced with like materials and sizes.
- C. Install 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.
- D. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.



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- E. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
- F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
  - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

### 3.3 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
  - 1. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
    - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
  - 2. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
    - a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Finish Grade shall be below finish grade of building for proper drainage away from building.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at application rate indicated on Drawings.

### 3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
  - 1. Excavate approximately three times as wide as ball diameter container-grown stock.
  - 2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
  - 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
  - 4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.

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5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
  6. Maintain supervision of excavations during working hours.
  7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
- B. Subsoil and topsoil removed from excavations may be used as planting soil.
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

### **3.5 TREE, SHRUB, AND VINE PLANTING**

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set container-grown stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
1. Use planting soil planting plan for backfill.
  2. Carefully remove root ball from container without damaging root ball or plant.
  3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
  5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

### **3.6 TREE, SHRUB, AND VINE PRUNING**

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.
- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

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D. Do not apply pruning paint to wounds.

### **3.7 TREE STABILIZATION**

1. See details on drawings.

### **3.8 GROUND COVER AND PLANT PLANTING**

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as noted on the planting plan.
- B. Use planting soil as shown on planting details on the drawings for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

### **3.9 PLANTING AREA MULCHING**

- A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches and secure seams with galvanized pins.
- B. Mulch backfilled surfaces of planting areas and other areas indicated.
  - 1. Trees in Ornamental Grass Areas: Apply mulch ring of 3-inch average thickness, with 24-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
  - 2. Mulch in Planting Areas: Apply 3-inch average thickness of mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.
  - 3. Cobble Mulch in Planting Areas: Apply 3-inch average thickness of mineral mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

### **3.10 EDGING INSTALLATION**

- A. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches apart, driven below top elevation of edging.

### **3.11 PLANT MAINTENANCE**

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

## **SECTION 02930 PLANTING**

### **3.12 PESTICIDE APPLICATION**

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

### **3.13 CLEANUP AND PROTECTION**

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

### **3.14 DISPOSAL**

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- B.

## **PART 4 - METHODS AND MEASUREMENTS**

### **4.1 DESCRIPTION**

- A. The sub-sections entitled "Measurement and Payments" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

## **PART 5 - BASIS OF PAYMENT**

### **5.1 DESCRIPTION**

- A. The sub-sections entitled "Measurement and Payments" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 02930**

**SECTION 02931  
SEEDING AND SODDING-NON-IRRIGATED AREAS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Provide and install permanent Seeding and Grass Sod as shown on the plans or as directed.

**1.2 RELATED WORK**

- A. For roadway excavation and backfill, see Section 02220, "Grading, Excavating and Backfilling"
- B. For utility trench excavation, excavation and backfill, see Section 02221, "Utility Excavation and Backfill".
- C. For cement treated base courses, see Section 02242, "Soil Stabilization: Cement Treatment"
- D. For water utility installation, see Section 02260, "Water Distribution Systems"
- E. For sanitary sewer utility installation, see Section 02730, "Sanitary Sewer Systems"
- F. For storm sewer installation, see Section 02700, "Storm Sewer Systems"
- G. For temporary asphalt repair, see Section 02072, "Removal and Restoration of Miscellaneous Existing Systems"
- H. For seeding and erosion control, see Section 01562, "Soil Erosion and Sediment Control"

**1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  - 1. City of Fort Worth Division 32, Exterior Improvement
    - a. 32-92-13, Hydro-Mulching, Seeding, and Sodding.

**1.4 SUBMITTALS**

- A. No change from reference specifications.

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. No change from reference specifications.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. No change from reference specifications.

### **3.2 TESTING**

- A. No change from reference specifications.

### **3.3 MAINTENANCE**

- A. Water and mow sod until completion and final acceptance of the Project in accordance with the reference specifications or for a period of 3 months from date of Substantial Completion, whichever is greater.

## **PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

## **PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION**

## **SECTION 03100 CONCRETE FORMWORK**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

- A. This Section specifies constructing and removing concrete formwork and falsework.

#### **1.2 RELATED WORK**

- A. For concrete reinforcement, see Section 03200, "Concrete Reinforcement"
- B. For cast-in-place concrete, see Section 03300, "Cast-In-Place Concrete"
- C. For portland cement concrete, see Section 03305, "Portland Cement Concrete"

#### **1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions, unless noted otherwise, of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  - 1. Texas Department of Transportation (TxDOT) (Non Railroad Structures)
    - a. Item 420, Concrete Substructures
    - b. Item 422, Concrete Superstructures
    - c. Item 423, Retaining Walls
  - 2. American Railway Engineering and Maintenance-Of-Way Association (AREMA), 2014 (Railroad Structures)
    - a. Volume 2, Chapter 8, Part 1, Materials, Tests and Construction Requirements, Section 1.9

#### **1.4 SUBMITTALS**

- A. No change from reference specifications.

#### **1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. No change from reference specifications.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. No change from reference specifications.

#### **3.2 TESTING**

- A. No change from reference specifications.

**SECTION 03100  
CONCRETE FORMWORK**

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 03100**



## **SECTION 03200 CONCRETE REINFORCEMENT**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

A. This Section specifies furnishing and placing reinforcing steel as shown on the plans.

#### **1.2 RELATED WORK**

A. None.

#### **1.3 REFERENCES**

A. The Contractor's design and installation shall comply with the latest editions, unless noted otherwise, of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.

1. Texas Department of Transportation (TxDOT) (Non Railroad Structures)

a. Item 440 Reinforcement for Concrete

2. American Railway Engineering and Maintenance-Of-Way Association (AREMA), 2014 (Railroad Structures)

a. Volume 2, Chapter 8, Part 1 Materials, Tests and Construction Requirements,

b. Volume 2, Chapter 8, Part 2 Reinforced Concrete Design

#### **1.4 SUBMITTALS**

A. No change from reference specifications.

#### **1.5 QUALITY ASSURANCE**

A. No change from reference specifications

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

A. In addition to the reference documents, see Bridge General Notes and relevant plan sheets for additional requirements regarding concrete reinforcement.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

A. No change from reference specifications.

#### **3.2 TESTING**

A. No change from reference specifications.

**SECTION 03200  
CONCRETE REINFORCEMENT**

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 03200**

## SECTION 03300 CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. This Section specifies constructing concrete substructures including culverts, headwalls, inlets, manholes, footings, drilled shafts, columns, caps, abutments, wingwalls, piers, superstructures, concrete deck slabs, approach slabs, other bridge substructure elements, retaining walls and other concrete structures as indicated.

#### 1.2 RELATED WORK

- A. For utility trench excavation and backfill, see Section 02221, "Utility Excavation and Backfill"
- B. For roadway excavations and backfill, see Section 02222, "Grading, Excavating and Backfilling – Fort Worth"
- C. For ditch lining, see Section 02272, "Ditch Lining and Slope Protection – Fort Worth"
- D. For drilled shaft foundations, see Section 02375, "Drilled Shaft Foundations"
- E. For storm sewer installation, see Section 02700, "Storm Sewer Systems"
- F. For storm sewer installation, see Section 02701, "Storm Sewer Systems – Fort Worth"
- G. For concrete formwork, see Section 03100, "Concrete Formwork"
- H. For concrete reinforcement, see Section 03200, "Concrete Reinforcement"
- I. For portland cement concrete, see Section 03305, "Portland Cement Concrete"
- J. For concrete finishing, see Section 03350, "Concrete Finishing"

#### 1.3 REFERENCES

- A. The Contractor's design and installation shall comply with the latest editions, unless noted otherwise, of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
1. City of Fort Worth Division 33, Utilities (Non Railroad Structures)
    - a. 33-49-10 Cast-In-Place Manholes and Junction Boxes
    - b. 33-49-40 Storm Drainage Headwalls and Wingwalls
  2. Texas Department of Transportation (TxDOT) (Non Railroad Structures)
    - a. Item 420, Concrete Substructures
    - b. Item 421 Hydraulic Cement Concrete
    - c. Item 422 Concrete Superstructures
  3. American Railway Engineering and Maintenance-Of-Way Association (AREMA), 2014 (Railroad Structures)
    - a. Volume 2, Chapter 8, Part 1 Materials, Tests and Construction Requirements,
    - b. Volume 2, Chapter 8, Part 2 Reinforced Concrete Design
    - c. Volume 2, Chapter 8, Part 17 Prestressed Concrete
    - d. Volume 2, Chapter 8, Part 27 Concrete Slab Track

**SECTION 03300**  
**CAST-IN-PLACE CONCRETE**

4. BNSF-UNION PACIFIC RAILROAD GUIDELINES FOR RAILROAD GRADE SEPARATION PROJECTS, January 24, 2007 (In addition to the AREMA code above, the contractor must also adhere to these guidelines for BNSF and UPRR Railroad Structures.)

**1.4 SUBMITTALS**

- A. In addition to the reference documents, see the Bridge General Notes for additional requirements for Mass Concrete placement for Railroad and Non Railroad Structures.

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. No change from reference specifications.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. In addition to the reference documents, see the Bridge General Notes for additional requirements for Mass Concrete placement for Railroad and Non Railroad Structures.

**3.2 TESTING**

- A. No change from reference specifications.

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 03300**

**SECTION 03305  
PORTLAND CEMENT CONCRETE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies furnishing portland cement concrete for concrete pavements, concrete structures, and other concrete construction.

**1.2 RELATED WORK**

- A. For seeding and erosion control, see Section 01562, "Soil Erosion and Sediment Control"
- B. For temporary asphalt repair, see Section 02072, "Removal and Restoration of Miscellaneous Existing Systems"
- C. For utility trench excavation, excavation and backfill, see Section 02221, "Utility Excavation and Backfill"
- D. For roadway excavation and backfill, see Section 02222, "Grading, Excavating and Backfilling – TxDOT"
- E. For portland cement treated base courses, see Section 02242, "Soil Stabilization: Portland Cement Treatment"
- F. For water utility installation, see Section 02660, "Water Distribution Systems"
- G. For storm sewer installation, see Section 02701, "Storm Sewer Systems - TxDOT"
- H. For sanitary sewer utility installation, see Section 02730, "Sanitary Sewer Systems"

**1.3 REFERENCES**

- A. The Contractor's design and installation shall comply with the latest editions, unless noted otherwise, of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
  - 1. Texas Department of Transportation (TxDOT) (Non Railroad Structures)
    - a. Item 421, Hydraulic Cement Concrete
  - 2. American Railway Engineering and Maintenance-Of-Way Association (AREMA), 2014 (Railroad Structures)
    - a. Volume 2, Chapter 8, Part 1, Materials, Tests and Construction Requirements

**1.4 SUBMITTALS**

- A. No change from reference specifications.

**SECTION 03305  
PORTLAND CEMENT CONCRETE**

**1.5 QUALITY ASSURANCE**

- A. No change from reference specifications

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. In addition to the reference documents, see Bridge General Notes and relevant plan sheets for additional requirements regarding portland cement concrete.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. No change from reference specifications.

**3.2 TESTING**

- A. No change from reference specifications.

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION 03305**

## **SECTION 03350 CONCRETE FINISHING**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

A. This section specifies finishing concrete surfaces as shown on the plans.

#### **1.2 RELATED WORK**

A. None.

#### **1.3 REFERENCES**

A. The Contractor's design and installation shall comply with the latest editions, unless noted otherwise, of all applicable Standards and Codes included herein. The Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.

1. Texas Department of Transportation (TxDOT) (Non Railroad Structures)

- a. Item 420, Concrete Substructures
- b. Item 422, Concrete Superstructures
- c. Item 427, Surface Finishes for Concrete

2. American Railway Engineering and Maintenance-Of-Way Association (AREMA), 2014 (Railroad Structures)

- a. Volume 2, Chapter 8, Part 1, Materials, Tests and Construction Requirements, sections 1.19 - 1.21.

#### **1.4 SUBMITTALS**

A. No change from reference specifications.

#### **1.5 QUALITY ASSURANCE**

A. No change from reference specifications

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

A. No change from reference specifications.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

A. No change from reference specifications.

#### **3.2 TESTING**

A. No change from reference specifications.

**SECTION 03350  
CONCRETE FINISHING**

**PART 4 - METHOD OF MEASUREMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**PART 5 - BASIS OF PAYMENT**

- A. The sub-sections entitled "Measurement and Payment" are eliminated from every specification section. Refer to Specification 01220, Measurement and Payment, for the specific details pertaining to the TRE Rail contract.

**END OF SECTION**





TRINITY METRO<sup>SM</sup>

**TRINITY RIVER EXPRESS (TRE)  
TRINITY LAKES PARKING LOT PROJECT  
PROJECT SPECIFICATIONS IFB**

I hereby certify that the following Specification(s) that contained herein were prepared under my direct supervision.

**DIVISION 16 – ELECTRICAL**

16880 – VIDEO IP SYSTEM - COMMUNICATIONS SYSTEM



TranSystems  
TBPE Firm No. 3557  
500 W. 7th Street, Suite 1100  
Fort Worth, Texas 76102  
817-339-8950



CONTRACT NO.  
23-026

**IFB  
Submittal**

March  
2023

## SECTION 16110 CONDUITS AND RACEWAYS

### PART 1 - GENERAL

Conduit and Fittings for Underground Installation

#### 1.1 DESCRIPTION

- A. This Work includes complete conduit and raceways for above ground Systems Work. Reference Section 02780, "Underground Electrical and Communications Distribution Systems", for underground electrical and distribution systems. Reference Section 16111, "Conduits", for above ground non-systems related conduits.
- B. This Section specifies the requirements for coating of metallic conduits.
- C. Conduits assembled into systems concrete encased duct banks, stub-ups and stub-outs shall meet the requirements of Specification Section 02780, "Underground Electrical and Communications Distribution Systems".

#### B. National Electrical Manufacturers Association (NEMA)

- 1. NEMA C80.1 - Rigid Steel Conduit, Zinc Coated Specification for
- 2. NEMA ANSI C80.3 – American National Standard for Electrical Metallic Tubing (EMT)
- 3. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit
- 4. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
- 5. NEMA TC 6 & 8 - Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations

#### 1.2 DEFINITIONS

- A. Conduit: Individual electrical raceway.
- B. Duct: Assembly of conduit in configurations shown, either concrete encased or not, with or without reinforcement.
- C. Raceway: An enclosed channel of metal or nonmetallic materials designed expressly for holding wires, cables, or busbars.

#### C. Nation Fire Protection Association (NFPA)

- 1. NFPA 70 - National Electrical Code (hereinafter referred to as NEC)

#### 1.3 REFERENCED STANDARDS

- A. ASTM International (Formerly known as American Society for Testing and Materials) (ASTM)
  - 1. ASTM A36/A36 M - Standard Specification for Carbon Structural Steel
  - 2. ASTM A48/A48 M - Standard Specification for Gray Iron Castings
  - 3. ASTM A123/A123 M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  - 4. ASTM A153/A153 M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  - 5. ASTM A615/ A615 M Rev B - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
  - 6. ASTM C33 - Standard Specification for Concrete Aggregates
  - 7. ASTM F512 - Standard Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC)

#### 1.4 SUBMITTALS

- A. Submit the following for Authority approval in accordance with these Specifications and with the additional requirements as specified for each.
- B. Submit product data 30 days to any conduit or raceway installation, on the following items unless noted otherwise:
  - 1. Raceways
  - 2. Fittings
  - 3. Metallic joint compounds, caulking and sealing compounds
  - 4. Pull cords
  - 5. Raceway tags and labels
  - 6. Conduit mandrels and brushes
  - 7. Warning tape
  - 8. PVC Conduit joint cleaning solvent and cement
  - 9. Conduit Numbering Schedule/Tabulation
- C. Mandrel log sheets shall be submitted 7 days after completion.

- D. All submittals shall be submitted at least 21 days prior to installation.
- E. Submittals for concrete encased conduits (CENC) conduits, duct banks and manholes shall be in accordance with Specification Section 02780, "Underground Electrical and Communications Distributions Systems".

**1.5 QUALITY ASSURANCE**

- A. Contractor shall perform the Work included in this Section in strict accordance with the requirements of the Contractor's Quality Control Program as approved by the Authority and in compliance with the requirements of these Specifications.
- B. Contractor shall perform the following in accordance with Contractor's Quality Control Program specified in these Specifications.
  - 1. Material qualification testing and certification for acceptance of materials, components, and assemblies.
  - 2. Job control testing of in-progress Work being performed in shops, factories, and on-site.
  - 3. On-site inspection of specified Work elements.

**1.6 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Receive, transport and store until use.
  - 1. Area for storage of those materials provided by other contractors or utilities.

**PART 2 - PRODUCTS**

**2.1 GALVANIZED RIGID STEEL CONDUIT (GRSC)**

- A. Conduit shall comply with NEMA C80.1 and shall be hot-dip galvanized inside and out. Threaded ends shall be galvanized using a zinc metallizing process, which sprays or blasts molten or semi-molten zinc on the threaded area. Minimum size shall be 3/4 inch.
- B. Approved manufacturers: LTC, Triangle, Allied or Authority approved equal.

**2.2 PVC SCHEDULE 40 CONDUIT (PVC)**

- A. Conduit shall comply with NEMA TC 2, rigid polyvinyl chloride, Schedule 40. Conduit shall be sunlight resistant and suitable for 194 degrees F conductors and exposed locations.
- B. Approved manufacturers: Carlon, PW Pipe, Western Plastics or Authority approved equal.

**2.3 PVC SCHEDULE 80 CONDUIT (PVC 80)**

- A. Conduit shall comply with NEMA TC 2, rigid polyvinyl chloride, Schedule 80. Conduit shall be sunlight resistant and suitable for 194 degrees F conductors and exposed locations.
- B. Approved manufacturers: Carlon, PW Pipe, Western Plastics or Authority approved equal.

**2.4 ELECTRICAL METALLIC TUBING (EMT)**

- A. Conduit shall comply with NEMA ANSI C80.3.
- B. Interior exposed, dry locations only, not subject to damage

**2.5 FLEXIBLE METAL CONDUIT**

- A. Galvanized flexible steel, listed for dry locations. Minimum size shall be 1/2 inch.
- B. Liquid tight: Polyvinyl chloride (PVC) weatherproof cover over galvanized flexible steel conduit, listed for damp and wet locations. Minimum size shall be 1/2 inch.

**2.6 GRSC CONDUIT FITTINGS**

- A. Conduit fittings shall be steel or cast malleable iron and shall be hot-dip or mechanically galvanized. Die-cast zinc fittings shall not be used.
- B. Bushings and grounding bushings shall have molded phenolic or "Nylon" insulating collars. Grounding bushings shall have a "lay-in" tin-plated copper lug.
- C. Expansion fittings for exposed conduit runs shall be weatherproof with external bonding jumper, providing up to 4 inches longitudinal movement with bushed conduit ends. Manufacturers shall reference the product to ANSI, IEEE, UL, NEMA or any other recognized standards or code.
- D. Watertight split couplings or 3-piece ('Ericson') couplings shall be O-Z/Gedney, or Authority approved equal.
- E. Running thread or set screw type fittings shall not be used.
- F. Lock nuts 2 inches and smaller shall be heavy galvanized steel. Lock nuts larger than 2 inches shall be galvanized malleable iron.
- G. Hubs shall be galvanized steel or galvanized malleable iron, with insulating inserts and sealing rings. Hubs shall provide watertight conduit connections to boxes and enclosures.

- H. Conduit outlet bodies shall be cast ferrous alloy, with gasketed ferrous alloy cover, hot-dip or mechanically galvanized. Aluminum alloy conduit bodies shall not be acceptable. "Short" conduit bodies such as SLBs shall not be acceptable. Acceptable manufacturers: O-Z/Gedney, Crouse-Hinds, Appleton, or Authority approved equal..

**2.7 PVC CONDUIT FITTINGS**

- A. Fittings for PVC conduit shall comply with NEMA TC 3. PVC conduit fittings shall be of the same manufacturer and type as the conduit.
- B. Expansion fittings shall allow expansion, with the same characteristics as the PVC conduit and be of the same manufacturer. Manufacturers shall reference the product to ANSI, IEEE, UL, NEMA or any other recognized standards or code.

**2.8 EMT FITTINGS**

- A. Fittings for EMT shall be by the same manufacturer and specifications as for EMT conduit.
- B. Fittings shall comply with NEMA ANSI C80.3.

**2.9 FLEXIBLE METAL CONDUIT FITTINGS**

- A. Flexible Metal Conduit Fittings: Galvanized malleable iron or steel squeeze-type, setscrew fittings with insulated throat. Acceptable manufacturer: O-Z/Gedney C-8T Series, Thomas and Betts 3112 Series, or Authority approved equal.
- B. Liquid Tight Flexible Metal Conduit Fittings: All fittings shall be galvanized steel compression fittings, with O-rings, conduit ferrule and insulated throat, and shall be oil-tight and water tight. Manufacturers shall reference the product to ANSI, IEEE, UL, NEMA or any other recognized standards or code.

**2.10 RACEWAY TAGS AND LABELS**

- A. Tags and labels shall be made from nonferrous metals with raceway designations shown on the Drawings stamped by steel dies.

**2.11 CONDUIT MANDRELS AND BRUSHES**

- A. Conduit brushes shall utilize round wire bristles for maximum cleaning of sand, grit, and obstructions from the conduit. They shall have a pulling eye on one end, and a smaller twisted eye on the other end, which shall allow for bi-directional pulling. Conduit brushes shall be sized as shown in Table 2.16A, Conduit Brush Sizes.
- B. Conduit mandrels shall be flexible, and manufactured for cleaning out mud, dirt, and light obstacles from ducts before the installation of

cable. Mandrels shall be suitable for pulling around tight bends, and use a tapered profile that allows pulling in either direction. Pulling eyes shall be provided on each end. The mandrel shall be fabricated from polyurethane, or an Authority approved equal material, and shall not damage conduit inner walls. Conduit mandrels shall be sized per Table 2.16B, Conduit Mandrel Sizes.

- C. Conduit mandrels and brushes shall not damage any conduit interior coating.
- D. Conduit brushes and mandrels shall be manufactured for the purpose by a company regularly engaged in the production of electrical equipment, such as Greenlee Textron, Inc., or Authority approved equal. Mandrels shall not be fabricated by the Contractor in the shop or field.

**2.12 WARNING TAPE**

- A. Tape shall be Installed in accordance with Specification Section 02780, "Underground Electrical and Communications Distribution Systems", and Systems Elements Standard Drawings.

**2.13 PULL CORD**

- A. Pull cord shall be twisted or braided nylon cordage with a minimum tensile strength of 1,000 pounds

**PART 3 - EXECUTION**

**3.1 GENERAL INSTALLATION REQUIREMENTS**

- A. Many raceways shall remain empty, with conductors installed in the future. All raceways installed for future use shall have a nylon pull-cord installed and secured at each end, with tags referenced the same at both ends on the pull-cord.
- B. Install raceways with not more than 270 degrees of bend, total, in each raceway run between boxes, manholes, handholes, and raceway terminations.
- C. Unless otherwise noted, minimum raceway size shall be 3/4 inch for inside buildings or in a building slab, and one inch for underground raceways governed by this specification section.
- D. Install raceways concealed in construction unless shown otherwise on the Contract Drawings.
- E. Cut raceway ends square, ream, and extend maximum distance into all couplings and connectors. Tighten all fittings securely.
- F. Field-cut threads and reamed ends in metallic conduit shall be protected from corrosion immediately after cutting, reaming and cleaning by application of a zinc-rich coating.

## CONDUIT AND RACEWAYS

- G. Use conductive joint compounds to insure electrical continuity of metallic raceway joints. Manufacturers shall reference the product to ANSI, IEEE, UL, NEMA or any other recognized standards or code.
- H. Install manufactured end caps or plugs on all raceway ends immediately after installation to prevent the entrance of liquids or foreign materials.
- I. Bends in GRSC shall be factory ells or field bends. Field bending shall be done using one-shot or segment benders which do not decrease the raceway cross-section. Bending shall be done in accordance with manufacturer's instructions.
1. Unless otherwise indicated, minimum bend radius for raceways within structures shall be in accordance with the NEC. Exceptions to the NEC shall not be used to determine conduit bend radius, even if permitted by the NEC, for any part of this Contract unless Authority approved. Minimum bend radius for raceways installed underground shall be as shown in Table 3.1, Underground Conduit Minimum Bending Radius, except where otherwise indicated.
- J. Route raceways to avoid structural obstructions and to minimize crossovers. Should any core drilling or installation of sleeves not shown on drawings be desired by the Contractor, such proposed concrete penetrations shall be submitted to the Authority for structural review prior to any core drilling or sleeving.
- K. Install expansion fittings complete with grounding jumpers where raceways cross expansion joints, construction joints, sawn joints, and where shown.
- L. All connections shall be watertight, except for non-liquid tight flexible metal conduit.
- M. Install PVC conduit in accordance with manufacturer's instructions. Cut the conduit ends square, deburr, and apply an Authority approved solvent to clean the joint. Apply Authority approved cement and allow to set 24 hours before mandrelling, brushing, and installing conductors. Joint cleaning solvent and cement shall be approved by the conduit manufacturer and the Authority.
- N. This Clause covers bends in PVC conduit runs underground but not in duct banks as governed by this specification section. Minimum bend radius for conduits/raceways installed underground shall be as shown in Table 3.1, Underground Conduit Minimum Bending Radius, except where otherwise indicated. Refer to Specification Section 02780, "Underground Electrical and Communications Distribution Systems", for bends in PVC conduit runs in CENC duct banks, stub-ups and stub-outs. PVC/GRSC shall be used for conduit bends 30 degrees or greater in PVC conduit runs underground but not in duct banks. Bends in PVC conduit runs underground but not in duct banks that are less than 30 degrees shall be factory PVC ells or field bend PVC conduit. Use of 2 PVC ells of less than 30 degrees with short, straight lengths of PVC between ells to make up a bend 30 degrees or greater is not acceptable. Field bends in PVC conduit with a radius of 100 feet or less shall be formed hot using only a heater recommended by the conduit manufacturer. Use conduit plugs during bending for conduit 2 inches and larger. Remove plugs only after conduit has cooled. Field bends (sweeps) with radius greater than 100 feet may be formed cold.
- O. Route all exposed raceways installed in a building parallel or perpendicular to building lines except where otherwise shown. Form bends in adjacent raceways to match radius and center of bend.
- P. Install all ground bushings, and incidentals.
- Q. All PVC conduits entering concrete manholes, handholes, or pullboxes shall be terminated with bell-end fittings.
- R. End Bells: Flared, smooth surfaced fittings of same material as conduit.

### 3.2 REQUIREMENTS FOR RACEWAY TYPES

- A. General
1. Raceway types for specific locations shall be as shown on the drawings. Where conduit types are not called out on the drawings, or specified elsewhere in this Section, the conduit type shall be as specified herein. See Tables 3.3-1, Summary of Conduit Types by Specific Location and 3.3-2, Summary of Conduit Types by Application.
2. For the purpose of this Specification raceways are considered 'subject to damage' in any of the following locations:
- a. Exposed installations within 48 inches of finished floor or final grade.
- b. Exposed installations where the area is subject to vehicular traffic, within 4 feet of established drive lanes or parking areas unless the area is protected by bollards or other structure. Height of affected area shall be 8 feet or maximum height of vehicles whichever is greater.
- c. Exposed installations where the area is subject to maintenance activity, including electrical and

mechanical equipment rooms.  
Height of affected area shall be 8 feet above finished floor.

- B. For interior and exterior installations above ground, exposed or concealed in construction, not embedded in concrete or masonry, and or not subject to damage, provide uncoated galvanized rigid steel conduit. For equipment requiring flexible connections, provide flexible metal conduit.
- C. For concrete encased conduits in underground duct banks, provide raceway types specified in Specification Section 02780, "Underground Electrical and Communications Distribution Systems".
- D. For direct buried underground conduit, provide PVC Schedule 80 or raceway type DB-120 specified in Specification Section 02780, "Underground Electrical and Communications Distribution Systems", . Conduit shall be encased and embedded in 4 inches of Authority approved cement based soil stabilizer/ flowable fill or clean sharp sand on all sides of the raceway, as indicated on the drawings.
- E. For concrete embedded conduit, such as conduit embedded in concrete building or structure walls, or where the conduit is fully encased in concrete not in a duct bank, or where used in formed concrete, provide uncoated galvanized rigid steel conduit. PVC conduit shall not be used, unless otherwise indicated.
- F. For conduits installed in pole foundations, in roadways, and all track crossings, not in duct banks, provide GRSC. PVC conduit shall not be used unless otherwise indicated.
- G. For direct buried raceway not in a roadway, for crossing lighting, roadway lighting, pathway lighting, or site lighting, or under station platforms provide schedule 40 PVC conduit, except where schedule 80 PVC conduit is indicated. Conduit shall be encased and embedded in 4 inches of Authority approved cement based soil stabilizer/ flowable fill on all sides of the raceway. PVC raceway is not permitted at burial depths less than 36 inches.
- H. For conduit risers on catenary poles, provide GRSC type conduit, ells and fittings unless otherwise indicated.
- I. For bridge abutment conduit risers, use GRSC type conduit unless otherwise indicated.

**3.3 RACEWAYS INSTALLED UNDERGROUND**

- A. Install underground raceways in accordance with Specification Section 02780, "Underground Electrical and Communications Distributions Systems".

**3.4 SLEEVES**

- A. All sleeves shall be GRSC unless otherwise indicated.
- B. Install, in advance of pouring concrete, all sleeves where shown. Sleeves shall terminate flush with the surface of the concrete with a coupling.

**3.5 RACEWAYS STUBBED UP THROUGH FLOORS, WALLS, FOOTINGS OR FOUNDATIONS**

- A. Install at such depth that the exposed raceway is vertical and no curved section of the elbow is visible. End of conduit stub-ups or stub ups shall terminate 3 inches above finished floor or vertical services, unless indicated otherwise.
- B. GRSC shall be provided for all raceways installed through floors, walls, footings, or foundations. PVC conduit shall not be stubbed-up through floors, walls, footings, or foundations. PVC conduit may be terminated in vault walls as shown on the drawings.

**3.6 CONDUIT MANDRELLING AND CLEANING**

- A. A log shall be kept for all conduits mandrelled. The mandrel log shall contain the following information in tabular format for each conduit mandrelled:
  1. Conduit designation
  2. Conduit endpoints
  3. Conduit size
  4. Date mandrelled
  5. Pass/fail for specified mandrel
  6. Install pull cord
- B. After final assembly is in place, all conduit 2 inches and larger shall be thoroughly cleaned and mandrelled prior to installing wires or pull cords. Each conduit shall be mandrelled by pulling a mandrel sized in accordance with these Specifications through the conduits, followed by a steel bristle brush to clean the conduit. At the completion of cleaning and mandrelling, and before final acceptance, a "Nylon" pull cord shall be installed in each empty conduit. The pull cord shall remain accessible from each end at all times.
- C. After final assembly is in place, all conduits smaller than 2 inches shall be thoroughly cleaned and mandrelled by one of the following methods:
  1. Pulling through the conduits a wire brush and mandrel sized 1/4 inch maximum less than the inside diameter of the conduit for

## CONDUIT AND RACEWAYS

1-1/2 and 1-1/4 inch conduits, and 1/8 inch maximum less than the inside diameter of the conduit for 1 inch and smaller conduits.

2. Pulling through the conduits a cloth rag or conductor bundle sized 1/4 inch maximum less than the inside diameter of the conduit for 1-1/2 and 1-1/4 inch conduits, and 1/8 inch maximum less than the inside diameter of the conduit for 1 inch and smaller conduits.

3. At the completion of cleaning and mandrelling, and before final acceptance, a "Nylon" pull cord shall be installed in each empty conduit. The pull cord shall remain accessible from each end at all times.

D. If requested by the Authority, cleaning and mandrelling shall be done in the presence of the Authority. Notify the Authority 7 days in advance of mandrelling.

E. Where raceways are stubbed and capped, the pull cord shall extend through a drilled hole in the cap.

F. Raceways that cannot meet the requirements for mandrelling, shall be deemed defective, and shall be replaced as Authority approved.

### 3.7 RACEWAY LABELING

A. Identify each exposed raceway conduit at each end with tags as described below. Tags shall always designate location conduit ends. Tags and labels shall be made from nonferrous metals with raceway designations stamped by steel dies.

B. Conduit numbering shall be decided by the Contractor at time of construction. Use a left to right convention for numbering all conduits.

C. Fasten tags above raceway in manholes using a stainless steel anchor screw. At stub- up locations, band tag to rim of conduit using a stainless steel tie wrap band.

1. MH (manhole no.) - (conduit no.) - (chain marker)

a. MH 110B - 08 - 552+28

2. POS - (conduit number) - (chain marker)

a. POS - 08 - 552+81

3. NEG - (conduit number) - (chain marker)

a. NEG - 06 -552+90

4. TPSS - (conduit number)- (conduit type)

a. TPSS - 08 – POS

b. TPSS - 06 – NEG

c. TPSS - 02 – COMM

d. TPSS - 02 - SIG

## PART 4 - MEASUREMENT AND PAYMENT

### 4.1 GENERAL

A. The Work specified in this Section will not be measured separately for payment.

### 4.2 PAYMENT

A. All costs will be considered incidental to the Work specified under Section 16312 "Traction Power System Substation Installation.

END OF SECTION 16110

CONDUIT AND RACEWAYS

**TABLE 2.16A  
CONDUIT BRUSH SIZES**

Duct Size (in)	Diameter (in)	Working Load (lbs)
2.0	1.87	200
2.5	2.38	200
3.0	2.87	200
3.5	3.38	200
4.0	3.87	200
5.0	4.87	200
6.0	5.87	200

**TABLE 2.16B  
CONDUIT MANDREL SIZES**

Duct Size (in)	Diameter (in)	Working Load (lbs)
2.0	1.88	2330
2.5	2.19	2330
3.0	2.81	2330
3.5	3.25	4800
4.0	3.75	4800
5.0	4.69	4800
6.0	5.81	4800

**TABLE 3.1  
UNDERGROUND CONDUIT MINIMUM BENDING RADIUS**

Conduit Size (in)	Conduit Radius (in)
1	14
1-1/4	18
1-1/2	18
2	24
2-1/2	27
3	30
3-1/2	33
4	36
5	42
6	48



CONDUIT AND RACEWAYS

**TABLE 3.3-1  
SUMMARY OF CONDUIT TYPES  
BY SPECIFIC LOCATION**

Location	Uncoated GRSC	Not Used	EMT	PVC 40	PVC 80
Underground ductbanks				X	
Underground direct buried, including under building slabs					X
Underground direct buried lighting only, not in a roadway	X			X	
Stub-ups through concrete slabs	X				
Embedded in concrete building walls, or in formed concrete	X				
Interior exposed or concealed in construction, dry locations only, not subject to damage	X		X		
Interior exposed or concealed in construction, dry locations only, subject to damage	X				
Interior exposed or concealed in construction, wet, or damp locations	X				
Exterior exposed above ground in construction, wet, damp, or dry locations, whether, or not subject to damage	X				
Sleeves	X			X	
Under station platforms direct buried, not in a roadway	X			X	
Under-track crossings	X			X	
Catenary pole risers	X				
Direct buried in a roadway	X				X

**TABLE 3.3-2  
SUMMARY OF CONDUIT TYPES  
BY APPLICATION**

Application	Conduit Type	Number* (Size)	Installation Method
Communication System Station – VMB Junction Boxes to VMB	Liquid-tight Flexible Metal	As required, (( 2 conduits) 1 inch per stanchion)	As Required
Communication System Station – Mounting column/pole to PA Speaker	Liquid-tight Flexible Metal	As required	As Required
Communication System – Interior House	EMT	As required	Surface Mounted

For CENC duct banks, stub-ups and stub-outs refer to the requirements of Specification Section 02780, "Underground Electrical And Communications Distribution Systems", for conduit type applications.

\* If cable fill is greater than 40 percent, add another conduit.

Note: These tables do not address all situations or locations. Conduit types shall meet all the requirements of these Specifications and Contract Drawings.

**SECTION 16801**  
**BASIC TECHNICAL REQUIREMENTS - COMMUNICATIONS SYSTEM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section provides an overview of technical requirements, engineering guidelines, technical constraints, and general conditions to be followed by the Contractor throughout the design of the Authority Light Rail Communications System.
- B. Technical requirements specific to each communications subsystem shall be found in each of the corresponding subsystem Specification Sections.
  - 1. Section 16837 – Miscellaneous Components and Products – Communications System
  - 2. Section 16838 – Communications Facilities – Communications System
  - 3. Section 16839 – Communications Interface Cabinet – Communications System
  - 4. Section 16841- Communications Cable – Communications System
  - 5. Section 16845 – Fiber Optic Cable Subsystem – Communications System
  - 6. Section 16850 – Basic Electrical Materials and Methods – Communications System
  - 7. Section 16851 – Telephone Subsystem – Communications System
  - 8. Section 16852 – Public Address Subsystem – Communications System
  - 9. Section 16853 – Visual Message Board Subsystem – Communications System
  - 10. Section 16854 – Fire Alarm Subsystem – Communications System
  - 11. Section 16855 – Intrusion Alarm Subsystem – Communications System
  - 12. Section 16856 – Closed Circuit Television – Communications System
  - 13. Section 16869 – Fare Collection Local Area Network – Communications System
  - 14. Section 16876 – Grounding and Bonding – Communications System

- 15. Section 16877 – Communications Transmission Subsystem – Communications System
- 16. Section 16879 – Power Supplies and Distribution – Communications System
- 17. Section 16897 – Manuals and Training – Communications System
- 18. Section 16899 – Technical Support and Spares – Communications System

**1.2 REFERENCED STANDARDS**

- A. American Society for Quality
  - 1. ASQ Z1.11 – Quality Management System Standards - Requirements for Education Organization
  - 2. ASQ Z1.11 – Quality Assurance Standards
- B. Institute of Electrical and Electronic Engineers (IEEE)
  - 1. IEEE 200 - Reference Designations for Electrical and Electronics Part and Equipment
- C. Military Standard
  - 1. MIL-STD-1472F - Human Engineering

**1.3 SUBMITTALS**

- A. Design Review Submittals – General Requirements
  - 1. This subsection defines the minimum set of design reviews to be conducted by the Contractor, and the minimum information and process requirements for Authority reviews.
  - 2. Design Review Submittals shall be submitted to the Authority and shall consist of a complete design description, including detailed Drawings, Specifications, and Submittals of all subsystems and elements within the subsystem. Each calculation, test procedure, Final Design Review drawing and submittal shall be reviewed, signed and sealed by a Licensed Texas Professional Engineer. The final design document shall contain sufficient details for construction.
  - 3. Contractor shall include in each submittal phase all materials, equipment, assembly

and installation required to carry out the functions and purposes indicated in these Specifications, and to make the system suitable for the purpose for which it is intended, whether or not such materials, equipment, assembly and installation are specifically indicated in the requirements of these Specifications.

4. The design proposed by the Contractor shall be subject to Authority approval. The Authority may disapprove the proposed design if it fails in any way to achieve the result intended by the requirements of these Specifications or is not in accordance with sound engineering principles. If the design or any portion of the design is disapproved by the Authority, the Contractor shall revise the design until it meets with Authority approval in accordance with the requirements of these Specifications.
5. No Authority approval or disapproval, or failure to approve or disapprove shall relieve the Contractor of any responsibilities under this Contract including the responsibility to provide a sound and practicable system design, suited for the intended purpose outlined in these Specifications.
6. Where requirements posed by individual subsystems, as defined in other sections of these Specifications, are different or greater than those specified in this subsection, those other requirements shall be deemed to augment the requirements specified herein.
7. Design Review requirements for each submittal – Preliminary and Final – are defined within the individual subsystem Specification Sections. Preliminary Design Review (PDR) packages shall be individual submittals for each subsystem, where the Final Design package is one complete submittal sufficient to provide all the required details for construction, overall system integration, and operation.
8. Contractor shall order the designated equipment and material only after Authority approval of the individual subsystem PDR submittal which includes design, calculations, operation, as well as the entire product data for that subsystem.

B. Preliminary Design Review Technical Requirements

1. Contractor shall submit PDR packages to satisfy the requirements outlined herein and the subject subsystem section of these Specifications. Communications

PDR packages shall be required for the following subsystems:

- a. Communications Facilities
  - b. Communications Interface Cabinets (CIC)
  - c. Communications Cable
  - d. Power Cable
  - e. Fiber Optics Cable Subsystem
  - f. Telephone Subsystem
  - g. Public Address (PA) Subsystem
  - h. Visual Message Board (VMB) Subsystem
  - i. Fire Alarm Subsystem
  - j. Intrusion Alarm Subsystem
  - k. Fare Collection Local Area Network (LAN)
  - l. Communications Transmission System (CTS)
  - m. Power Supplies and Distribution
  - n. Control Center Modifications
  - o. Supervisory Control and Data Acquisition (SCADA) Remote Terminal Units (RTU)
  - p. Miscellaneous Items
  - q. CCTV Subsystem
2. Each PDR package shall be organized to include the following headings and information:
    - a. PDR package Purpose and Scope: A brief description and introduction of the package.
    - b. Reference Material: List of relevant references and standards.
    - c. Specification compliance matrix table: Acknowledging and referencing the Contractor's conformance to each technical requirement clause of every subsystem specification section.

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- d. Design Description: As a minimum shall include the subsystem description, detailed design and interface information, all performance, functionality and operational description, as well as details such as the cable and equipment identification.
  - each item while identifying in boldface type the equipment with greater than 30 days lead time. The table or list shall be grouped for each subsystem with functional descriptions of equipment or material included. Quantities and locations shall be included.
- e. Interface Requirements: Contractor shall identify all required interfaces with other communications and non-communications systems and subsystems. This section of the PDR shall include:
  - 1) Interfaces between Work performed under this Contract and any other Communications contracts. For example, Supervisory Control Software, Control Center provisioning, Alarm Points and any other required interfaces.
  - 2) Interfaces between the subsystems defined under this Contract. Examples are CTS and Fare Collection LAN, Telephone and CTS, and all the other required interfaces defined in these Specifications.
  - 3) Identification and description of any required hardware and software modifications, or additions to existing subsystems equipment.
  - 4) Identification of all external interfaces, including those to facilities and equipment provided by others. Interface examples include power, cable facilities, discreet signals, voice, and data.
  - 5) Interfaces between the systems defined under this Contract. This includes Communications, Signals and Traction Electrification System (TES).
- f. Equipment List: Contractor shall submit a table or list of model and part numbers for all proposed equipment and materials to be used for individual subsystems. Include the expected lead-time for
  - g. Product Data Sheet: Contractor shall submit product information in sufficient detail to determine if the component meets these Specifications.
  - h. Calculations: Contractor shall provide all the required signed and sealed calculations as outlined in the subject subsystem section.
  - i. Phasing and Cutovers: Identification and description of all major system cutover events or integration activities describing techniques, methods, duration and procedures.
  - j. Certifications, Registration, and Resumes: Contractor shall provide a copy of all the required certifications, registrations and resumes as outlined in the subject subsystem section.
  - k. Drawings: Electrical, mechanical, block and functional diagrams with corresponding parts list.
- C. Final Design Review (FDR) Technical Requirements
  - 1. Contractor shall submit one complete FDR package no later than 60 days after Authority approval of all the PDR submittals. The FDR submittal package shall not be submitted until the Authority approves all the individual PDR submittals.
  - 2. The FDR Submittal Package shall be organized to include the following final design information:
    - a. Authority approved and updated versions of all previously submitted design review materials. Updated material shall represent complete design, final calculations; detailed product and component level parts list, drawings, phasing and interface details required for construction. All the new and revised sections

BASIC TECHNICAL REQUIREMENTS - COMMUNICATIONS SYSTEM

of the subsystem PDRs shall be marked with revision bars to reflect the changes.

each location and Operational Impact.

- b. Updated product submittals for all materials and components for which product submittals were not previously submitted and Authority approved.
- c. Complete Drawing index.
- d. Complete cable identification and equipment labels.
- e. Complete wiring diagrams for all equipment to be installed, modified, upgraded, or interfaced to under this Contract.
- f. Top level mechanical drawings, if applicable.
- g. Grounding details.
- h. Power panel schedule and distribution.

- h. Daily Preparation and Clean-up Procedures.
- i. Storage, staging facilities, security, and the overall job-site security.
- j. Installation procedures shall include each subsystem hardware and software components including any software and configuration settings and changes.
- k. Installation drawings:
  - 1) Corresponding subsystem design review drawings with updates and details. Include detailed physical layout drawings with material list keyed to the layouts.

D. Installation Work Plans and Detailed Documentation

- 1. Complete installation Work Plan and detailed documentation and drawings shall be submitted no later than 60 days prior to the scheduled installation date for each location and each subsystem.
- 2. Installation detailed documentation applicable to a subsystem shall not be submitted prior to Authority approval of the FDR submittal.
- 3. The Installation Work Plan package shall be organized to include the following headings and information:
  - a. Scope and description of Work
  - b. Prerequisites
  - c. Tools
  - d. Installation staff and their roles
  - e. Safety rules, regulations, procedures, and requirements
  - f. Permits, traffic plans, licenses, training including confined space, and certifications.
  - g. Planned access dates and times for each location, and the Authority resources required for

- 2) Cable and conduit schedules that show exactly where each cable is to be installed. Include and identify raceways, cable trays, conduit, junction boxes, pull boxes, manholes, hand-holes, and floor boxes.
- 3) Cable and wiring connectors and terminal assignments.
- 4) Wiring diagrams to include terminal blocks, power panel details, Local Distribution Frames (LDF), Main Distribution Frame (MDF), and any additional wiring required for a complete design.
- 5) Names and labels for all equipment including every wire, cable, connector, terminal and rack.
- 6) Electrical power diagrams and panel and power strip schedules.
- 7) Mounting, securing, and installation details for all equipment and materials.
- 8) For racks in which equipment will be installed,

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- rack face elevations with all intra-rack and inter-rack wiring and cabling to be installed.
  - 9) Power connections, panel schedules and grounding connections.
  - 10) Location of all safety and hazard warning signs and labels.
  - 11) Site Survey detailed information.
- E. Product Samples. As required in individual subsystem Specification Sections or where requested by Authority.
- F. Testing and Inspection
  - 1. A Test Program shall be submitted no later than 60 days after Authority approves FDR, outlining the Contractor's overall testing strategy and schedule.
    - a. The program shall include a list of all tests to be performed for all subsystems and integral equipment and materials to meet the requirements of these Specifications.
    - b. The program shall include individual subsystem test plans.
    - c. Contractor shall provide:
      - 1) Qualified personnel throughout all the required troubleshooting activities that may involve Communications System equipment provided under this Contract.
      - 2) All the required testing activities specified in these Specifications, specifically those defined under Communications subsystems test requirements including the System Integration tests.
    - d. At a minimum, the test program shall cover the following testing activities:
      - 1) Factory Testing
      - 2) Inspection
  - 2. Test and inspection procedures shall be submitted no later than 60 days prior to the scheduled activity. All the required test and inspection procedure submittals shall be detailed and organized to be consistent and include, but not be limited to the following headings and information:
    - a. Scope and Purpose: Clearly state the scope, case, and conditions the procedure tests.
    - b. Prerequisites: Describe test environment and the prerequisites, including access, availability, and equipment configuration for each group of functions.
    - c. References.

- 3) Field Equipment and Subsystem Testing
- 4) End-to-End Acceptance Test
- 5) System Integration Test
- e. The test program shall include a list of all the required tests per subsystem, to be performed in order to meet the requirements of these Specifications. This list shall be organized to include:
  - 1) Type of test
  - 2) Tools and Test Equipment
  - 3) Prerequisites
  - 4) Pass and fail criteria
  - 5) Personnel and laboratory requirements
  - 6) Required Cutover, Phasing
  - 7) Expected Impacts (Outages, Operational, Environmental, Traffic, and Revenue) and recovery Plan when required
  - 8) Authority resources
  - 9) Scheduled date and expected duration
  - 10) Additional comments and notes

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- d. Tools: List test equipment and tools, with calibration data for each item.
  - e. Personnel: List test participants and roles.
  - f. Procedure: Contain enumerated step-by-step procedures. This shall include regression test and Pass and Fail Criteria.
  - g. Drawings: Include detailed drawings depicting test setup. This shall include list of equipment, parts and material used and tested.
  - h. A Test Data Form that includes space to record the tools with calibration date, environmental condition during the test, i.e., rainy, cloudy, and temperature, test measurement, pass and fail criteria and space to record the pass and fail outcome and the signature of the test engineer and a test witness.
  - i. The Test Exception Form shall be used to record the identifier of the defect report and problem report generated as a result of faults or problems detected during the test. All the troubleshooting techniques and corrective actions shall be documented on this sheet.
- c. Open Items: Identify any open items requiring resolution. Include the corrective action to resolve the open items.
  - d. Conclusion: This Section shall document the Professional Engineer's review and how the test and inspection meets the system design and performance requirements outlined in these Specifications.
  - e. Completed Test and Inspection Records: Completed, signed, and dated test/inspection procedure sheets, as well as a defect/problem report for each fault/problem found during the testing.

G. Test and Inspection Records and Reports

- 1. All test and inspection records and reports shall be submitted within one week of completion of the corresponding test.
- 2. Test and inspection records shall be reviewed, signed and sealed by a Licensed Texas Professional Engineer to certify adherence to design requirements and standards.
- 3. Test and inspection report submittal shall be organized to include the following headings and information:
  - a. Purpose/Introduction: Defines the submittal scope.
  - b. Test/Inspection Results Summary: Including measurements, results, problem areas, workarounds, troubleshooting, and exceptions.

H. As-Built Documentation

- 1. As-Built versions of the following documentation shall be signed and sealed by a Licensed Professional Engineer, who is registered in the state of Texas, and provided in accordance with these Specifications and as outlined herein for the communications system:
  - a. Equipment inventory, with serial numbers including delivered, installed and spares.
  - b. Drawings as a minimum shall include the ones submitted under FDR, installation and test procedure documents. The As-Built drawings shall be numbered and grouped in accordance with Authority standards for Communications System.
  - c. Final software data and source codes.
  - d. Final equipment configuration, provisioning, programming and settings.
  - e. Technical Specification to reflect the final system design implemented in the field.

1.4 QUALITY ASSURANCE

- A. Comply with:
  - 1. Applicable Standards and Codes
  - 2. IEEE 200

- B. Material and Workmanship Requirements:
  - 1. Requirements shall be provided as described in each Specification Section.

- D. Continued Operation of the Existing Light Rail System

**PART 2 - PRODUCTS**

**2.1 AUTHORITY FURNISHED MATERIALS**

Not Used

**2.2 CONTRACTOR FURNISHED MATERIALS**

Not Used

**PART 3 - EXECUTION**

**3.1 INSTALLATION AND GENERAL DESIGN REQUIREMENTS**

- A. Information regarding Authority facilities and space in Authority facilities is provided in the Contract Drawings.
- B. Environmental conditions to which equipment shall be designed is defined in these Specifications.
- C. Operation and Maintenance
  - 1. Operating and maintenance safety shall be the highest consideration in equipment and subsystem design, construction, and installation.
  - 2. Human Factors for both operation and maintenance, equipment configuration and positioning shall:
    - a. Support the reach and view of a person the size of the 5th percentile female, as defined in MIL-STD-1472.
    - b. Fit a person the size of the 95th percentile male, as defined in MIL-STD-1472.
    - c. User interface equipment and characteristics such as display devices, preferred viewing angles, lettering, control devices and their tactile characteristics, indicators, use of colors, and use of audible indicators shall be consistent with MIL-STD-1472.
  - 3. Where applicable, equipment and design shall comply with ADA requirements.

- 1. The Authority Light Rail System conducts Revenue Operations between the hours of 3:00 AM and 1:00 AM, 7 days a week. The existing Communications and Central Control System is in use 24 hours per day, 7 days per week.
- 2. Installation, replacement, testing or modification of equipment or software during implementation of the new Communications System shall not disrupt continued operation of the Light Rail System, including operation of the Supervisory Control System (SCS).
- 3. During revenue or non-revenue hours, any disruption to the existing Communications and Central Control System shall be minimized.
  - a. To the extent possible, no more than a single node shall be unavailable through the existing Communications and Central Control System at any point in time without the prior Authority approval.
- 4. Track access time is limited and shall be coordinated and approved through the Authority's track allocation request process. Contractor shall follow Authority's rules for access to and working in any rail operating territory.
- 5. Any work that could potentially interfere with the operating systems shall be coordinated and approved through the Authority's track allocation request process. Contractor shall follow Authority's rules for access to and working in any rail operating territory.

- E. Design Review Meetings

- 1. Preliminary Design Review
  - a. Contractor shall conduct a formal review of the PDR Submittal with the Authority.
  - b. The review shall be conducted no less than 21 days, but no more than 45 days following an Authority "Approved" or "Approved As Noted – Confirm" status of all the PDR submittals.
  - c. The meeting minutes shall be submitted by the Contractor to the Authority for concurrence no later



than 7 days after the PDR meeting.

2. Final Design Review

- a. Contractor shall conduct a formal FDR Submittal review with the Authority after the approval of all PDR submittals.
- b. The review shall be conducted no less than 21 days, but no more than 45 days following an Authority "Approved" or "Approved As Noted – Confirm" status of the FDR.
- c. The meeting minutes shall be submitted by the Contractor to the Authority for concurrence no later than 7 days after the FDR meeting.

cabling, cable management, labels, tags or grounding connections are present in the unit under inspection, the workmanship standards, practices and procedures associated with the respective element shall be included as part of the FAI.

- c. Determine whether an acceptable level of operating and maintenance safety is provided in the initial product submittal. If not, the unit shall be re-designed and re-assembled.

3. For each subsystem and component, the FAI shall be conducted at the earliest possible time in the manufacturing stage.

4. Contractor shall notify the Authority at least 21 days prior to each FAI so that the Authority may be present.

F. First Article Inspections

1. First Article Inspection (FAI) shall be performed by the Contractor for each subsystem and component that is custom-built, custom-assembled, or generally not accepted as a commercial off-the-shelf item or assembly. Examples of items for which an FAI should be performed include Communication Facilities and pre-wired Communications Interface Cabinets.

2. The purpose of each FAI shall be to:

- a. Determine, based on inspection, measurement, and basic operation, whether the layout and mechanical aspects of the unit under inspection, e.g., Communications Facility, are consistent with Authority approved drawings, requirements of these Specifications, and other design documentation. If not, the subject unit shall be re-assembled and the FAI repeated. Where maintainability, e.g., accessibility, safety, status indicators, power indicators and control and exposure to power connector, are present in the unit, assessment of those maintainability aspects shall be included in the FAI.
- b. Determine whether an acceptable level of workmanship that is consistent with approved workmanship standards and practices, is present in the initial copy of the unit under inspection. Where wiring, wiring connections,

5. The Authority may request a FAI on any subsystem or component at no cost to Authority. For those subsystems or components where the Authority requires a FAI:

- a. The Authority shall approve the level of workmanship deemed to be acceptable.

- b. The following, applicable to the subject subsystem or component, shall be available at the time of the FAI:

- 1) Authority approved drawings and other design documentation
- 2) Subsystem or Component Parts List
- 3) Manufacturing and Quality Assurance Inspection Records
- 4) Test Plan and Procedures
- 5) Tools and staff to make measurements
- 6) Tools and staff to remove covers and perform limited disassembly

**3.2 TESTING AND INSPECTION**

**A. General**

1. This subsection and the following subsections include basic testing requirements. Where requirements for these activities are present elsewhere, the requirements specified in this Section shall be augmented by those additional requirements.
2. Contractor shall:
  - a. Be responsible for successfully completing all tests required by these Specifications.
  - b. Provide all test instruments and any other materials, equipment and personnel needed to perform the tests.
  - c. Be fully responsible for the replacement of all equipment damaged as a result of the tests, and shall bear all associated costs.
  - d. Maintain comprehensive records of all tests.
  - e. Notify the Authority in writing, no less than 21 days prior to each test activity.
  - f. Provide test plans, procedures, records and reports for Authority approval.
3. The Authority reserves the right to:
  - a. Witness any and all tests and inspections required by these Specifications.
  - b. Inspect test records at any time.
  - c. Perform additional testing, beyond that specified herein, of any equipment or material at any time to determine conformance with these Specifications. Additional Authority testing is not to be considered as a replacement for any Contractor required testing or manufacturer producing materials for the Contract required testing.

**B. Factory Testing**

1. Contractor shall notify the Authority at least 21 days prior to each Factory Test

so that the Authority may be present. Factory testing shall be conducted for:

- a. All equipment provided for and installed under this Contract.
- b. All components installed, integrated, and operated as a subsystem (to be tested as a subsystem).
2. Subsystem factory testing shall occur only after FDR submittal package approval for that subsystem.
3. Factory testing for a subsystem must be successfully completed prior to shipping any equipment for that subsystem to the Authority.
4. If the equipment for a location is assembled at the factory, factory testing for that equipment shall be conducted after all the racks and other subassemblies are integrated and rack interconnections are in place.
5. In order to show proper operation of all aspects, behavior, and characteristics, minimum requirements for equipment testing include:
  - a. Manufacturer's Recommended Testing.
  - b. Environmental Testing for Custom Equipment.
  - c. Power-up Testing.
  - d. Equipment burn-in of 72 hours, with concurrent operation of the equipment, for the full burn-in period.
  - e. After burn-in, comprehensive functional testing, including testing of all controls and indicators.
  - f. After burn-in, comprehensive diagnostic testing.
  - g. After burn-in, comprehensive performance testing.
  - h. After burn-in, comprehensive external interface testing, including verification of:
    - 1) Electrical Interface
    - 2) Functional Interface

- 3) Mechanical Interface
- 6. Minimum requirements for subsystem testing include:
  - a. Comprehensive Functional Testing
  - b. Comprehensive Performance Testing
  - c. Comprehensive External Interface Testing, including verification of:
    - 1) Electrical Interface
    - 2) Functional Interface
    - 3) Mechanical Interface
    - 4) Rack-to-rack Interconnects
- C. Installation Inspection and Test
  - 1. Pre-Installation inspection shall include inspection for:
    - a. Missing components and parts
    - b. Correct serial numbers
    - c. Damage to equipment
    - d. All installed equipment shall undergo as a minimum, inspections for:
      - 1) Conformance to standards, methods, and quality
      - 2) Correct location, positioning, mounting, orientation, and labeling
      - 3) Damage to equipment
      - 4) Correct and secure external connections
      - 5) Correct and secure routing of cable and wires
      - 6) Correct and secure internal connections
      - 7) Proper grounding
      - 8) Verification of all configuration data and setting
      - 9) Correct labeling
- D. Field Equipment and Subsystem Testing
  - 1. The following equipment field tests shall be performed for all installed equipment. Additional field tests for each subsystem, listed in the subsequent subsections shall not be construed to limit or otherwise relieve the Contractor of the responsibility for performing comprehensive field testing of the following:
    - a. Basic equipment operation
    - b. Functional and performance testing
    - c. All external interfaces such as mechanical, electrical, and functional
    - d. Operation in the presence of equipment and software failures
    - e. Operation in the presence of power failure and restart
  - 2. Subsystem testing shall include:
    - a. Tests for proper local operation
    - b. Tests to confirm the installed equipment or subsystem meets performance requirements
    - c. Validation of all data used to configure or operate the subsystem
- E. End-to-End Acceptance Testing
  - 1. To be defined within respective System Testing Section.
- F. Support For Authority's Systems Integration Testing
  - 1. System Integration Testing (SIT) shall be conducted in accordance with Authority requirements.
  - 2. Upon turn-up, interface, and integration of all required individual subsystems required for each line section cutover, the Contractor shall provide technical support for the Authority's SIT. Technical support shall include providing engineer, technician, and installation staff, as well as tools, appliances, fixtures, expendable materials, supplies, and test equipment as needed to perform the SIT procedures or to develop and implement required corrective actions on the Contractor's elements.

3. This testing shall involve the interaction of the Communications System operating with one or more other sub-systems and will be required through System Final Acceptance.
4. SIT shall include testing of all communications subsystems added to, modified, or integrated as a result of work performed under this Contract and integrated or interfaced to any other contract. Subsystem integration testing shall include:
  - a. SCS indications and controls between intended field and control locations
  - b. CTS node integration
  - c. Proper operation and reporting between Fire Alarm Control Panel IP Communicators and IP Receiver (DACR) at the OCC from field transmitter sites and all other Fire and Intrusion subsystem indications.
  - d. Proper local and remote operation of Station PA and VMB messaging and CCTV monitoring.
  - e. Proper operation of all voice circuits
  - f. Proper transport and operation of Signaling controls and indications
  - g. Proper transport and operation of Traction Power Substation (TPSS) controls and indications
  - h. Proper transport and operation of Fare Collection data and indications
3. "Complete Testing" shall be performed for all equipment that exhibited faults during the SIT. "Complete Testing" shall be testing that is equivalent to the field and functional testing performed on the equipment when first installed as required by these Specifications, and Authority approved test procedures including submission of test results and test reports.
4. Complete Testing shall be performed by the Contractor for all equipment that was replaced under warranty. For all subsystems and equipment that have been changed after initial testing, and once installation work is completed the Contractor shall perform complete testing of such subsystem and equipment.
5. Contractor shall verify the accuracy of the as-built documentation for each equipment location.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. The Work described in this Section shall be full compensation for providing and installing the Communications System complete in place as specified including finalizing design, shop drawings, submittals, testing, and inspection; and for all Work as described in the Contract Drawings and in this Section and related Specification Sections; and for all operations, materials, tools, labor, equipment, and incidentals required to complete the specified Work.

**4.2 PAYMENT**

- A. The Work described in this Section will be paid as a lump sum.

END OF SECTION 16801

**G. Inspections And Tests For Final Acceptance**

1. Final Acceptance inspections and tests for each portion of the Communications System shall be performed subsequent to the Authority's SIT for that portion. At this stage of the Contract all the defects and open items relevant to the system and identified up to that time, are closed and system is ready for final inspection and acceptance test.
2. Inspection and tests as outlined in these Specifications shall demonstrate to the Authority that the System is operating in accordance with the requirements of these Specifications.

**SECTION 16837**  
**MISCELLANEOUS COMPONENTS AND PRODUCTS - COMMUNICATIONS SYSTEM**

**PART 1 - GENERAL**

**1.3 SUBMITTALS**

**1.1 DESCRIPTION**

A. This Section describes the detailed technical requirements for the Miscellaneous Components and Products to be designed, provided, installed, and tested under this Contract. Scope of work for the Authority Light Rail Communications System includes:

1. Contractor shall design, provide, install and test all Miscellaneous Components and Products to complement the communications subsystems as specified in these Specifications.

**1.2 REFERENCED STANDARDS**

A. ASTM International (Formerly known as American Society for Testing and Materials) (ASTM)

1. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire
2. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials

B. International Organization for Standardization

1. ISO 9001 – Quality Management Systems - Requirements

C. National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code (hereinafter referred to as NEC)
2. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials
3. NFPA 703 – Standard for Fire Retardant Impregnated Wood and Fire Retardant Coatings and Building Materials

D. Telecommunication Industry Association (TIA)/ Electronic Industries Alliance (EIA)

1. TIA/EIA-606 – Administration Standards for Commercial Telecommunications Infrastructure

E. Underwriters Laboratories (UL)

1. UL 497 – UL Standard for Safety Protectors for Paired-Conductor Communications Circuits

A. Submittal format and content shall comply with the general requirements of these Specifications, as well as the specific technical requirements further listed in this Section.

1. **Manufacturer Qualifications:** Any manufacturer differing from those specified herein shall require a prequalification and Authority approval. Acceptability of the manufacturer shall be based on the manufacturer's experience, qualifications, certifications (i. e. ISO-9001), equipment reliability, compliance with standards specified herein, and full compatibility with the Authority's current system.

2. **Preliminary Design Review (PDR) Technical Requirements.** Contractor shall include the following information as part of the PDR submittal package for the Miscellaneous Components and Products:

- a. Product data including description and model number, catalog cuts and technical literature.
- b. Design calculation for cable tray fill capacity per Specification requirement.
- c. Communications Facilities Local Distribution Frame (LDF) mounting and equipment layout (on LDF).
- d. Equipment cabinet and rack details.
- e. Cable, wire and equipment tagging software, material and type schedule per Article 2.2 of this Section.

3. **Final Design Review (FDR) Technical Requirements.** Contractor shall include the following information as part of the FDR submittal package for the Miscellaneous Components and Products:

- a. Updated PDR information. All drawings, calculations and design information shall reflect a final design.
- b. Final equipment layout and mounting details.

4. Installation Work Plan. Contractor shall submit the following installation document for each site no later than 60 days prior to the scheduled installation activities. The installation work plan shall include:
  - a. Equipment layout and plan views.
  - b. Conduit installation to LDF.
  - c. Wiring diagrams to LDF including all tagging identifiers.
5. Calculations and Certifications
  - a. Calculations as listed in the PDR and FDR.
  - b. Certifications: Copy of the following certifications shall be included:
    - 1) ISO certification for all proposed manufacturers.
6. Product Samples: Product samples shall be provided and demonstrated when requested by the Authority.
7. Test Plan and Procedures: Not required.
8. Test Records: Not required.
9. As-Built Documentation: Contractor shall submit complete As-Built documentation and drawings for all Miscellaneous Components and Products. Reference Section 01785, "Project Record Documents".

**1.4 QUALITY ASSURANCE**

- A. Applicable Standards and Codes
  1. Contractor's design and installation shall comply with all applicable Standards and Codes as listed herein.
  2. All equipment and methods shall comply with the latest version of codes and standards as applicable in Article 1.2, Referenced Standards.
- B. Material and Workmanship Requirements
  1. All equipment provided under this Section shall be UL listed.
  2. All products specified herein shall be subject to the Authority's approval based on the Contractor's ability to demonstrate adherence to the specified requirement and approval of the manufacturer's quality process.

3. Discontinued product models, refurbished equipment, or products scheduled for either end-of-life, end-of-sale, or end-of-service within one calendar year of the installation date shall not be allowed.
4. All grounding shall be in accordance with the NEC, and specifications required by this Contract except as modified herein. Each piece of equipment shall be grounded in accordance with the recommendations of the manufacturer.

**PART 2 - PRODUCTS**

**2.1 CIRCUIT BREAKERS, FUSES, AND FUSE CLIPS**

- A. Capacity: Fuses and circuit breakers shall be suitable for protection of the equipment and cabling connected.
- B. Fuse Type
  1. Fuses shall be non-renewable time lag fusion type.
  2. Protective resistance shall be used in branch circuits.
- C. Fuse Clips: Positive contact pressure shall be applied to the fuses to ensure electrical continuity.

**2.2 TAGGING**

- A. Cables and Wires
  1. Contractor shall install cable identification tags at both ends of each cable, including wires, where they terminate on terminals, punch-down blocks, and connectors. Communications cable identifiers shall comply with standard TIA/EIA-606. This includes all electrical power wires and cable for communication facilities and equipment.
  2. Contractor shall tag all cables at the entrance and the exit of each manhole, pullbox, handhole, junction box, splice-box, cable trough, or fiber-slack enclosure. Contractor shall tag all conduits as required in these Specifications.
  3. Contractor shall use water-resistant identification tags with lamination over its designation for all cables and wires. Permanently typed lettering shall be used.
  4. Contractor shall use sleeve type non-metal tags where cable diameter permits.
  5. Contractor shall use flat plastic tags for smaller cables as follows: Two holes in the

MISCELLANEOUS COMPONENTS AND PRODUCTS - COMMUNICATIONS SYSTEM

- tag shall be provided for attachment with a dielectric tie.
6. Contractor shall purchase, populate, and deliver a dedicated cable-management software, including software license, to provide Class 4 administration of the communication cables per standard TIA/EIA-606. Prior to submitting, verify software compatibility with the Authority. The software shall be able to produce the following types of schedules:
- a. Typed wiring interconnect schedule for all external and internal wires and cables listing wire (cable) tag identification, To and From locations, To and From termination terminals, wire (cable) size and type.
  - b. Typed wiring interconnect schedule for each location and each facility for the entire project.
  - c. Typed schedule of conduits, wires, or cables to include quantity of each.
7. Contractor shall submit typed schedule per items a, b, and c above for approval.
8. Contractor shall submit a complete list of cable and wire identification tags. The tags shall follow the sample format in the paragraph below. Each cable and wire shall have its own unique identification tag. If a wire is not terminated, then tag it "spare-1", "spare-2", "spare-3".
- a. Tag Scheme for External Cable: 18P-COM-FDP / PPK-TPS-FDP-FS12-01
    - 1) 18P represents originating location (18<sup>th</sup> Place)
    - 2) COM represents originating facility type (Communication)
    - 3) FDP represents originating termination cabinet/panel (Fiber Distribution Panel)
    - 4) "/" represents "to"
    - 5) PPK represents ending location (Plano Parkway)
    - 6) TPS represents ending facility type (Traction Power Substation)
  - b. Tag Scheme for Internal Cable, PPK-COM-LDF / RTU-CAT5-01
    - 1) PPK represents Location
    - 2) COM represents facility type
    - 3) LDF represents originating cabinet/panel
    - 4) "/" represents "to"
    - 5) RTU represents ending cabinet, panel, or equipment
    - 6) CAT5 represents cable type
    - 7) 01 represents cable number (01 through 99)
  - c. Tag Scheme for Internal Wires and Wires of External Cables.
    - 1) CAT5-01-LDF-TB2-14 / RTU-TB5-11
    - 2) CAT5 represents cable type
    - 3) 01 represents cable number (01 through 99)
    - 4) LDF represents originating cabinet/panel
    - 5) TB2-14 represents originating termination block and termination terminal
    - 6) "/" represents "to"
    - 7) RTU represents ending cabinet, panel, or equipment
    - 8) TB5-11 represents ending termination block and termination terminal
- 7) FDP represents ending termination cabinet/panel
- 8) FS12 represents cable type (Fiber Singlemode 12 strand)
- 9) 01 represents cable number (01 through 99)

B. Equipment

1. Label all terminal blocks, card cages, circuit cards, punchdown blocks, and jack fields. Communications equipment identifiers shall comply with TIA/EIA-606.
2. Permanent lettering scheme shall be utilized.
3. Labels shall be attached with a non-drying adhesive.
4. Contractor shall show the correct communication equipment identifier on every respective equipment drawing and schematic.

facility (e.g. Communications Facilities and CIC). Connectorized PETs shall be used in all applications unless specifically stated otherwise in this Section or on the Contract Drawings.

2. PETs shall have a data throughput of 1 Gbps and clamping speeds of 2-3 nanoseconds.
3. PETs shall have a field splice line side connection stub pre-wired to 3 element (5 pin) protector sockets.
4. Blocks shall be 110 Cat 5/5e rated or approved equal.
5. PETs shall include an integral splice chamber.
6. Protected entrance terminals shall be provided in 25, 50, and 100 pair sizes and fully populated with protector modules as per the application shown on the Contract Drawings.

**2.3 PUNCHDOWN BLOCKS**

A. Type

1. Blocks shall be Krone IDC-Type 50 pair punchdown blocks. Blocks shall be configured with 2 columns of 25 pairs of 2 termination clips. Clips shall accept No. 20 AWG through No. 26 AWG insulated wire, and No. 18 AWG through No. 19 AWG bare wire.
2. Clips shall be pre-wired to an Amphenol type RJ21X connector socket, or approved equal.
3. Blocks shall be equipped with a base, standoff bracket, cover, and bridging clips.

B.

Protector Sockets: Protector sockets shall be UL standard 5 pin sockets, with 2-position (normal and detent) design. In the detent position, the protector shall be retained, the line side shall be disconnected, and the equipment side shall be protected. When fully inserted, the line and equipment side shall be protected.

B. Base

1. The base shall be impact resistant plastic.
2. Molded fanning strips shall be provided on each side of the split blocks.
3. Permanent numbering shall be applied to the fanning strips.
4. A standoff of 2 inches from the mounting surface shall be provided.
5. A removable cover with circuit designations permanently applied shall be provided.
6. Connector retention screws shall be provided.

**2.5 MULTI-PAIR PROTECTED TERMINAL BLOCKS**

A.

Design

1. Multi-pair protected terminal blocks shall be utilized for applications requiring non-connectorized 25 pair or less terminal blocks, as specified on the Contract Drawings.
2. Types and pair counts for terminal blocks shall be in accordance with these Specifications and as shown on the approved Drawings.
3. Terminal blocks shall consist of pairs of brass binding posts imbedded in high impact plastic potted with a high dielectric polyurethane compound.
4. Binding posts shall be pre-wired to 2-element protector sockets. The ground of all protector sockets shall be wired to a common ground terminal.
5. Binding posts shall be equipped with 2 brass nuts and washers. Binding posts shall be sized to accept up to 2 No.14 AWG conductors.

**2.4 PROTECTED ENTRANCE TERMINALS**

A. Design

1. Protected entrance terminals (PETs) shall be used at the input for all signal circuits using metal cable and entering/exiting the



**2.6 PROTECTOR MODULES**

- A. Three Element (5-Pin) Protectors: Protectors shall be solid-state modules with fuses or heat coils specifically designed for lightning protection.
1. Modules shall plug into 5-pin protected entrance terminal sockets.
  2. Each module shall protect both halves of a pair.
  3. Protector modules shall be UL 497 listed for primary protection.
  4. Modules shall have 2 ns to 3 ns response time and support 1 Gbps data transfer rates.
  5. Modules shall protect for voltages over 300 V DC.

Section. Quantity of terminal blocks shall at a minimum provide 50% spare capacity.

- B. Outdoor Communication Interface Cabinet (CIC) Local Distribution Frame. Each LDF for use in an Outdoor CIC or similar application shall consist of the following equipment mounted to the Lexan panel mounted on the interior side panel of the CIC:
1. One 100-pair connectorized protected entrance terminal contained within an enclosure. Enclosure shall have a fully removable cover in order to provide access to protected terminal modules.
  2. A minimum of two 110 Type CAT 6 50-pair connectorized punchdown blocks (as described in Article 2.3) utilizing 25 pair connectors as cross-connects.
  3. Multi-pair protected terminal blocks designed for a minimum of 36-pairs of PA speaker connections as described in Article 2.5 of this Section, and as shown on Contract Drawings.

**2.7 LOCAL DISTRIBUTION FRAMES**

- A. Communication Houses, CIC, Demarcation, and CCTV cabinets LDF per UL: Each LDF shall consist of the following equipment:
1. A wall mounted backboard 4 feet by 5 feet or as shown in Contract Drawings. Utilize 3/4 inch marine grade smooth surface plywood backboard for mounting all equipment described in paragraphs below and as shown in the Contract Drawings. The backboard shall have all finished sides primed and painted white with fire retardant paint that is compatible with wood treatment.
  2. Protected entrance terminals fully equipped with protector modules for each active and inactive or unused circuit, as described herein. PET block shall be contained within a separate enclosure mounted on the LDF backboard. Enclosure shall have a fully removable cover in order to provide access to protected terminal blocks. Quantity of pairs for PET shall at a minimum provide 100% spare capacity.
  3. A minimum of eight, or as shown on Contract Drawings; 110 Type CAT 6 50-pair connectorized punchdown blocks (as described in Article 2.3 of this Section) utilizing 25 pair connectors per Article 2.4 of this Section as cross-connects.
  4. A 110 Type CAT 6 patch panel for local Ethernet connections between the Ethernet switch and the VoIP phones and fire alarm. Quantity of connections shall at a minimum provide 100% spare capacity.
  5. Binding post type terminal blocks shall be provided as described in Article 2.5 of this

**2.8 CABLE TRAYS**

- A. Cable trays shall be of open ladder type, aluminum, or other suitable material commercially available and providing support spacing and strength of material characteristics equal to or greater than the aluminum.
- B. The aluminum ladder type cable tray shall meet the following requirements:
1. Ladder rung spacing shall be approximately 6 inches.
  2. Side stringer section shall be a minimum of 0.094 inches.
  3. Top and bottom flange section shall each be a minimum of 2 inches.
  4. Flange width shall be approximately 0.75 inches.
  5. Height of rail shall be approximately 3.375 inches.
  6. Rung thickness shall be a minimum of 0.062 inches.
  7. Rung bottom width shall be approximately 2.20 inches.
  8. Rung top width shall be approximately 0.75 inches.
  9. Plastic tray insert barrier to separate power and signal cables.

- C. Each cable tray shall be designed and fabricated with sufficient capacity to provide 50 percent of the cross-sectional area as free air space after the full number of cables and wires are installed. Corners shall have a minimum radius of 6 inches, for either horizontal or vertical turns. Sufficient overhead space must be available after installation to permit wires and cables to be inspected. Sufficient cable trays should be installed to allow for one row of racks to be added for future expansion (i.e., if one row is needed, a second cable tray row shall be added. If two rows are needed, a third cable tray row shall be added.
- D. Where practical, the tray shall be constructed in straight sections joined with approved couplers. Electrical continuity of the tray shall be maintained across sections by bonding straps.
- E. Using the manufacturer's standard, the tray shall be laid out using a minimum number of sections, but providing maximum continuous runs without gaps.
- F. All fittings, supports, and accessories shall be provided in accordance with the manufacturer's recommendations.
- G. Insofar as practical, cable trays shall be supported by cantilever type brackets in order that the cables can be laid into the tray without pulling.
- H. Where the width of the tray, or the loading of cables is such that cantilever supports are impractical, other approved suspension methods may be used, but such application must be kept to a minimum.
- I. At least 3 supports shall be provided for each length of tray. Supports shall be evenly spaced insofar as possible; in no case shall the spacing between adjacent supports exceed 5 feet.
- J. To prevent damage to cables, no metal edges of any description shall protrude and no sharp corners shall exist in the completed layout.
- K. Fiberglass support arms, where required to insulate the cable tray from the equipment racks, shall be flame retardant, reinforced polyester laminate Class "B" 266 degrees F electrical sheet, meeting NEMA GPO-2 requirements.

**2.9 EQUIPMENT RACKS**

- A. Equipment racks shall be 19 inch wide floor mounted aluminum racks with a minimum of 40 rack units height, unless otherwise indicated on the Contract Drawings. The racks shall have EIA-310D standard 1 3/4 inch spaced single side drilled, tapped mounting holes.
- B. The racks base shall have a minimum depth of 15 inches, with bolt hole spacing of 12 inches minimum, front to back.

- C. Racks shall be painted Benjamin Moore No. 2125-20.
- D. Racks shall be equipped with screw clamp connection for grounding.
- E. Racks shall be grounded to the Chassis Grounding Bussbar (CGB).
- F. Cabinet shelves (both fixed and slide-out type) shall be provided as shown in the Contract Drawings.

**2.10 INDOOR COMMUNICATIONS EQUIPMENT CABINETS**

- A. Design
  - 1. Cabinets shall be designed for server type equipment with the following features:
    - a. Continuously welded seams
    - b. Gasketed front and rear doors
    - c. Steel mesh or fully ventilated front and rear doors
  - 2. Construction. The materials and construction shall be as follows:
    - a. 14 gauge or heavier steel frame.
    - b. 16 gauge or heavier panels.
    - c. 16 gauge or heavier struts.
    - d. 16 gauge mounting rails with EIA-310D rack mount standard spaced holes for equipment mounting widths of 19 inches and 23 inches.
    - e. Both front and rear doors shall be removable.
    - f. Locking front and rear removable doors shall be provided. All keys shall be alike and master keys shall be provided to the Authority.
    - g. Communications House cabinets shall be installed on insulating sills as shown on Contract Drawings.
    - h. Cabinet shelves (both fixed and slide-out type) shall be provided as shown in the Contract Drawings.
- 3. Finish
  - a. Cabinets shall be painted Benjamin Moore No. 2125-20 "Deep Space" or as directed by the Authority. All

cabinets shall be painted identically.

- b. Contractor shall finish inside of each cabinet in flat white enamel.

- B. Racks shall be grounded to the Chassis Grounding Busbar (CGB) as shown in the Contract Drawings.

**2.11 MULTI-PAIR DISCONNECT MODULE TERMINAL BLOCKS**

- A. Design: Multi-pair disconnect module terminal blocks shall be 110 Type CAT 6 Rated or approved equal. Terminal blocks shall provide normally closed 2-piece (line side and equipment side) insulation displacement contacts in 8 to 50 pair modules, as per the application shown on the Contract Drawings. Disconnection of the line side from the equipment side shall be by insertion of a disconnect plug.

B. Performance

- 1. Contacts shall accept No. 20 AWG through No. 26 AWG insulated conductors.
- 2. Contact resistance shall be less than  $1 \times 10^{-3}$  ohms.
- 3. Insulation resistance shall be greater than  $50 \times 10^{12}$  ohms.
- 4. Wire retention force shall be greater than or equal to 75 percent of wire breaking force.

**2.12 RTU WIRING INTERFACE**

- A. Contractor shall provide 2 RTU wiring interfaces at each Communication Facility. The wiring interfaces shall be Allen Bradley 40-point feed-through digital interface modules with extra terminals for inputs, type 1492-IFM40F-2.

- B. Each wiring interface module (IFM) shall include the following:

- 1. IFMs with adhesive label cards.
- 2. DIN rails and mounting panel.
- 3. Cable management and support hardware.

- C. Each wiring interface shall be mounted on the RTU cabinet rack as shown on the Contract Drawings.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. General: All parts of the Specifications pertaining to miscellaneous components and products shall be installed by Contractor as specified in this paragraph, or in any other part of this Specification and in accordance with the Contract Drawings.

B. Twenty-Five Pair Connectors

- 1. Cable Attachment Tool: Twenty-five pair connectors that are attached to cables in the field shall be made-up utilizing a connector attachment tool Manufacturer approved.

C. Terminal Blocks

- 1. All connections to terminal blocks shall be made in accordance with the connection details approved as a part of FDR or installation work plan. Twisted pair jumper wire shall be utilized for cross-connections.
- 2. All wiring on terminal blocks shall be neatly bundled, and restrained to prevent tracing wires by pulling.
- 3. Tags and labels shall be utilized to identify the terminal block designation and the pair number terminated on each terminal.
- 4. Protected terminal blocks shall be grounded with No. 6 AWG minimum ground wire.

D. Local Distribution Frames

- 1. Backboard mounting in Communications Facilities.
  - a. The S4S plywood backboard shall be firmly affixed to the wall in such a manner that it will adequately support the weight of all equipment and cables that are attached to it. Cable termination and management devices shall be provided and subject to Authority's approval.
  - b. Fire retardant paint shall comply with the requirements of ASTM E84 (NFPA 255) and matching Federal Standard FS-595b, Color No. 27925, (Reference NFPA 255 and NFPA 703) shall be applied to the backboard prior to installation of any equipment.

- c. Floor conduit stub-ups shall be extended to 2 feet above finished floor as shown on Contract Drawing.
- 2. LDF and miscellaneous equipment mounting in CICs shall be as shown on Contract Drawings.
- 3. Wiring
  - a. Each LDF shall be wired in accordance with cross-connect and wire termination plan approved as a part of FDR or installation work plan.
  - b. Tags and labels shall be utilized to identify the cross-connect module designation and the pair number terminated on each quick-clip. All tag and label designations shall be transferred to the as-built drawings. Method of tagging and labeling shall be in accordance with Article 2.2 of this Section.
  - c. Cables and cross-connect wiring shall be neatly bundled and restrained using Velcro ties.
  - d. Distribution frame racks and protected terminal block ground wires shall be grounded to the Communications Facilities, CIC, and Crew Room Chassis Main Grounding Buss bars/Chassis Grounding Buss bars (CMGB/CGB or earth ground buss bar) with No. 6 AWG minimum ground wire as shown on Contract Drawings.

E. Cable Tray

- 1. Attachment
  - a. Each cable tray section shall be attached to the Communications Facility ceiling utilizing expansion fasteners required for the ceiling material. Fasteners shall be rated for a pull-out load equal to at least 150 percent of the maximum rated load for each cable tray section Grounding.
  - b. Cable tray shall be grounded to the Communications Facility CMGB utilizing No. 6 AWG minimum ground wire. Electrical continuity of the cable tray shall be maintained between sections utilizing No. 6 AWG minimum ground wire and attachment hardware, as recommended by the manufacturer.

- 2. Installation of Cable: Cables shall be laid into the tray, rather than pulled, wherever possible, so as to eliminate twisting. Cables shall be attached to the tray utilizing dielectric ties so as to maintain straight runs and adequate separation of cables. Cables carrying AC and DC power shall be separated from audio and data cables to the maximum extent possible.

F. Internal Wiring and Cabling

- 1. Internal wiring shall be installed in wiring harnesses or cable trays.
- 2. Wire and cable shall be secured within ducts or open wire ways to prevent chafing movement.
- 3. Strain relief shall be provided where needed.
- 4. Wire or cable splices will not be permitted.
- 5. All wires and cables shall be fully protected against any contact with any surface other than that designed specifically to support or protect them.
- 6. Wires and cables shall be laid in place with sufficient slack at the bends so that wires and cables will clear the inside bend surface of the wire way, thereby preventing the insulation from being crushed.
- 7. All wire and cable shall be free of kinks and insulation damage. Wire installation shall not be subject to accumulations of moisture or foreign matter.
- 8. Wire and cable dress shall allow for sufficient slack to provide for shock and vibration induced movements, movement of sliding racks, equipment shifting, alignment, cover removal, and component replacement.
- 9. Wiring and cabling dress in harness arrangements shall be tied with a high strength approved Velcro type wire-tie.
- 10. All wires and cables shall be free from metal edges, bolt heads, and other interference points, and shall have electrical clearance from the covers, regardless of the insulation properties of covers or doors.

**PART 4 – MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. The Work specified in this Section will not be measured separately for payment.

**4.2 PAYMENT**

- A. All costs connected herewith shall be considered incidental to the Work specified under Section 16801 "Basic Technical Requirements-Communications System."

END OF SECTION 16837

**SECTION 16841**  
**COMMUNICATIONS CABLE – COMMUNICATIONS SYSTEM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. To provide and install the internal and external single and multi-pair copper conductor cables required for the communications subsystems.

**1.2 REFERENCED STANDARDS**

- A. Contractor's design and installation shall comply with the latest editions of all applicable Standards and Codes included herein. Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.

1. ASTM International (Formerly known as American Society for Testing and Materials) (ASTM)
  - a. ASTM B 3 - Standard Specification for Soft or Annealed Copper Wire
  - b. ASTM D 470 – Standard Test Methods for Crosslinked Insulations and Jackets for Wire and Cable
  - c. ASTM D 2863 - Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-like Combustion of Plastics
  - d. ASTM D 4101 - Standard Specification for Polypropylene Injection and Extrusion Materials
  - e. ASTM E 662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
  - f. ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops
2. Insulated Cable Engineers Association (ICEA)
  - a. ICEA S-84-608-2002 – Filled Telecommunications Cable, Polyolefin, Insulated, Copper Conductor
3. Military Standards (MS)
  - a. MIL-C-24643 - Cable Assembly, Aircraft Electrical Service

4. National Fire Protection Association (NFPA)
  - a. NFPA 70 - National Electric Code (hereinafter referred to as NEC)
  - b. NFPA 130 - Standard for Fixed Guide-way Transit Systems and Passenger Rail Systems.
  - c. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
5. Occupational Safety and Health Administration
  - a. 29 CFR 1910 – Occupational Safety and Health Standards
  - b. 29 CFR 1926 – Safety and Health Regulations for Construction
    - 1) 29 CFR 1926 Subpart P - Excavations
6. Telecommunications Industry Association (TIA)/Electronics Industry Alliance (EIA):
  - a. TIA-758-B - Customer-owned Outside Plant Telecommunications Infrastructure Standard
  - b. TIA-568-C - Commercial Building Telecommunications Cabling Standard
  - c. TIA-569-C - Commercial Building Standard for Telecommunications Pathways and Spaces.
  - d. TIA/EIA-606-B - Administration Standard for Telecommunications Infrastructure of Commercial Buildings
  - e. TIA-607-B – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
7. Underwriters Laboratories (UL)
  - a. UL 444 - Communications Cables
  - b. UL 1581 - Reference Standard for Electrical Wire, Cable, and Flexible Cords

- c. UL 1666 - Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
- d. UL 1690 - Data-Processing Cable
- 8. United States Department of Agriculture, Rural Utilities Service (RUS)
  - a. 7 CFR 1755, Bulletin 1753F-201 (PC-4), RUS Standard for Acceptance Tests and Measurements of Telecommunications Plant, PC-4.
  - b. 7 CFR 1755.390, RUS Specification for Filled Telephone Cables
  - c. 7 CFR 1755.890, Bulletin 1753F-208 (PE-89), RUS Specification for Filled Telephone Cables with Expanded Insulation.

- 1. Updated PDR information for drawings, calculations and design information shall reflect a final design.
- D. Installation Work Plans and Detailed Documentation. In accordance with these specifications, the Contract Drawings, and this Section submit as part of the Installation Plan cable installation details, including the following:
  - 1. Pulling layout including distances and tension calculations, for each section of installation.
  - 2. Pulling equipment and tension monitoring devices.
  - 3. Procedures and materials for terminating the cable and preparing it for connection to the termination points.
  - 4. Cable labeling including ID scheme, ID of each cable, and location of each tag.
  - 5. Proposed installation procedures including:
    - a. Hardware.
    - b. Attachment.
    - c. Routing.
    - d. Conduit fill.
    - e. Pull locations and equipment.
  - 6. Proposed cable splicing procedures including:
    - a. Material.
    - b. Equipment.
    - c. Testing.
  - 7. Chronological plan for installing cable, including estimated time for each pull and plan for protecting cable on-reel and in slack loops during installation. Where staging of cable is required (e.g., UPRR crossing warning systems), identify details.
  - 8. Contractor shall submit 1 original plus 10 copies of the projected loads and voltage drop calculations and optical loss calculations.
  - 9. Contractor shall provide to the Authority 1 original plus 10 copies of the cable manufacturer's instructions and procedures for potheading of each type underground cable to be provided.

**1.3 SUBMITTALS**

- A. Manufacturer Information: Contractor shall submit information for each proposed manufacturer describing relevant experience in manufacturing optical cable for rapid transit and railroad applications and quality assurance program and warranty.
- B. Preliminary Design Review (PDR) Technical Requirements
  - 1. Cable Product Data: Submit cable product data, including the following:
    - a. Cable cut sheets or shop drawings.
    - b. Certificates of Compliance confirming that wire and cable provided meets or exceeds the requirements of these Specifications.
  - 2. Cable Terminations: Submit product data and cable termination details, including the following:
    - a. Ring-type solder-less wire terminals.
    - b. Crimping tools.
    - c. Calibration certifications for crimping tools.
- C. Final Design Review (FDR) Technical Requirements. Contractor shall include the following information as part of the Final Design Review (FDR) Technical Requirements submittal package for the Communications Cables:

- 10. The manufacturer shall supply 1 original plus 10 copies of instructions for splicing for each type of cable specified. The instructions shall be forwarded with the certified test results for each reel of cable. The instructions shall specify the exact nature of splicing materials to be employed, and the manner they are to be spliced.
  - 11. Conduit and Cable Schedule.
  - 12. Cable Entrance Sealant - Add fire stop prior to filling with foam sealant.
- E. Certifications. Submit cable qualification data, including the following:
- 1. Listing of Railroads and Transit Authority Customers: Provide a list of names of 5 railroads and transit properties to which the manufacturer has provided cables similar to those required by these Specifications.
  - 2. Cable Manufacturer's Quality Plan.
  - 3. Cable Manufacturer Qualification Report.
  - 4. Insulation Qualification Test Documentation.
- F. Contractor shall, provide to the Authority sample specimens in 1200 mm (4 foot) lengths similar to that which the manufacturers propose to provide for each type cable specified herein. The sample specimens shall remain the property of the Authority.
- G. Test Plan, Procedures, and Results
- 1. Cable Production and Factory Test Documentation: Submit cable production test documentation, including certified test results indicating clear indication of pass/fail criteria and cable performance.
  - 2. Submit test reports verifying compliance with field-testing requirements, per Part 3 requirements, within 14 days of completion of each test.
  - 3. Submit cable installation details, including the following:
    - a. Pull Tension Calculations, and the actual pull tension during the cable installation showing the maximum pulling tension limits are not exceeded.
    - b. Update Conduit and Cable Schedule.
    - c. Conduit and Mandrel Report.
- H. As-Built Documentation: Contractor shall submit complete As-Built documentation and drawings including cable routing, termination details, connection diagrams, cable labeling and cable schedules. Reference Section 01785, "Project Record Documents".
- 1.4 QUALITY ASSURANCE**
- A. Applicable Standards and Codes.
- B. Cable Flammability, Toxicity, and Smoke Characteristics.
- a. Low smoke, halogen-free, jacketed cables shall be utilized for all applications required by code.
  - b. Communications cables specified herein shall meet the following flammability requirements:
    - 1) As a minimum, all communications cable shall meet UL 1581 vertical tray test and shall be type CM listed with Underwriters Laboratories. Type CMR, or CMP may be used as substitutes.
    - 2) Cables used in a riser environment shall meet UL 1666 flame test and shall be CMR listed with UL. Type CMP may be used as a substitute.
    - 3) Plenum rated cable shall be used when cable is installed in an air plenum environment. The cable shall meet NFPA 262-2002 and shall be type CMP listed with UL.
- C. Material and Workmanship Requirements: Material and workmanship of all cables specified in this section shall be consistent with the following requirements:
- 1. Life expectancy of the cable shall be 40 years in a railroad and transit environment.
  - 2. Cable shall be constructed for continuous operation at 90 degrees Celsius, in a wet or dry environment.
  - 3. Conductor to conductor and conductor to ground resistance shall be equal or greater than 1 meg-ohm (1MΩ).
  - 4. Cable shall be constructed for continuous operation at negative 40 degrees F without cracking or becoming brittle.



- D. Manufacturer Pre-Qualification Requirements: Any manufacturer differing from those specified herein shall require a prequalification and Authority approval. Manufacturer acceptability shall be based on the manufacturer's experience, qualifications, certifications such as ISO-9001, equipment reliability, and compliance with standards specified herein, and full compatibility with the Authority's existing system.
- manufactured to telephone industry standards.

## PART 2 - PRODUCTS

### 2.1 CONTRACTOR FURNISHED MATERIALS

#### A. Telephone, Public Address (PA), Visual Message Board (VMB), and Data Cable

1. Local inside facility distribution of low-level voice circuits shall, at a minimum, be by standard Category 6 cable.
2. Wire conductors shall be composed of soft or annealed copper, meeting insulating, sensitivity and elongation requirements of ASTM B3, latest edition.
3. The insulation shall be colored virgin propylene copolymer meeting the requirements of ASTM D4101, or equivalent, for propylene plastic. High molecular weight polyethylene is also acceptable.
4. Insulated conductors shall be in twisted pairs. Each pair shall be individually colored. The average length of pair twist shall not exceed 6 inches. To minimize noise and crosstalk, each pair of a multi-pair cable shall have a different average length of twist from any other pair in the cable.
5. Inside wire (wiring run within any building) from telephone terminals to telephone instruments shall be No. 22 AWG and meet Category 6 Specification TIA 568.C.2. Cable shall be low smoke and non-toxic.
6. All main riser cables shall be No. 22 AWG and shall meet RUS Specifications 7 CFR 1755.890. RUS Specification 7 CFR 1755.390 cables shall not be used as a substitute for 7 CFR 1755.890 cables.
7. All main and riser paired cables shall be shielded.
8. No cable shall contain less than twelve pairs unless otherwise indicated in the Contract Drawings and shall have at least 50 percent spare pairs. In addition to the requirements listed herein, all cables shall meet the requirements of NEC and NFPA 130 latest editions and shall be

#### B. Low-Smoke Jacket

1. Telephone, Supervisory Control and Data Acquisition (SCADA) I/O or data cable entering from an outside environment exceeding 50 feet in length inside a facility shall be low smoke.
2. Low-smoke jacket material for cables shall be flame retardant cross-linked polyolefin, as Authority approved. The jacket thickness shall be 60 mils minimum.
3. Jacket material shall meet or exceed the following specifications:
  - a. Tensile Strength (ASTM D470) 1100 psi minimum
  - b. Elongation (ASTM D470) 200 percent minimum
  - c. Tear Strength (ASTM D470) 7 lb/inch minimum
  - d. Oxygen Index (ASTM D2863) 27 minimum
  - e. Smoke Density (ASTM E662)
    - 1) Flaming Mode Ds 4 minute 50 minimum
    - 2) Flaming Mode Dm 20 minute 175 minimum
    - 3) Non-flaming Mode Ds 4 minute 65 minimum
    - 4) Non-flaming Mode Ds 20 minute 300 minimum
  - f. Smoke Index (MTL-DTL-32180) 25 minimum
  - g. Halogen Content (MTL-DTL-32180) 0.2 percent minimum
  - h. Toxicity Index (MTL-DTL-32180) 8.0 minimum
  - i. Acid Gas Equiv. (MTL-DTL-32180) 2.0 percent minimum
  - j. Ozone Resistance (ASTM D470) Pass (150 ppm at 25C)
4. All outside communications cables (e.g. those run in conduits, trough or duct-banks) shall be foam/skin insulated conductors that meet RUS Specification

7CFR 1755.890 and shall be protected using armor taping or approved equivalent.

**2.2 PUBLIC ADDRESS CABLE**

- A. Contractor shall provide and install loudspeaker wiring for connection of all speakers at all stations. Loudspeaker cables shall be twisted pairs, foil-shielded, and stranded No. 14 AWG minimum.
- B. Local distribution cables for the PA System shall be placed in separate conduit or raceways from low-level voice and data circuits. Cable jacket shall have a 600-volt rating.
- C. Contractor shall provide and install cable for connection of all ambient sensing microphones. Cable shall be No. 18 AWG, shielded twisted pairs.
- D. All grounding conductors for public address cables shall be insulated.

**2.3 DATA CABLE**

- A. RS-232D Data Communications Cable
  - 1. Serial data cables used for RS-232 applications shall meet the following characteristics:
    - a. Jacket: NEC CL2P, Low Smoke
    - b. Wires: Uniquely Color Coded
    - c. Cable Type: Twisted pair
    - d. Conductor gauge: No. 24 AWG (7 X 32 AWG) stranded, minimum.
    - e. Shield: 1 overall foil shield, with a braided shield minimum.
    - f. Capacitance: 12 pf/foot
    - g. Resistance: 30 ohms/1000 feet
    - h. Conductors: 6 to 12-1/2 pairs

**2.4 RS-422 DATA COMMUNICATIONS CABLE**

- A. Serial data cables used for RS-422 balanced electrical transmission of data shall have a 600-volt insulation rating and meet the following characteristics:
  - 1. Jacket: NEC CL2P, Low Smoke
  - 2. Wires: Uniquely Color Coded

- 3. Cable Type: Twisted Pair
- 4. Conductor gauge: No. 24 AWG (7 X 32 AWG) stranded, minimum.
- 5. Shield: Individually foil shielded pairs each with a drain wire. One overall foil shield, with a braided shield minimum.
- 6. Capacitance: 13 pf/feet
- 7. Resistance: 16 ohms/1000 feet
- 8. Conductors: 2 to 12 pairs

**2.5 T1 DATA COMMUNICATIONS CABLE**

- A. The cable for connection of DSX-1 compatible signals shall be Western Electric type ABAM or approved equivalent.
- B. The cable shall also meet the following requirements:
  - 1. Jacket: NEC CMR, Low Smoke
  - 2. Wires: Conforms to PIC color code.
  - 3. Cable Type: Twisted Pair
  - 4. Conductor gauge: Solid annealed
  - 5. Shield: Individually shielded pairs each with a drain wire.
  - 6. Characteristic Impedance: 100 ohms @ 772 KHz
  - 7. Average mutual capacitance: 90 nf/mi.
  - 8. Conductors: Two pair per T1 connection.

**2.6 OUTDOOR TELEPHONE, SCADA I/O AND DATA CABLE**

- A. Contractor shall provide, install and terminate outdoor telephone and I/O data cabling as indicated in the Contract Drawings.
- B. The multi-pair No. 22 AWG, filled cable shall conform to RUS Specification 7 CFR 1755.890 except as noted herein.
- C. The conductors shall be solid annealed bare copper conforming to the latest requirements of ASTM-B-3.
  - 1. Conductors shall be individually insulated with a colored, solid insulating grade, high density-polyethylene or polyolefin of ICEA S-56-434.

2. The insulating material color shall be coded per U.S. telephone industry standards with color concentrates chosen for permanency and electrical balance of individual circuits. The colors of insulated conductors shall be provided in accordance with ICEA S56-434, Section II-7 and shall comply with the requirements of EIA TIA-359.
  3. The insulated conductors shall be twisted into pairs. The length of pair twists shall be designed to meet ICEA S45-434 latest edition.
  4. The average twist length of any pair in the finished cable shall not exceed 6 inches.
  5. The insulated pairs shall be twisted into specified color combinations to provide pair identification as well as low susceptibility to noise pick-up and with varying lay lengths to minimize crosstalk.
  6. The insulated pairs shall be assembled into a cable core. Cable cores of 25 or less pairs shall be assembled concentrically.
- D. The filling compound, a petroleum jelly base multi-component, shall be applied to the cable core in such a way as to provide as near to 100 percent fill of the available air space within the core as is commercially practicable. The filling compound shall be applied in a manner to fill all voids and conductor interstices under the core to restrict the migration of moisture. The filling compound shall be compatible with the insulation and other cable components.
- E. The filled core shall be completely covered with a layer of non-hygroscopic, non-wicking polymeric tape applied with overlap over the cable core to ensure high dielectric strength from cable core to shield.
- F. A 0.008-inch thick corrugated aluminum tape shall be applied over the core. The tape shall be coated with a 0.002-inch thick copolymer compound and shall be applied longitudinally with overlap.
- G. The outer jacket shall be of virgin, black high molecular weight polyethylene copolymer except low-smoke jacketed cables that shall be as specified below. The overall jacket shall be sequentially marked at 2-foot intervals with cable type, year of mfg., footage, pair count, conductor size and manufacturer. The jacket shall be free from holes, splits, blisters or other imperfections and shall be smooth and concentric.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. Field Installation

1. Contractor shall inspect cables at time of delivery to the construction site to assure that no damage was done in shipping and that the specified cable was received. Contractor shall inspect every reel for physical damage such as nails driven into reels to secure shipping blocks, lagging, or reel covering missing and cable and seals missing or damaged. A copy of these inspection reports shall be submitted to the Authority. Contractor shall replace all damaged or rejected cables promptly, at no cost to the Authority.
2. Wires and cables shall be stored on solid surfaces that shall adequately support the cable reels, but which shall be well drained and not allow accumulation of liquids, oils, or chemicals.
3. The cable reels shall be aligned and protection provided so as not to allow the reel flanges to damage other reels. Adequate aisles and barricades shall provide accessibility but prevent construction equipment from damaging the cable reels.
4. Cable ends shall be resealed promptly when a length is cut from the reel. Cable reels shall be properly handled, i.e., by using a sling and spreader attached to a shaft through the reel hubs, or by cradling both flanges between lift truck forks. The reels shall not be lifted by the top reel flange or dropped from any height. Lift truck forks shall not touch cable surfaces on the reel. Reels shall always be rolled in the direction opposite the cable wind on the reel. Reels shall not be laid flat.
5. Contractor shall verify that the installation design is correct and adequate for the cables to be installed. Contractor shall assure that conduit size, conduit fill, conduit bend radii, manhole spacing, manhole size, raceways, ducts, and associated hardware are proper for the intended installation.
6. Contractor shall be responsible for verifying the required cable length for each cable run prior to installation. Civil stationings appearing on referenced drawings may be used for defining locations and estimating cable lengths. However, no existing drawings shall be used to determine final lengths and cuts. Actual lengths shall be determined by

- making on-site inspections and measurements.
7. Wires and cables shall be continuous without splices between junction boxes, terminals, pull boxes, manholes and hand holes. Cables shall not be bent to a radius less than the greater of 20 times the diameter of the cable or the manufacturers' recommended minimum bending radius, during installation or as finally installed.
8. Develop a written cable installation procedure and check-off list for approval prior to cable installation. This procedure shall be prepared based on Contractor's review of the conduit plans, and field site survey and shall include a cable plan and installation information for each cable pull. The installation plan shall include proper procedures for feeding cable into conduit, to maintain proper bend radii, and to minimize friction.
9. Contractor shall give the Authority at least 48 hours notice prior to installing cables.
10. Install cable per the approved installation and cable plan. Contractor shall provide any installation hardware required to route, support, terminate, or protect any cable installation.
11. Crimp-on connectors or lugs shall not be used on solid conductors.
12. Provide additional conduit as required to access equipment enclosures or apparatus.
13. Contractor shall provide sufficient slack in cable conductors at all terminating points to enable 3 re-terminations of each conductor without re-servicing or re-potheading the cable.
14. In certain types of installation, the cable cannot be constrained; therefore, ample cable slack shall be provided for additional flexibility due to vibration of such equipment.
15. Tags to identify cables shall be of plastic material. Tags shall be lettered to correspond with the cable destination and number of pairs in the cable.
16. All cables shall be terminated in order according to the color code. Individual cable pairs shall be identified at each cable termination with plastic tags. All spare pairs in each cable shall be terminated and identified. Cable tags shall be placed on all cables at termination points and 1 label applied to each cable at manholes, pull-boxes, junction boxes, and similar facilities.
17. All cable entrance openings in equipment enclosures, houses, rooms and junction boxes shall be sealed with either a compression type fitting or pliable sealing compound after the cable is in place. Sealing compounds for rooms, houses, walls, or other partitions shall be fire retardant per ASTM E814. Sealing compound shall be used to seal the area around cable where the cable emerges from the end of a conduit, pipe, or duct-bank. All spare conduits shall be sealed or plugged in an approved manner.
18. Where cable transfers from trays or troughs to conduit the ends of the conduit shall be fitted with plastic end bells to prevent damage to the cable.
19. Wherever cables are terminated the outer sheath of the cable shall be carefully removed to the point of cable entrance. At the end of the cable sheath or covering, 2 layers of plastic electrical tape shall be applied.
20. OSHA's "Confined Spaces" procedures shall be followed in all installation activities.
- B. Contractor shall install wayside cables in the buried duct-bank, trough, and conduit currently in place along the right-of-way.
1. Contractor shall review civil segment Referenced Drawings, and verify that all ducts are correctly configured for Work to be performed, stub-ups are in the proper locations, and conduits are free of obstruction and/or extraneous material. During the installation, if Work areas are exposed to heavy equipment, the Contractor shall take appropriate actions to protect exposed sections, covering such areas with heavy steel plate or other suitable material. Cable/express trough shall remain with lids installed during the times when Work not performed.
2. Contractor shall utilize only installers who are qualified and experienced in handling and installing underground cable in conduit. Experienced supervision shall be provided to ensure that all required precautions are taken and that the installation is in accordance with the requirements of this Section.
3. Contractor shall install wires and cables in accordance with cable handling and pulling practice as defined by the cable manufacturer's recommendations.

4. Contractor shall establish the maximum allowable length of cable, which may be safely pulled into each conduit after obtaining the wire and cable manufacturer's recommendations regarding pulling limits for the cables. Consideration shall be given to the following parameters - fill, friction, clearance, configuration, jam ratio of the cables and conduit, weight correction factor, bend radii, training of the cables on entering and exiting the conduits, maximum allowable tension, sidewall load, and weight of the cables. These factors shall be calculated for each pull as required and Contractor shall not exceed the maximum allowable values of sidewall pressure, pulling strain on conductors or sheath, limits of pulling device and pulling tension. If the pulling tension for any cable exceeds the maximum allowable, that cable shall be removed and replaced with new cable. Calculations shall be signed, sealed and dated by a Texas Licensed Professional Engineer.
5. Pulling tensions shall be calculated by Contractor from both directions to determine which will be easier and result in less pulling tension on the cable. The lower tension direction shall be utilized. Calculations shall be signed, sealed and dated by a Texas Licensed Professional Engineer.
6. Proper procedures for feeding cable into the conduit shall be established by Contractor. Feed-in tubes, sheaves, cable reel jacks, and other required tools required to provide proper bending radii and minimal friction during installation shall be used. Direction or training of the cables on entering and exiting the conduit shall coincide with other parts of the installation arrangement so that the cable is not damaged or over-stressed.
7. Contractor shall use only the wire and cable manufacturer's approved pulling compound or lubricant compatible with the cable. The lubricant shall be used in ample quantity to reduce friction and applied in such a manner that the cable is lubricated throughout the entire length being pulled through the conduit.
8. Cables installed in manholes and pull boxes shall not interfere with the future use of or access to unused conduit.
9. Cables shall be mounted and dressed on cable racks. Where the provided racking is not sufficient to properly support and dress the cable, the Contractor shall supply and install additional racks, matching those already installed to complete cable installation.
10. All exposed wires and cables entering or leaving all equipment housings, junction boxes, and cable transition points shall be protected from abrasion. Chase nipples and/or split ring plastic grommets shall be provided in drilled or punched openings in equipment housings and junction boxes.
11. The installation shall be in accordance with Contractor's approved installation procedure and check-off list which shall include the following considerations:
  - a. Spare wires and cables shall be installed at the same time that the active wires and cables are being installed.
  - b. The cables shall not be pulled through manholes.
  - c. Cables shall not be pulled into a conduit that already contains conductors. If it becomes required to remove a cable from a conduit, all cables in that conduit shall be removed. Cable removed from conduit shall not be used elsewhere. Cable removed from conduit shall be reinstalled under the Authority's direction. The restoration of all functions supported by the removed and reinstalled cables shall be the responsibility of the Contractor and under the Authority direction.
  - d. Two-way communication between pulling and feed ends shall be established before and during the installation.
  - e. In pulling cable, an approved wire cable grip extending not less than 18 inches back from the end of the cable shall be used. The clutch on the pulling device shall be set to slip at 50 percent of the weight per 1,000 feet of the cable to be pulled. The equipment used for pulling cable shall be equipped with a dynamometer, which shall indicate the pulling force in pounds.
  - f. Pulling shall be done at a constant velocity between 15 and 50 feet per minute. The pull shall not be stopped once started unless absolutely required.
  - g. Crossovers and kinks shall be avoided at feed end.
  - h. Cable shall be protected after installation and prior to terminating or splicing.

- i. After pulling, the tension end of the cable damaged in the pulling process shall be cut off.
  - j. All cables shall be identified.
  - k. The cable installation in manholes and pull boxes shall not interfere with the future use of or access to unused conduit.
12. Each existing conduit to be used for cable installation shall be blown or swabbed dry to ensure cleanliness, rodded and mandrelled to ensure no obstructions and to minimize chafing. Each new conduit shall be mandrelled in accordance with these specifications.
13. Cables shall be placed in the duct identified to the Contractor by the Contract Drawings. All cables to be placed in 1 duct shall be installed simultaneously. Extreme care shall be used in installing cables so as to avoid twisting, kinking, or in any way injuring the cable or its sheath.
14. When required, the Contractor shall pump water out of manholes, cable pits, and pull chambers before installing any cables and shall be responsible for maintaining manholes and pull chambers in a dry condition while the cables are being pulled.
15. Cable installation in conduit shall not exceed 40 percent fill per conduit, unless otherwise allowed by the Authority.
16. Cables installed in manholes shall be properly constrained and fastened to the walls of the manhole in accordance with the approved installation drawings.
- C. Non-Buried Installation
- 1. Routing of wires and cables in the Train Control Center (TCC), signals, Traction Power Substation (TPSS) and communications facilities shall be within Contractor-provided cable trays.
  - 2. Cable installed in trays or troughs shall be laid loosely, neatly and with a minimum of crossovers, and not pulled into place. They shall have a minimum amount of crossover and shall not be pulled tightly around bends.
  - 3. Cabling between racks or cabinets shall be routed via the overhead cable trays, with 1 foot of slack between the cable tray and each rack to which the cable is connected. Cables shall be secured to the last strap of the cable tray before transitioning to equipment racks or cabinets.
4. Where transfers of cable from trays to conduit occur, conduit ends shall be fitted with plastic end bells to prevent damage to cable.
5. Cable identification tags shall be installed at each termination.
6. Installation in Conduit or Pipe
- a. Contractor shall have all communications conduits, including the Authority provided conduits inspected, mandrelled, swabbed, and cleaned prior to cable installation. Manholes shall be cleaned and the location of pulling eyes shall be determined.
  - b. Contractor-provided conduits shall have a clean, smooth concentric interior surface. Conduits shall be painted to match the color of the column or wall on which they attached.
  - c. Crossover of cables shall be avoided when cables are pulled into conduits. Care shall be taken not to have the conductors pulled tight or kinked in conduit fittings or boxes. All cables to be installed in a single conduit shall be pulled and installed simultaneously.
  - d. Special Protection: Contractor shall provide required special protection for cables in areas where the cables are unavoidably exposed to hazardous conditions such as vibration or sharp corners on equipment. Cables damaged due to Contractor's neglect while installing cables shall be replaced by the Contractor at no additional cost to the Contract.
  - e. Multi-Pair Cables: Multi-pair cables shall be continuous without splices, between termination locations. Termination locations shall be located within indoor communication interface cabinets (CIC) and wayside equipment enclosures, as shown on the Contract Drawings. No terminations of any kind shall be acceptable at other locations, except as Authority approved.
    - 1) The shield of each section of communication cable shall be electrically

continuous between terminations on terminal blocks. Each section of communications cable shall have its shield grounded at the terminal block location at one end of the cable section only. The shield shall be grounded with the use of tin plated brass shield connectors and No. 6 AWG insulated ground wire, in a manner as recommended by the cable manufacturer. The shield connectors shall be compatible with the cable's aluminum binder tape. The ground wire shall be connected to the terminal block housing ground grid.

- 2) Pairs shall be maintained intact, and shall terminate in order following the color code. Cable pairs from different pair units shall not occupy the same line terminal block.

- b. Ultimate Elongation 400 percent minimum
  - c. Environmental Stress Cracking 20 percent maximum
  - d. Maximum Shrink-back 5 percent minimum
  - e. Impact Failure 20 percent maximum
3. The provided multi-pair shall be tested per RUS Specification 7 CFR 1755 Bulletin 1753F-201 (PC-4) for the following:
    - a. Mutual Capacitance: 0.083+0.004 uF/mi.
    - b. Mutual Capacitance Deviation: 3 percent RMS maximum
    - c. Pair-to-Pair Capacitance Unbalance: 25 pF/1000 feet max (RMS).
    - d. Pair-to-Ground Unbalance (maximum): 800 pF/1000 feet max.
    - e. Pair-to-Ground Unbalance (average): 175 pF/1000 feet max.
    - f. Equal Level Far End Crosstalk (150 kHz): 63 db/kft minimum
    - g. Near End Crosstalk (772 kHz): 47 db/kft minimum
    - h. Insulation Resistance: 1000 meg-ohm per mile.
    - i. Maximum Conductor Resistance (at 20C): 91 ohms/mi.
    - j. Maximum Average Attenuation (772 Hz at 20C): 4.5 dB/mi.
    - k. High Voltage Test (3 seconds. between conductors): 3600V DC
    - l. High Voltage Test (3 seconds. between conductors and shield) 10,000V DC
    - m. Cable Bend Test: No Shield Cracks

**3.2 TESTING**

- A. Contractor shall present to the Authority, for approval, a cable test plan showing the tests to be made and the limiting values to be used.
- B. Contractor shall provide test or inspection procedures for Authority approval, 45 days prior to each scheduled test or inspection.
- C. Contractor shall provide test or inspection records within 14 days after each test or inspection.
- D. Factory Tests
  1. Conductor insulation shall be tested per RUS Specification RUS Specification 7 CFR 1755 Bulletin 1753F-201 (PC-4) for the following:
    - a. Minimum Tensile Strength 2400 lb./sq. inch minimum
    - b. Ultimate Elongation 300 percent minimum
    - c. Maximum Shrink-back 3/8 inch minimum
  2. The jacket material shall be tested per RUS Specification 7 CFR 1755 Bulletin 1753F-201 (PC-4) for the following:
    - a. Minimum Tensile Strength 1700 lb./sq. inch minimum

**E. Field Tests**

1. Insulation Resistance Tests
  - a. Tests shall be performed on all cables entering or leaving houses, after the cables are terminated.

- b. Disconnect external apparatus prior to performing the test.
  - c. Contractor shall verify conductor-to-ground resistance.
  - d. Contractor shall verify conductor-to-conductor resistance for each pair.
  - e. Record all data on an approved test form.
- 2. Attenuation, S/N, Peak-To-Average Tests: Utilize transmission impairment measurement sets to determine the 1000 Hz attenuation, signal to noise ratio, and peak to average ratio.
  - 3. DC Loop Resistance Test
  - 4. Utilize Volt OHM Meter (VOM) to measure DC loop resistance of each cable pair.
- F. End-To-End Test: Tests shall be performed end-to-end on all cables where the cables enter or leave cases, communication houses or other facilities.

#### **PART 4 - MEASUREMENT AND PAYMENT**

##### **4.1 GENERAL**

- A. The Work specified in this Section will not be measured separately for payment.

##### **4.2 PAYMENT**

- A. All costs connected herewith shall be considered incidental to the Work specified under Section 16801 "Basic Technical Requirements - Communications System."

END OF SECTION 16841



**SECTION 16845**  
**FIBER OPTIC CABLE SUBSYSTEM - COMMUNICATIONS SYSTEM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. Contractor shall design, provide and install a complete fiber optic cable subsystem as specified herein, and as shown on the Contract Documents.

1. Contractor shall provide, install, splice, terminate and test Fiber Optic cable in accordance with the Contract Documents.

2. Scope of Work for the portion of the work where the Authority provides fiber optic cable does not include Factory Tests; however, additional Authority approved tests shall be required for the Contractor to take possession of the cables.

B. Ancillary Devices

1. Additional equipment to be provided with the fiber optic cable shall include the following:

- a. Fiber Slack Enclosures (FSE)
- b. Fiber Distribution Panels (FDP)
- c. Optical patch cords
- d. Pigtailed
- e. Splices
- f. Attenuators (as required)
- g. Field splice and connector kits
- h. Media converters
- i. Wire pulling lubricant

**1.2 REFERENCED STANDARDS**

A. ASTM International (Formerly known as American Society for Testing and Materials) (ASTM)

1. ASTM D1248 - Standard Specification for Polyethylene Plastic Extrusion Material for Wire and Cable

2. ASTM E814 - Standard Test Method for Fire Tests of Through - Penetration Fire Stops

B. Electronic Industries Alliance (EIA)/Telecommunication Industry Association (TIA)

1. TIA/EIA 455-25-C, FOTP-25 - Impact Testing of Fiber Optic Cables

2. TIA/EIA 455-B - Standard Test Procedure for Fiber Optic Fiber Cables, Transducers, Sensors, Connecting and Terminating Devices and other Fiber Optic Components

3. TIA - 455-3-A, FOTP-3 - Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components

4. TIA - 455-13-A, FOTP-13 - Visual and Mechanical Inspection of Fiber Optic Components Devices and Assemblies

5. TIA - 455-33-A, FOTP-33-B - Fiber Optic Cable Tensile Loading and Bending Test

6. TIA/EIA 455-37-A, FOTP-37 - Low or High Temperature Bend Test for Fiber Optic Cable

7. TIA/EIA 455-41-A, FOTP-41 - Compressive Loading Resistance of Fiber Optic Cables

8. TIA - 455-78-B, FOTP-78-B - Optical Fibers: Measurement Methods and Test Procedures - Attenuation

9. TIA/EIA 455-81-B, FOTP-81 - Compound Flow (Drip) Test for Filled Fiber Optic Cable

10. TIA - 455-82-B, FOTP-82 - Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable

11. TIA/EIA 455-85-A, FOTP-85 - Fiber Optic Cable Twist Test

12. TIA/EIA 455-88, FOTP-88 - Fiber Optic Cable Bend Test

13. TIA - 455-91, FOTP-91 - Fiber Optic Cable Twist-Bend Test

14. TIA - 455-104-A, FOTP-104 - Fiber Optic Cable Cyclic Flexing Test

15. TIA 455-133-A, FOTP-133 IEC-60793-1-22 Optical Fibers - Part 1-22: Measurement Methods and Test Procedures - Length Measurement

16. TIA/EIA 455-171-A, FOTP-171 - Attenuation by Substitution Measurement for Short-Length Multimode Graded-Index and Singlemode Optical Fiber Cable Assemblies

17. TIA 455-177-B, FOTP-177 - IEC 60793-1-43 Optical Fibers Part 1-43: Measurement Methods and Test Procedures - Numerical Aperture

FIBER OPTIC CABLE SUBSYSTEM - COMMUNICATIONS SYSTEM

- |  |  |
|--|--|
| <p>18. TIA-472C000-B, Standard for Optical Fiber Premises Distribution Cable</p>   | <p>G. National Fire Protection Association (NFPA)</p>  |
| <p>19. TIA/EIA 455-181, FOTP-181 - Lighting Damage Susceptibility Test for Optic Cables with Metallic Components</p>   | <p>1. NFPA 70 - National Electrical Code (hereinafter referred to as NEC)</p>  |
| <p>20. TIA/EIA 492-AAAA-A, Detail Specification for 62.5-<math>\mu</math>m Core Diameter/125 <math>\mu</math>m Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers</p>  | <p>2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces</p>   |
| <p>21. TIA 492-CAAB - Detail Specification for Class IVa Dispersion - Unshifted Singlemode Optical Fibers with Low Water Peak</p>  | <p>H. Occupational Safety and Health Administration (OSHA)</p>   |
| <p>22. TIA-526-7 - OFSTP-7 Measurement of Optical Power Loss of Installed Singlemode Fiber Cable Plant</p>   | <p>1. 29 CFR 1910 - Occupational Safety and Health Standards</p>   |
| <p>23. TIA-526-14-A, OFSTP-14 - Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant</p>  | <p>2. 29 CFR 1926 - Safety and Health Regulations for Construction</p>   |
| <p>24. TIA-568-B.1-3 - Commercial Building Telecommunications Cabling Standard</p>   | <p>I. Underwriters' Laboratories, Inc. (UL)</p>  |
| <p>25. TIA-598-B - Optical Fiber Cables Color Coding</p>   | <p>1. UL 910 - Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air</p>                           |
| <p>26. TIA/EIA-606 - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings</p>   | <p>2. UL 1581 - Reference Standard for Electrical Wires, Cables, and Flexible Cords</p>  |
| <p>C. Institute of Electrical and Electronic Engineers (IEEE)</p>  | <p>3. UL 1666 - Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts</p>  |
| <p>1. IEEE 802.3u - Supplement to Local and Metropolitan Area Networks Media Access Control (MAC) Parameters, Physical Layer, Medium Attachment Units, and Repeater for 100 Mb/s Operation, Type 100BASE-T (Clauses 21 - 30)-Supplement to ISO/IEC 8802-3:1993 (ANSI/IEEE 802.3, 1993 Edition)</p> | <p>4. UL 2024 - Standard for Optical Fiber and Communication Cable Raceway</p>   |
| <p>D. Insulated Cable Engineers Association (ICEA)</p>   | <p>J. United States Department of Agriculture (USDA)</p>   |
| <p>1. ICEA S-87-640-2011 - Standard for Optical Fiber Outside Plant Communications Cable</p>   | <p>1. USDA Rural Utilities Service (RUS) 7 CFR 1755.900</p>  |
| <p>E. International Organization for Standards (ISO)</p>   | <p>K. Telcordia</p>  |
| <p>1. ISO 9001 - Quality Management Systems - Requirements</p>   | <p>1. Telcordia GR-196-CORE - Generic Requirements for OTDR-type Equipment</p>   |
| <p>F. National Electric Manufacturers Association (NEMA)</p>   | <p>2. Telcordia SR-4731 - Special Requirements for Optical Time Domain Reflectometer (OTDR) Data Format</p>  |
| <p>1. NEMA Standards Publication 250, Enclosures for Electrical Equipment (1000 Volts Maximum)</p>   | <p><b>1.3 SUBMITTALS</b></p>   |
|  | <p>A. Qualifications:</p>  |
|  | <p>1. Manufacturer Information:</p>  |
|  | <p>a. Contractor shall submit information for each proposed manufacturer describing relevant experience in manufacturing optical cable and quality assurance program and warranty.</p> |

2. Installer Information: prior to the release of the cable from the Authority. Contractor shall submit the following:
- a. Submittal shall demonstrate previous successful experience in installation and testing of fiber optic cable specified herein.
    1. Procedures shall be submitted within 120 days after NTP.
    2. Certified copies of test results in accordance with the reporting requirements of Article 3.2 shall be submitted within 14 days after test completion for Authority approval.
      - a. Optical Time Domain Reflectometer (OTDR) Testing.
      - b. A certification by the Contractor of acceptability of the Authority provided cable for installation. For rejected cables, the Contractor shall submit justification for the rejection of the cable based on both visual inspection and test results.
  - b. Submittal shall include a list of 3 recently completed projects of similar type and size with contact names and telephone numbers for each.
- B. Preliminary Design Review (PDR) Technical Requirements.
1. Product Technical Data: Contractor shall submit complete technical data for the cable and all ancillary devices he proposes to provide. The data submitted shall demonstrate compliance with all properties specified herein:
    - a. Performance data and descriptions of all products shall be submitted for the List of Proposed Products and Materials submittal.
    - b. As a minimum the following shall be provided: manufacturer model number, UL listing or rating, critical dimensions and mounting arrangement, technical specifications, and replacement parts list.
  2. Complete end-to-end fiber optic subsystem splice and termination diagrams.
  3. Equipment enclosures, panels, and material shop drawings including description and model numbers of all fiber splice and termination distribution equipment to be installed.
- C. Final Design Review (FDR) Technical Requirements.
1. Contractor shall include the following information as part of the Final Design Review (FDR) Technical Requirements submittal package for the fiber optic subsystem:
    - a. Update the PDR information, including drawings. Information shall include location specific final designs.
- D. Product samples: Contractor shall submit 2 samples (4 feet long) for each one of the proposed cables for Authority approval.
- E. Authority Provided Cable Acceptance Tests: Acceptance tests shall be performed on the Authority provided outside plant singlemode cable
- F. Cable Factory Tests: Factory tests shall be performed in accordance with TIA/EIA-455-B and Article 3.2 of this Specification. Contractor shall submit the following:
1. Test procedures shall be submitted 30 days prior to any scheduled test.
  2. Results with reporting requirements of Article 3.2 of this Specification shall be submitted within 14 days of test completion for authority approval.
    - a. Optical Time Domain Reflectometer (OTDR) (1310/1550/1625 nm singlemode and 850/1310 nm multimode).
    - b. Chromatic Dispersion (singlemode only).
    - c. Attenuation in dB/km.
  3. Contractor shall submit a certification statement confirming compliance with all mechanical testing requirements of these specifications.
- G. Cable Field Tests: Field tests shall be performed in accordance with TIA/EIA-455-B and Article 3.2 of this Section. Contractor shall submit the following:
1. Test procedures, 60 days prior to any scheduled test.
  2. Results in with reporting requirements of Paragraph 3.2.A through 3.2.D within 14 days after test completion for Authority approval:

- a. Attenuation in dB/km for all terminated fibers
- b. Optical Time Domain Reflectometer (OTDR) Testing

evaluation and shall make the arrangements for any required demonstrations and tests. Such compliance shall promote a thoroughly tested and properly installed cable subsystem.

H. Installation Plan: Contractor shall submit, at least 60 days prior to installing cable, the following information for each segment of cable to be installed:

- 1. Pulling layout, including distances and tension calculations, for each section of installation.
- 2. Pulling equipment and tension monitoring devices.
- 3. Chronological plan for installing cable, including estimated time for each pull and plan for protecting cable on-reel and in slack loops during installation.
- 4. Contractor shall submit link budget calculations showing all intended links to be used by the submitted media conversion devices as required by Article 2.3 of this Section. This link budget will be used to compare and qualify actual loss measurements to acceptable loss measurements for pass/fail evaluation.

I. Termination Procedures: Contractor shall submit, prior to installing cable, the following information:

- 1. Procedure for terminating cable within the FDP, including fusion splicing of pigtails.
- 2. Fusion splice equipment description.
- 3. Splice and termination testing procedure.

J. Test Records. Contractor shall provide all test records within 14 days after completion of each test for Authority approval.

**1.4 QUALITY ASSURANCE**

- A. Contractor's materials, design, installation, and testing shall comply with all applicable Standards included herein. Contractor shall be familiar with and adhere to the latest editions of these codes, regulations, specifications and standards. Work shall meet or exceed the standards and procedures specified.
- B. In the event of conflicts between reference standards, the most stringent provisions shall apply to the Work of this Section.
- C. Manufacturer Pre-Qualification Requirements
  - 1. Cable manufacturers and Contractors shall be Authority approved. Contractor shall provide all data required for Authority

2. Qualifications shall be based on the following criteria:

a. Past Performance and Experience: Cable manufacturers shall demonstrate previous successful experience in supplying, testing and installation of fiber optic cable specified herein.

b. Quality Assurance Program:

- 1) The manufacturer of cables, in accordance with the requirements of these Technical Specifications, is required to have in place or implement, an effective quality assurance program adhering to the requirements of ISO 9001 to ensure purchase control performance.
- 2) The cable manufacturer shall be ISO 9001 certified and Contractor is to submit ISO 9001 Certification Number.

c. Warranty

- 1) The manufacturer shall warrant that the design, material, and workmanship incorporated in each item of cable shall be of the highest grade and consistent with the established, and generally accepted, standards for fiber optic cable for transit applications; and that each such item and every part and component thereof shall comply with these Specifications.
- 2) Contractor shall monitor the manufacturers of the cable to assure that the approved Quality Assurance Program is being closely adhered to and that the fiber optic cable is being manufactured in accordance with these Technical Specifications.

- 3) If the cable supplier is not the manufacturer of the fiber, the fiber manufacturer shall be identified.

- D. Point of Origin: The cable and the fibers shall be American-made.

**1.5 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Packing - Cable shall be shipped on non-returnable wooden reels. The diameter of the drum shall be at least 20 times the diameter of the cable. Cable shall be shipped on reels substantial to withstand reasonable handling and shall be so designed that the inner end of the cable be accessible, but protected from injury. All ends of the cable shall be sealed to prevent entrance of moisture and securely fastened to prevent them from becoming loose during transit.

- B. Marking - Each reel shall contain on the outside flange, the following information:

1. Manufacturer's name.
2. Contract name and number.
3. Cable identification number.
4. Cable length.
5. Date of manufacture.
6. Copy of the factory test results.

**PART 2 - PRODUCTS**

**2.1 FIBER OPTIC CABLE**

- A. General

1. The life expectancy of the cable shall be no less than 25 years for service in a railroad and transit environment.
2. The cable shall be designed for installation in underground conduit, wet or dry environments, including alternating wet and dry conditions.
3. All fiber optic cable run in conduits or duct banks shall be listed with USDA Rural Utilities Service (RUS) 7 CFR 1755.900 and meet the requirements of ICEA S-87-640-2011.
4. The number of fiber cable strands are noted on the Contract Drawings. A minimum of 50 percent spare fibers shall be provided.

**B. Outside Plant (OSP) Cable**

1. All OSP fiber optic cable shall be certified to meet applicable tests of TIA-455, but as a minimum shall meet the following:

- a. When tested in accordance with TIA 455-3-A, FOTP-3, the change in attenuation at extreme operational temperatures (negative 40 degrees F and 185 degrees F) shall not exceed 0.15 dB/km at 1550 nm for singlemode cable and shall not exceed 0.30 dB/km at 1300 nm for multimode cable.

- b. When tested in accordance with TIA-455-82-B, FOTP-82, a 1-meter length of unaged cable shall withstand a 1-meter static head or equivalent continuous pressure of water for 1 hour without leakage through the open cable end.

- c. When tested in accordance with TIA/EIA 455-81-B, FOTP-81, the cable shall exhibit no flow (drip or leak) of filling and/or flooding material at 158 degrees F.

- d. When tested in accordance with TIA/EIA 455-41-A, FOTP-41, the cable shall withstand a minimum compressive load of 220 N/cm (125 lbf/in) applied uniformly over the length of the sample. The 220 N/cm (125 lbf/in) load shall be applied at a rate of 2.5 mm (0.1 in) per minute. The load shall be maintained for a period of 1 minute. The load shall then be decreased to 110 N/cm (63 lbf/in). Alternatively, it is acceptable to remove the 220 N/cm (125 lbf/in) load entirely and apply the 110 N/cm (63 lbf/in) load within 5 minutes at a rate of 2.5 mm (0.1 in) per minute. The 110 N/cm (63 lbf/in) load shall be maintained for a period of 10 minutes. Attenuation measurements shall be performed before release of the 110 N/cm (63 lbf/in) load. The change in attenuation shall not exceed 0.15 dB/km at 1550 nm and 0.30 dB/km at 1300 nm for multimode cable.

- e. When tested in accordance with TIA-455-104-A, FOTP-104, the cable shall withstand 25 mechanical flexing cycles around a sheave diameter not greater than 20 times the cable diameter. The change in attenuation shall not exceed 0.15 dB/km at 1550 nm and 0.30 dB/km at 1300 nm for multimode cable.

- f. When tested in accordance with TIA/EIA 455-25-C, FOTP-25, except that the number of cycles shall be 2 at 3 locations along a 1-meter cable length and the impact energy shall be at least 4.4 Nm (in accordance with ICEA S-87-640). The change in attenuation shall not exceed 0.15 dB/km at 1550 nm and 0.30 dB/km at 1300 nm for multimode cable.
- g. When tested in accordance with TIA 455-33-A, FOTP-33-B, using a maximum mandrel and sheave diameter of 560 mm, the cable shall withstand a rated tensile load of 2670N (601 lbf) and residual load of 30 percent of the rated installation load. The axial fiber strain shall be less than or equal to 60 percent of the fiber proof level after completion of 60 minute conditioning and while the cable is under the rated installation load. The axial fiber strain shall be less than or equal to 20 percent of the fiber proof level after completion of 10 minute conditioning and while the cable is under the residual load. The change in attenuation at residual load and after load removal shall not exceed 0.15 dB/km at 1550 nm and 0.30 dB/km at 1300 nm for multimode cable.
- h. When tested in accordance with TIA/EIA 455-85-A FOTP-85-A, a length of cable no greater than 2 meters shall withstand 10 cycles of mechanical twisting. The change in attenuation shall not exceed 0.15 dB/km at 1550 nm and 0.30 dB/km at 1300 nm for multimode cable.
- i. When tested in accordance with TIA/EIA 455-181, FOTP-181, the cable shall withstand a simulated lightning strike with a peak value of the current pulse equal to 105 kA without loss of fiber continuity. A damped oscillatory test current shall be used with a maximum time-to-peak value of 15  $\mu$ s (which corresponds to a minimum frequency of 16.7 kHz) and a maximum frequency of 30 kHz. The time to 1/2 value of the waveform envelope shall be from 40 to 70  $\mu$ s.
- j. When tested in accordance with TIA/EIA 455-37-A, FOTP-37, the cable shall withstand 4 full turns around a mandrel of less than or equal to 20 times the cable diameter after conditioning for 4 hours at test temperatures of negative 22 degrees F and 140 degrees. Neither the inner or outer surfaces of the jacket shall exhibit visible cracks, splits, tears, or other openings. The change in attenuation shall not exceed 0.15 dB/km at 1550 nm and 0.30 dB/km at 1300 nm for multimode cable.
2. Construction
- a. Optical fibers shall be placed inside a loose buffer tube. The nominal outer diameter of the buffer tube shall be either 2.5 mm or 3.0 mm. Each buffer tube shall contain up to 12 fibers. The fibers shall not adhere to the inside of the buffer tube. The buffer tubes shall be resistant to external forces and shall meet the buffer tube cold bend and shrink-back requirements of USDA RUS 7 CFR 1755.900.
- b. Each fiber shall be distinguishable by means of color-coding in accordance with TIA-598-C. The fibers shall be colored with ultraviolet (UV) curable inks.
- c. Buffer tubes containing fibers shall be color-coded with distinct and recognizable colors in accordance with TIA-598-C. Buffer tube colored stripes shall be inlaid in the tube by means of co-extrusion when required. The nominal stripe width shall be 1.0 mm. In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together.
- d. Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed. Fillers shall be placed so that they do not interrupt the consecutive positioning of the buffer tubes. In dual layer cables, any fillers shall be placed in the inner layer. Fillers shall be nominally 2.5 mm or 3.0 mm in outer diameter.
- e. The central member shall consist of a dielectric, glass reinforced plastic (GRP) rod. The purpose of the central member is to provide tensile strength and prevent buckling. The central member shall be over coated with a thermoplastic when required to achieve dimensional sizing to accommodate buffer tubes/fillers.

- f. Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel. The gel shall be free from dirt and foreign matter. The gel shall be readily removable with conventional nontoxic solvents. Buffer tubes shall be stranded around the dielectric central member using the reverse oscillation, or "S-Z", stranding process. Water swellable yarn(s) shall be applied longitudinally along the central member during stranding.
- g. Two polyester yarn binders shall be applied contra-helically with sufficient tension to secure each buffer tube layer to the dielectric central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking, and dielectric with low shrinkage.
- h. For single layer cables, a water swellable tape shall be applied longitudinally around the outside of the stranded tubes/fillers. The water swellable tape shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matter.
- i. For dual layer cables, a second (outer) layer of buffer tubes shall be stranded over the original core to form a 2 layer core. A water swellable tape shall be applied longitudinally over both the inner and outer layer. The water swellable tape shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matter.
- j. Cables shall contain 2 ripcords under the steel armor for easy armor removal. Additionally, armored cables that have an inner sheath shall also contain 1 ripcord under the inner sheath.
- k. Tensile strength shall be provided by the central member, and additional dielectric yarns as required. The dielectric yarns shall be helically stranded evenly around the cable core.
- l. Cables shall have an inner sheath of Medium Density Polyethylene (MDPE). The minimum nominal jacket thickness of the inner sheath shall be 1.0 mm. The inner jacket shall be applied directly over the tensile strength members (as required) and water swellable tape. A water swellable tape shall be applied longitudinally around the outside of the inner jacket. The armor shall be a corrugated steel tape, plastic-coated on both sides for corrosion resistance, and shall be applied around the outside of the water blocking tape with an overlapping seam with the corrugations in register. The outer jacket shall be applied over the corrugated steel tape armor. The outer jacket shall be a MDPE with a minimum nominal jacket thickness of 1.4 mm. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.
- m. The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C Category 4 and Grades J4, E7 and E8. The jacket or sheath shall be free of holes, splits, and blisters. The cable jacket shall contain no metal elements and shall be of a consistent thickness.
- n. The outer surface of the jacket of each shipping length of cable shall be permanently identified by printing (in a contrasting color) descriptive information on the outer surface of the jacket at intervals of 1500 mm (5 feet) or less. The information shall include identification (Authority Communications System), country of origin (made in), count of fibers, fiber type, date of manufacturing (month and year), manufacturer's part number, manufacturer's name, sequential meter or foot markings, a telecommunication handset symbol as required by NESC Section 350G, fiber count, and fiber type. The actual length of the cable shall be within plus or minus 0 to 1 percent of the length markings. The print color shall be white, with the exception that cable jackets containing 1 or more co-extruded white stripes, which shall be printed in light blue. The height of the marking shall be approximately 2.5 mm.
- o. If the initial marking fails to meet the specified requirements, i.e., improper text statement, color, legibility, or print interval, the cable may be remarked using a contrasting alternate color. The numbering sequence shall differ from the previous numbering sequence, and a tag shall be

- attached to both the outside end of the cable and to the reel to indicate the sequence of remarking. The preferred remarking color shall be yellow, with the secondary choice being blue.
- p. Size and construction shall recognize the nature of fiber optic cables regarding installation, especially at manholes. Allowance for such fiber characteristics shall be made in cable pull budgets.
- q. The fiber colors shall meet the centroid colors and tolerances as specified in TIA/EIA-598. Since TIA/EIA-598 is specified for opaque colors, local injection/detection (LID) compatible inks, which are translucent, shall make the best fit with the centroid colors. Fiber coloring shall be compatible with LID systems.
3. Singlemode Optical Fiber Characteristics. Singlemode (Dispersion Un-shifted) with Low Water Peak fiber utilized in the optical fiber cable shall meet TIA-492-CAAB, and ITU recommendation G.652.C. These fibers shall have the same specified performance and geometry values as noted below.
- a. All fibers shall be usable fibers and shall meet the following requirements:
- 1) Fiber and cable protective coverings shall be continuous with no factory splices.
  - 2) All optical fibers shall be sufficiently free of surface imperfections and inclusions to meet optical, mechanical and environmental requirements of this Specification.
  - 3) The attenuation specification shall be a maximum value for each cabled fiber at 23 within plus or minus 73.4 degrees F on the original shipping reel.
- b. Glass Composition: SiO<sub>2</sub>, which may include small amounts of germanium (Ge), fluorine (F), or phosphorous (P) to control the index of refraction or to assist in fiber manufacture.
- c. Operational Wavelength: 1310 nm, 1550 nm, and 1625 nm.
- d. Cutoff Wavelength: Less than 1260 nm.
- e. Maximum Optical Attenuation:
- 1) At 1310 nm: Less than or equal to 0.35 dB/km at 73 degrees F
  - 2) At 1383 within plus or minus 3 nm: Less than or equal to 0.35 dB/km at 73 degrees F
  - 3) At 1550 nm: Less than or equal to 0.2 dB/km at 73 degrees F
  - 4) At 1625 nm: Less than or equal to 0.23 dB/km at 73 degrees F
- f. Attenuation vs. Wavelength
- 1)  $\lambda_{ref} = 1310$ ;  $1285 \leq \lambda \leq 1330$ ;  $\Delta = 0.03$  dB/km
  - 2)  $\lambda_{ref} = 1550$ ;  $1525 \leq \lambda \leq 1575$ ;  $\Delta = 0.02$  dB/km
- g. Water Peak Attenuation: At 1383 within plus or minus 3 nm; less than or equal to 2.1 dB/km.
- h. Fiber Macro-bend
- 1) 1 Turn at 32 within plus or minus 2mm; less than or equal to 0.10 dB at 1550 nm
  - 2) 100 Turns at 50 within plus or minus 2mm; less than or equal to 0.05 dB at 1310 nm
  - 3) 100 Turns at 50 within plus or minus 2mm; less than or equal to 0.05 dB at 1550 nm
  - 4) 100 Turns at 60 within plus or minus 2mm; less than or equal to 0.10 dB at 1625 nm
  - 5) 100 Turns at 50 within plus or minus 2mm; less than or equal to 0.05 dB at 1625 nm
- i. Point Discontinuity: No point discontinuities greater than 0.05 dB at either 1310 nm or 1550 nm.



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| <p>j. Total Optical Dispersion</p> <p>1) At 1285-1330 nm: Less than or equal to 3.5 ps/(nm·km)</p> <p>2) At 1550 nm: Less than or equal to 18 ps/(nm·km)</p> <p>3) At 1625 nm: Less than or equal to 22 ps/(nm·km)</p> <p>k. Zero Dispersion Slope: Less than or equal to 0.089 ps/(km·nm<sup>2</sup>).</p> <p>l. Zero Dispersion Wavelength: 1302 nm ≤ λ<sub>0</sub> ≤ 1322 nm.</p> <p>m. Maximum Polarized Mode Dispersion: less than or equal to 0.5 ps/(km)<sup>1/2</sup>.</p> <p>n. IEEE 802.3 GbE - 1300 nm Laser Distance: Up to 5000 m.</p> <p>o. Fiber Core Diameter: 8.3 μm nominal.</p> <p>p. Fiber Coating Diameter: 245 μm within plus or minus 5 μm.</p> <p>q. Coating-Cladding Concentricity: Less than 12μm.</p> <p>r. Colored Fiber Nominal Diameter: 253-259 μm.</p> <p>s. Coating Strip Force</p> <p>1) Dry: 0.6 lbs</p> <p>2) Wet: 0.6 lbs</p> <p>t. Fiber Curl Radius of Curvature: Greater than 4.0 m.</p> <p>u. Fiber Cladding Diameter: 125.0 μm within plus or minus 0.7 μm.</p> <p>v. Cladding Non-circularity: Less than or equal to 0.7 percent.</p> <p>w. Core/Cladding Concentricity: Less than or equal to 0.5 μm.</p> <p>x. Mode Field Diameter</p> <p>1) 1310 nm: 9.2 within plus or minus 0.4 μm</p> <p>2) 1550 nm: 10.4 within plus or minus 0.5 μm</p> | <p>y. Effective Group Index of Refraction</p> <p>1) 1310 nm: -77 dB</p> <p>2) 1550 nm: -82 dB</p> <p>z. Refractive Index Difference: 0.3 within plus or minus 0.0011 percent.</p> <p>4. Multimode Optical Fiber Characteristics. Multimode fibers shall meet TIA/EIA-492-A AAAA-A "Detail Specification for 62.5-μm Core Diameter/125-μm Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers." These fibers shall have the same specified performance and geometry values as noted below:</p> <p>a. All fibers in the cable shall be usable and meet required specifications.</p> <p>b. Each optical fiber shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this Specification.</p> <p>c. Each optical fiber shall consist of a germanium-doped silica core surrounded by a concentric glass cladding. The fiber shall be a matched clad design.</p> <p>d. The attenuation specification shall be a maximum value for each cabled fiber at 23 within plus or minus 41 degrees F on the original shipping reel.</p> <p>e. Geometry</p> <p>1) Core Diameter 62.5 within plus or minus 3.0 μm</p> <p>2) Core Non-Circularity less than or equal to 5 percent</p> <p>3) Cladding Diameter 125.0 within plus or minus 2.0 μm</p> <p>4) Cladding Non-Circularity less than or equal to 2.0 percent</p> <p>5) Core-to-Cladding Concentricity less than or equal to 3.0 μm</p> <p>6) Coating Diameter 245 within plus or minus 5 μm</p> <p>7) Colored Fiber Nominal Diameter 253 to 259 μm</p> |
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f. Optical

- 1) Cabled Fiber Attenuation
  - a) 850 nm less than or equal to 3.5 dB/km
  - b) 1300 nm less than or equal to 1.0 dB/km
- 2) Point discontinuity
  - a) 850 nm less than or equal to 0.2 dB
  - b) 1300 nm less than or equal to 0.2 dB
- 3) Macro-bend Attenuation
  - a) Turns - 100; Mandrel OD -75 within plus or minus 2 mm, less than 0.5 dB at 850 nm
  - b) Turns - 100; Mandrel OD - 75 within plus or minus 2 mm less than 0.5 dB at 1300 nm
- 4) Cabled Effective Modal Bandwidth
  - a) 850 nm, greater than 385 MHz•km
- 5) IEEE 802.3 GbE Distance
  - a) 1000BASE-SX Window (850 nm), up to 500 m
  - b) 1000BASE-LX Window (1300 nm), up to 1000 m
- 6) OFL Bandwidth
  - a) 850 nm, greater than 200 MHz•km
  - b) 1300 nm, greater than 500 MHz•km
- 7) Numerical Aperture 0.275 within plus or minus 0.015

5. Mechanical Specifications:

- a. Each optical fiber shall be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m<sup>2</sup>).
- b. The fiber shall be coated with a dual layer acrylate protective coating. The coating shall be in physical contact with the cladding surface.
- c. Crush Resistance: 10 kN/m (685 lb/ft) length of cable.
- d. Cable Outside Diameter: Less than 0.65 inch.
- e. Weight per 1000 linear foot:
  - 1) Less than 160 lbs.
- f. Minimum Bending Radius
  - 1) Installation, 15X Diameter
  - 2) Static, 12X Diameter
- g. Temperature: Operational
  - 1) Negative 22 degrees F to 140 degrees F
  - 2) Continuous operation at negative 22 degrees F without cracking or becoming brittle
- h. Storage: Negative 40 degrees F to 158 degrees F on reel.
- i. Humidity: 0 to 100 percent, inclusive
- j. Tensile Strength
  - 1) Installation: 2,700 N (600 lbf)
  - 2) Static: 890 N (200 lbf)

**2.2 FIBER CONNECTORS**

- A. FDP connectors shall be SC type, unless otherwise directed.
- B. Connectors for media converter equipment shall be SC type. Jumper cables shall be provided that match the connectors at each end of the cable.
- C. Optical parameters of the connectors shall meet the requirements of TIA/EIA-568.
- D. Singlemode connectors shall be Ultra Physical Contact (UPC) factory polished. Typical optical return loss for UPC polish is 50 dB.

- E. Multimode connectors shall be Physical Contact (PC) factory polished. Typical optical return loss for PC polish is 30 dB.

- b. Protocol Compatibility: IEEE 802u 100 Base-TX and 100 Base-FX Standards

**2.3 MEDIA CONVERTER**

- A. LAN media converters shall convert the 10/100 BASE-T/TX ports of the ADM Ethernet module at stations to 10 BASE-FL and 100 BASE-FX to the attached devices for media transmission. Contractor shall install and test these media converters.

- c. Operating Distance: 100 m for 100 Base-TX, 2 km for 100 Base-FX MM, 15 km for 100 Base-FX SM

- B. Media converters shall be installed in a rack mounted card cage in CICs, and Communications Facility equipment cabinets. At Signals Houses and Traction Power Substations (TPSS), media converters shall be mounted separately on shelves as shown on Contract Documents. The converters shall comply with the following requirements:

- d. Data Flow: Half or Full Duplex Support

- e. LEDs: Power, Link, Transmit, Receive

- f. Fiber Requirements: Multimode, and singlemode fiber cabling with SC connectors

- 1. 10/100 BASE-T/TX to 10 BASE- FL Converter

- 3. Contractor shall submit link budget calculations showing all intended links to be used by the submitted media conversion device. In addition to all fiber, splice, component aging, and connector losses, the calculation shall yield a minimum of 6 db of margin over the specified worst-case budget of the conversion device.

- a. Interfaces: RJ-45 to SC singlemode optical

**2.4 FIBER SLACK ENCLOSURES**

- b. Minimum power link budget 16 dB over singlemode cable at 1310 nm operating optical wavelength

- A. Enclosure

- c. Protocol Compatibility: 10 Base-T, 100 Base-TX, and 10 Base-FL standards

- 1. Enclosures shall be NEMA-12 type with hinged cover and securing mechanism.

- d. 802.3u compliant auto-negotiation

- 2. Enclosures shall be sized for 300 feet of cable slack.

- e. Operating Distance: 100 m for 10/100 Base-T/TX, 15 km for 10 Base-FL

- B. Hardware

- 1. Hooks shall be provided to hold cable slack, with coils of required bend radius.

- f. Data Flow: Half or Full Duplex Support

- 2. Velcro ties to restrain cable shall be utilized.

- g. LEDs: Power, Link, Transmit, Receive

**2.5 FIBER DISTRIBUTION PANELS**

- h. Store and forward switching mode. Data packet forwarding and filtering at a minimum of 148,000 pps at 100 Mbps or 14,880 at 10 Mbps

- A. Enclosure

- 1. The enclosure shall house the splice shelf and connector sleeve panels for all optical connections. As a minimum, the enclosure shall be capable of providing connections for all singlemode and multimode fibers and in accordance with the Contract Documents.

- i. Automatic address learning and aging

- 2. All OSP cable jackets and central strength members shall be secured to relieve strain.

- j. Input power requirement as shown on Contract Documents.

- B. Distribution Panels

- 1. Distribution panels shall be a complete system of components by a single manufacturer.

- 2. 10/100 BASE-T/TX to 100 BASE- FX Converter

- a. Interfaces: 100 Base-TX (RJ-45), 100 Base-FX (SC)

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2. Rack mountable connector housings shall be available for cross-connecting or inter-connecting purposes. The units shall provide for direct connectorization and pigtail splicing.
  - b. Splice capacity shall be 12 splice trays.
3. Housings shall be mountable in an EIA-310 compatible 18.3 inch rack.
4. The unit shall meet the design requirements of TIA-568.
5. Molded plastic parts shall meet the flammability requirements of UL 94 V-0.
6. The connector housings shall have a labeling scheme that complies with TIA/EIA-606. The housing shall incorporate labeling via an adhesive backed label and a retractable sliding label panel that pulls out from the bottom front of the housing.
7. Housings shall be manufactured using 16-gauge aluminum and shall be finished with a two-tone gunmetal grey and/or anodized silver for durability. Installation fasteners shall be included and shall be black in color.
8. The unit shall be capable of connectorization and jumper management. The unit shall be capable of splicing or combination connectorization/splicing with the use of an additional splice tray kit.
9. Fiber Cable Routing: The unit shall have a fiber routing guide platform located in the rear of the housing. The fiber routing guide platform shall be removable using 2 plunger style latches so that room can be made for an optional splice tray kit.
10. Jumper Routing
  - a. The unit shall have a hinged top jumper management panel capable of locking in the horizontal or vertical position. When the top panel is locked in the horizontal position, it shall act as a jumper routing area in the top front of the housing and shall enclose the top of the housing.
  - b. When the hinged panel of the unit is locked in the vertical position it shall serve as a horizontal jumper management panel capable of routing jumpers out of the top of the housing. Total height of the housing shall be 5U or less.
11. Fan-Out Devices
  - a. Provisions for mounting fan-out devices shall be incorporated into the housing if direct terminations are required.
12. Units shall include a clamshell-type cable clamping mechanism to provide cable strain relief. The cable clamp shall accept 1 cable from 0.37 inches to 1.12 inches in diameter. The cable clamp mechanism shall also handle multiple smaller fiber count cables when used with a multiple cable insert. The total cable capacity per clamp shall be 5 cables (0.4 inches) OD when used with the multiple cable insert. Housing cable clamp capacity shall be 2 clamps. Additional cable clamps shall be available as an accessory kit.
13. The housing shall have 4 grommet openings for cable entry in the rear of the housing. The unit shall have 2 removable panels on both the left and right rear of the housing if more than 4 cable entries are required.
14. Front and rear doors of the connector housings shall be hinged and removable for ease of cable installation.
15. Access Doors
  - a. The front doors shall be made from tinted polycarbonate.
  - b. Front and rear doors shall utilize a single slide latch to provide ready access and closing. An opening shall be provided in the front and rear doors so that an optional key lock kit may be used. The opening shall be filled with a removable plastic insert so that dust may not enter if the optional lock kit is not used. There shall be a removable retaining bracket to prevent the door from being unintentionally slid off the hinges.
16. The housing shall accommodate the future installation of SC, ST, FC, D4, or MTRJ, type connector modules. Each module shall provide twelve connector sleeves.
17. Where armored cable is utilized, the armor shall be grounded to the main chassis ground bus at 1 termination location. Contractor shall not ground the armor at both ends of the cable, regardless of the length.
- C. Splice Shelf
  1. The splice shelf shall accept slide in/out splice trays for a maximum number of

- connectors and for the fiber types to be installed.
  - 2. Each splice tray shall restrain and protect fusion splices. Mechanical splices shall not be utilized.
- D. Connector Sleeves
- 1. Connector sleeves shall be the SC type. The connector sleeve shall meet TIA-568-B.1-3 requirements when connecting mated pairs.
  - 2. The FDP shall be fully populated with connector panels, each consisting of 12 connector sleeves.
  - 3. Dust Caps shall be provided for all sleeves.
  - 4. Loss across connection shall not exceed the following, with optical attenuators removed:
    - a. Singlemode: 0.5 dB
    - b. Multimode: 0.5 dB
  - 5. The FDP sleeves shall be capable of accepting optical attenuators as required for maintaining the Optical Loss budget.
- E. Slack Retention
- 1. Slack in pigtails and patch cords shall be neatly coiled and retained such that the minimum-bending radius shall not be exceeded.
  - 2. Slack shall be sufficient for accessing splice shelves and connectors.

**2.6 OPTICAL FIBER PATCH CORDS AND PIGTAILS**

- A. Patch cords and pigtails shall be cable assemblies consisting of flexible optical fiber cable with SC compatible connectors. Patch cords shall be complete factory fabricated assemblies from manufacturer's standard product lines. Fiber optic jumper cables shall meet the following requirements:
  - 1. Patch Cord Assemblies
    - a. The cable construction shall allow a small bend radius for installation in space-constrained areas. The cable shall contain a dielectric strength member and a protective outer jacket.
    - b. The Patch Cord shall comply with the requirements of TIA-568-B.1-3.

- 2. Connectors
  - a. Two duplex connectors shall be provided on patch cords.
  - b. One duplex connector shall be provided on pigtails, with the other end prepared for splicing.
- 3. Fiber Cable
  - a. Patch cords and pigtails shall utilize a 2-fiber zip-cord type jacketed cable, in lengths required to meet minimum bend radius while connected and routed through cable management hardware but no less than 6 feet in length. The cable jacket color shall be orange for multimode and yellow for singlemode cable. The fiber core size shall also be identified on the outer jacket.
  - b. The optical fiber shall meet the same characteristic requirements of the distribution panel terminated cable to which it mates.
  - c. Tensile strength of the jacketed cable shall be greater than or equal to 20 lbs.

**2.7 INNERDUCT**

- A. Constructed of flame retardant PVC, FCP, or HDPE material and shall meet the following flammability requirements:
  - 1. Outside Plant (OSP) innerduct, (General-purpose optical fiber cable raceway) shall meet the UL 2024 (raceways) Vertical Flame Test (General Use) for being resistant to the spread of fire.
  - 2. Inside Plant (ISP) innerduct, inside building horizontal, and inside building riser innerduct shall meet the UL 2024 (raceways) Test for Flame Propagation (Riser) for having fire-resistant characteristics capable of preventing the spread of fire from floor to floor.
  - 3. ISP Innerduct installed in any air plenum environment shall meet the UL 2024 (raceways) Test for Flame Propagation and Smoke-Density Values for having adequate fire-resistant and low smoke-producing characteristics.
- B. Inside building horizontal and riser innerducts shall be flexible and corrugated type.
- C. Compatible with the fiber optic cable installed within.

- D. Inner diameter shall be 1-1/4 inch minimum.
- E. Couplers, if used, shall not reduce the inside diameter of the innerduct.
- F. All unused innerduct shall be pre-installed with lubricated pull tape or line.

utilities, it becomes required to pull fiber optic cable in existing conduit system, that already have cables in them, 21 days prior to installation, contractor shall submit a request for approval. Provide working drawings and shop drawings showing plan and scheduling for performance of the Work.

**2.8 WIRE PULLING LUBRICANT**

- A. Wire Pulling Lubricant shall have the following characteristics:
  - 1. Polymer-based
  - 2. Average Coefficient of Friction: Less than or equal to 0.055
  - 3. Temperature Range: Negative 28 degrees F to 180 degrees F
  - 4. Compatible with all cable types

- 6. If a winch or pulling machine is used during installation, a dynamometer shall be used to monitor the tension on the cable. The dynamometer shall be certified as calibrated and shall hold the peak value of the cable pull. The peak value shall be recorded and forwarded to the Authority as part of the installation test data submittals.
- 7. Contractor shall exercise caution during construction to protect existing cable, express trough/manholes and any other utilities and elements that are located in areas of work. If necessary, the Contractor is responsible for relocation of existing utilities as per project requirements and/or replacement of damaged utilities/elements as caused by performance of this work.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. All optical cable installation shall be accomplished in accordance with the approved plan:
  - 1. OSP fiber optic cable shall be installed in innerduct. No more than 1 OSP fiber optic cable shall be installed in a single innerduct without Authority approval. The innerduct shall be installed without coils or twists.
  - 2. Pull locations shall be selected to protect the cable on the reel and in slack loops. Contractor shall be responsible for protecting cable after working hours where cable installation is not completed during a single shift. Cables damaged due to Contractor's negligence while installing cable shall be replaced by the Contractor at no additional cost to the Authority.
  - 3. Pull lengths shall be designed to allow a 20 percent margin in cable tensile strength. The Contractor shall not exceed the lesser of 80 percent of the cable's maximum tensile rating or 600 lbs during installation. No residual tension shall remain on the cable after installation except that due to the cable's weight in the vertical rise. Wire pulling lubricant shall be used to reduce tension on the cable during the installation process.
  - 4. Fiber optic cables shall not be pulled into a conduit that already contains conductors, unless otherwise allowed by the Authority or shown on the Contract Drawings.
  - 5. In case, due to the actual site condition and/or conflicts with existing or proposed

- 8. The maximum vertical rise shall be defined as the distance over which the cable is self-supporting. Cable strain relief shall be used at the top of each vertical rise and no less than every time that 80 percent of vertical rise rating of the cable is exceeded.
- 9. Contractor shall not exceed the cable's minimum bend radius for cable under tension or long-term installation/storage.
- 10. Continuity of cable shall be maintained between termination or splice locations shown on the Contract Drawings. Additional splices shall not be allowed without the prior written Authority approval.
- 11. Contractor shall notify the Authority in writing at least 48 hours in advance of installation of each section of optical cable.
- 12. All cable entrance openings in equipment enclosures, houses, rooms and junction boxes shall be sealed with either a compression type fitting or pliable sealing compound after the cable is in place. Sealing compounds for rooms, houses, walls, or other partitions shall be fire retardant per ASTM E814. Sealing compound shall be used to seal the area around cable where the cable emerges from the end of a conduit, pipe, or duct bank. All spare conduits shall be sealed or plugged in an approved manner.
- 13. Protect and maintain existing utility service in accordance with Section 02760,

“Maintenance, Support, and Restoration of Existing Utility Facilities”.

B. Termination

1. Slack in FSE's shall be carefully coiled in order to avoid violating the short and long-term minimum bend radius. Contractor shall supply a minimum slack of 150 feet of fiber optic cable at each end of the cable span inside the FSE.
2. Only hook and loop fasteners shall be used for strain relief and support of patch cords. Zip ties shall be used to mount pig tails in the splice tray.
3. The outer jacket of the cable shall be attached to the FDP with a manufacturer's clam shell cable clamp.
4. All fiber optic splices shall be fusion splices. Fusion splices shall be performed by qualified personnel only.
5. Mechanical optical splices are not permitted. This includes all mechanical fiber assemblies, crimp-on connectors, and connectors that do not require epoxy or field polishing.
6. At all wayside and communications facilities, all fibers shall be terminated. Terminations shall utilize fiber optic pigtails with factory installed connectors and shall be fusion spliced to the main fiber optic cable.
7. Contractor shall notify the Authority in writing at least 1 week in advance of terminating each section of optical cable.
8. Where armored cable is utilized, the armor shall be grounded to the ground bus at 1 termination location at 1 end of each cable span only.
9. All routing of fibers within fiber distribution panels (FDPs) and enclosures shall be neatly organized and retained such that the minimum bending radius shall not be exceeded. A slack or service loop shall be made inside the panel to be sufficient to re-prepare and re-splice the fibers if they are ever severed at the entry to the splice tray without removing the cable clamp to the FDP and un-jacketing additional cable.
10. Fusion splicing equipment shall be equipped with local injection and detection (LID) or core alignment system to optimize splices and to minimize return trips to repair unacceptable splices. The fusion machine estimated loss across each spliced fiber shall be less than or equal to 0.04 dB.

11. A heat shrinkable splice protection sleeve with a bracing strength member shall protect each fusion splice. Each splice tray shall restrain and protect fusion splices.
12. All splices shall be sequentially organized in a fiber splice tray. All fiber shall be clean and neatly wrapped in the tray and shall not be tangled, knotted, or curved in a non-flowing manner.
13. Contractor shall label all pigtail splices stored in the FDP splice tray as well as the FDP front panels. Labels shall indicate the cable terminated fiber numbers, and unique equipment assignments.

**3.2 CABLE PLANT TESTING**

A. Factory Cable Tests

1. Cable shall be tested on-reel prior to shipment.
2. End to end loss shall be recorded for each fiber at 1310 nm, 1550 nm and 1625 nm.
3. End to end loss shall be recorded for each multi-mode fiber at 850 nm and 1300 nm.
4. OTDR with hardcopy record shall be provided for each singlemode fiber, at 1310 nm, 1550 nm and 1625 nm.
5. OTDR with hardcopy record shall be provided for each multimode fiber, at 850 nm and 1300 nm.
6. Polarized Modal Dispersion (PMD) for each singlemode fiber shall be measured using a PMD analyzer and polarized light source.
7. Chromatic optical dispersion shall be tested for each singlemode fiber.
8. Certified copies of tests results shall be submitted to the Authority as described in these Specifications 14 days after completion of each test.
9. Original manufacturer's factory test results, certifications, and statements confirming compliance with all of the requirements of Article 2.1 of these Specifications may be submitted for Authority approval in lieu of performing these factory tests.

B. Cable Plant Field Tests

1. Tests shall be performed after installation is complete.
2. Notice shall be provided to the Authority 7 days in advance prior to the start of testing.

3. Optical attenuation from FDP to FDP shall be measured and recorded in compliance with TIA 526-7 for singlemode fibers and TIA-526-14-A for multimode fibers.
  4. Every fiber optic cabling link installed by the Contractor shall be tested in accordance with the field test specifications defined by the TIA standard TIA-568-B.1-3 (or by the required network application standards) whichever is more stringent. See Paragraph 3.2.D of this Specification.
  5. TIA-568-B.1-3, shall be used to define the passive cabling network, to include cable, connectors, and splices (if present), between 2 optical fiber patch panels (connecting hardware). This TIA document shall be used to describe all applicable link segments. Tests shall include the representative connector performance at the connecting hardware associated with the mating of patch cords but not the performance of the connector at the interface with the test equipment.
  6. All of the cabling links installed shall be tested and shall pass the requirements of the standards mentioned in Paragraphs 3.2.A and 3.2.B above and as further detailed in Paragraphs 3.2.C and 3.2.D. Any failing link shall be diagnosed and corrected prior to the system acceptance. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with Paragraph 3.2.D below.
  7. Every fiber optic cabling link installed by the Contractor shall be tested in accordance with the field test specifications defined by TIA standard TIA-455-133-A and TIA 455-78-B (or by the required network application standards), whichever is more stringent. See Paragraph 3.2.C of this Specification.
  8. Optical Time Domain Reflectometer (OTDR) equipment used shall be Telcordia GR-196-CORE and SR-4731 compliant.
  9. Trained technicians who have successfully attended a required training program and have obtained a certificate, as proof thereof shall be used to execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
    - a. The manufacturer of the fiber optic cable and/or the fiber optic connectors.
    - b. The manufacturer of the test equipment used for the field certification.
    - c. Training organizations authorized by BiCSi (Building Industry Consulting Services International with headquarters in Tampa, Florida) or by the ACP (Association of Cabling Professionals™) Cabling Business Institute located in Dallas, Texas.
    - d. Technician resume with appropriate experience and references may be submitted in lieu of training programs for Authority review and approval.
  10. Field attenuation test instruments for multimode fiber cabling shall meet the requirements of TIA-526-14A. Field attenuation test instruments for singlemode fiber cabling shall meet the requirements of TIA-526-7.
  11. The test instrument calibration date shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
  12. The fiber optic launch cables and adapters shall be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the test instrument interface adapters.
  13. An Authority representative shall be invited to perform field-testing. The representative shall be notified of the start date of the testing phase 5 business days before testing.
  14. The Authority representative shall select up to 5 percent of the links installed. The representative (or authorized delegate) shall test these selected links and the results are to be stored in accordance with the prescriptions in Paragraph 3.2.D. The results obtained shall be compared to the data provided by the Contractor. If the sample results differ in terms of the pass/fail determination, the Contractor under observation of the Authority representative shall repeat testing of the affected link.
- C. Cable Plant Performance Test Parameters
1. In compliance with TIA-568-B, the single performance parameter for field-testing of fiber optic links shall be link attenuation (insertion loss).
  2. The maximum acceptable link attenuation for each span of cable shall be calculated



- by the following formulas specified in TIA-568-B:
- a.  $\text{Link Attenuation} = \text{Cable Attenuation} + \text{Connector Attenuation} + \text{Splice Attenuation}$
  - b.  $\text{Cable Attenuation (dB)} = \text{Attenuation Coefficient (dB/km)} \times \text{Length (km)}$
  - c.  $\text{Connector Attenuation (dB)} = \text{number of connector pairs} \times \text{connector loss (dB)}$
  - d.  $\text{Splice Attenuation (dB)} = \text{number of splices (S)} \times \text{splice loss (dB)}$
3. The values for the Attenuation Coefficient are listed below:
    - a. Singlemode (outside plant), 1310nm: 0.5 dB/km
    - b. Singlemode (outside plant), 1550nm: 0.5 dB/km
    - c. Multimode, 850 nm: 3.5 dB/km
    - d. Multimode, 1300 nm: 1.5 dB/km
  4. The following values listed below are to be used in the Link Attenuation formula:
    - a. Attenuation Coefficient (dB/km) Singlemode, 1310 nm = 0.4 dB/km
    - b. Attenuation Coefficient (dB/km) Singlemode, 1550 nm = 0.3 dB/km
    - c. Attenuation Coefficient (dB/km) Multimode, 850 nm = 3.5 dB/km
    - d. Attenuation Coefficient (dB/km) Multimode, 1300 nm = 1.5 dB/km
    - e. Splice loss (dB) Singlemode = 0.1 dB
    - f. Splice loss (dB) Multimode = 0.05 dB
    - g. Connector loss (dB) Singlemode = 0.5 dB
    - h. Connector loss (dB) Multimode = 0.5 dB
    - i. "Number of splices (S)" and Number of connector pairs are based on physical characteristics of the span of fiber being tested
  5. Link attenuation shall not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation shall not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
  6. The value calculated by the above maximum acceptable Link Attenuation formula for each fiber span is to be used as one of the determining factors regarding the pass/fail acceptance of each fiber based on the measured attenuation for each fiber using the One Reference Jumper Method specified by TIA-526-7, Method A.1, TIA-526-14-A, Method A, or the equivalent method. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.
  7. All multimode fiber cables shall be attenuation (power meter) tested in one direction at both 850 nm and 1300 nm wavelengths to account for attenuation deltas associated with wavelength in accordance with TIA-526-14-A.
  8. All singlemode fiber cables shall be attenuation (power meter) tested in one direction at both 1310 nm and 1550 nm operating wavelengths in accordance with TIA-526-7, Method A.1. One Reference Jumper or the equivalent method.
  9. OTDR Testing
    - a. All singlemode fiber cables shall be bi-directionally OTDR tested at 1310 nm and 1550 nm operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss. All multimode fiber cables shall be bi-directionally OTDR tested at 850 nm and 1300 nm operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.
    - b. OTDR tests shall be performed utilizing a launch cable such that the FDP termination or first test link shall be clearly shown.
    - c. Optical Return Loss (ORL) for each link shall be measured.
    - d. Fiber Length shall be measured.
    - e. OTDR range, resolution, pulsewidth, and index of refraction
  - j. "Length (km)" is based on the OTDR measurement of the fiber

settings should be appropriate for the fibers being tested. Contractor must scrutinize and correct the traces (in the field) for testing-related issues, including but not limited to; ghost reflectance, noisy traces, excessive dead-zones, low launch levels, bad launches, and bad connections.

f. Test Results

- 1) Reflective events shall not exceed negative 40 dB.
- 2) Attenuation of mated connections (connector pairs) shall not exceed 0.5 dB for multimode fiber, and 0.5 dB for singlemode fiber.
- 3) Non-reflective events (splices) shall not exceed 0.05 dB for multimode fiber and 0.1 for singlemode fiber.
- 4) Point discontinuities shall not exceed 0.1 dB in continuous fiber.
- 5) ORL shall be less than negative 30 dB.

g. OTDR Test results shall include OTDR link and channel plots, OTDR settings, user heading information, and complete event tables at the required wavelength(s) for each optical fiber as by the OTDR. The event table shall indicate distances and measurements of all connections and splices performed.

D. Cable Plant Test Result Documentation

1. The test result information for each fiber and link shall be recorded in the memory of the field tester upon completion of the test.
2. The test result records saved by the test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee shall be made that these results are transferred to the PC unaltered, i.e., "as saved in the tester" at the end of each test. The popular 'csv' format (comma separated value format) does not provide adequate protection and shall not be acceptable.
3. The database records of all fiber shall be stored and delivered on CD-ROM or DVD. This CD-ROM or DVD shall include the

software tools required to view, inspect, and print any selection of test reports.

4. General Information to be provided in the electronic database containing the test result information for each link:

- a. The identification of the testing site, including address, building, rack, panel, and fiber information.
- b. The overall pass/fail evaluation of the link-under-test.
- c. The name of the standard selected to execute the stored test results.
- d. The cable type and the specified value of the index of refraction (IOR) used for the fiber.
- e. The date and time the test results were saved in the memory of the tester.
- f. The initials or name of the technician who performed the testing.
- g. The brand name, model and serial number and calibration data of the tester.
- h. The revision of the tester software and the revision of the test standards database in the tester.

5. The detailed test results data to be provided in the electronic database for each tested optical fiber shall contain the following information:

- a. The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.
- b. The attenuation measured for each fiber at each wavelength (using TIA-526-14-A or TIA-526-7), the reference value used, and the attenuation test limit calculated for the corresponding wavelength.
- c. The OTDR trace plots and associated settings and headers shall be reported for each optical fiber for which the test limit was calculated based on the formulas in Paragraph 3.2.C.

6. A paper copy of the OTDR and attenuation test results shall be provided that lists all the links and fibers that have been fully

tested with the following supporting information.

performed in the inner or outer end of the reel.

- a. The identification of the link in accordance with the naming convention defined in the overall system documentation.
- b. The identification of the testing site, including address, building, rack, panel, and fiber information.
- c. The initials or name of the technician who performed the testing.
- d. The date and time the test results were saved in the memory of the tester.
- e. OTDR trace plots (dB vs. km) indicating all events with their associated range, resolution, pulsewidth, index of refraction, number of averages, and wavelength settings.
- f. OTDR numerical event table per trace plot showing loss and reflectance measurements for all events. The overall pass/fail of the OTDR event measurements shall be based on the measured values versus the criteria in Paragraph 3.2.C.9.f.
- g. The attenuation measured for each fiber at each wavelength (using method TIA-526-14-A or TIA 526-7), the reference value used, and the attenuation test limit calculated for the corresponding wavelength.
- h. The overall pass/fail evaluation of the measured attenuation results shall be based on the maximum acceptable link attenuation value as defined in Paragraphs 3.2.C.3 and 3.2.C.4.

- b. Attenuation in dB/km as measured by placement of the A and B cursors inside the launch end reflection spike respectively on the traces.

**3.3 MEDIA CONVERSION LINK TESTS**

- A. Contractor shall measure and record output power at the optical port of each media converter's transmitter output and at the fiber cable connector serving each media converter's receiver input.
  - 1. Received power through the fiber link cable shall be no less than 6 dB above the converter's worst-case minimum sensitivity specification.
  - 2. Transmitted power shall be no less than the manufacturer's worst case transmitted output power specification.
- B. Contractor shall perform and report on Ethernet link testing between media conversion devices from twisted pair interface to twisted pair interface. The field tests shall include all applicable test requirements of RFC 2544, as a minimum shall include the following tests to verify compliance with the manufacturer's specifications:
  - 1. Throughput testing to find the highest rate at which the media converter can forward frames.
  - 2. Frame Loss tests to show how the media converter responds to streams with different gaps separating the frames.
  - 3. Back-to-back tests to show how the media converter responds to different quantities of frames, with the frames separated at the minimum gap allowed by IEEE 802.3 protocol specifications.
  - 4. Latency testing to show how much processing overhead the media converter requires for forwarding frames.

**E. Authority Provided Cable Tests**

- 1. Optical Time Domain Reflectometer (OTDR) testing for each strand of fiber in the cable.
  - a. Unidirectional bare fiber OTDR test at 1550 nm only unless an anomaly is detected. If an anomaly is detected on a fiber during the unidirectional reel test, testing shall be performed in both directions and at both 1310 nm and 1550 nm wavelengths. Indicate in the trace information section if testing is

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. The Work specified in this Section will not be measured separately for payment.

**4.2 PAYMENT**

- A. All costs connected herewith shall be considered incidental to the Work specified under Section 16801 "Basic Technical Requirements - Communications System".

END OF SECTION 16845

**SECTION 16850**  
**BASIC ELECTRICAL MATERIALS AND METHODS - COMMUNICATIONS SYSTEM**

**PART 1 - GENERAL**

which satisfies the operational and performance requirements in the Contract Documents and these Specifications.

**1.1 DESCRIPTION**

- A. Contractor shall be responsible for completing an expansion of the existing communications system that performs as intended, is easy to operate and maintain, and includes inherent protection against certain deleterious ambient conditions that are anticipated in a railroad environment. Contractor shall bear total responsibility for system elements that are designed, provided, installed, tested, and commissioned under this Contract.
- B. Contractor shall deliver complete operable systems that comply with performance and availability requirements in these Specifications notwithstanding any errors or omissions in these Specifications or Drawings, which might otherwise render such delivery uncertain or impossible.
- C. In providing equipment and systems, the Contractor shall accept responsibility for development, design, fabrication, equipment selection and configuration, material, parts and details, wiring and cabling, software, documentation, testing, and all other related hardware and services.
- D. Contractor shall bear total responsibility for the correction of any damage, malfunction, or degradation in equipment performance if the difficulty is caused by Contractor's system design, interfacing equipment, software, connection details, site work, or such other factors under Contractor's control.
- E. Specification requirements and Contract Drawings are intended as the baseline (elementary) requirements for the Work under this Contract.
  - 1. Specification requirements and Contract Drawings are not to be construed as a complete outline of or a limitation on the Work. The Specifications and Drawings include specific mention of all materials, equipment, installation details and other things required to be included in the design or to be provided or accomplished by the Contractor.
  - 2. Where plans and these Specifications describe portions of the Work in general terms and where details are incomplete or silent, it is understood that only the best general practice is to prevail and that only new materials and first-quality workmanship are to be used.
  - 3. Omissions of Work details that are customarily performed or are standard practices shall not relieve the Contractor from the obligation to perform such Work and to provide a fully functioning system

- F. Systems and equipment that do not meet performance requirements of these Specifications, and Authority approved submittals shall be corrected at the Contractor's expense until conformance with the governing requirements is achieved

**1.2 REFERENCED STANDARDS**

- A. Federal Communications Commission (FCC)
  - 1. 47 CFR Part 15 - Radio Frequency Devices
- B. IPC Guidelines (IPC)
  - 1. IPC-CM-770E – Guidelines for Printed Board Component Mounting
  - 2. IPC-2221B – Generic Standard on Printed Board Design
- C. Joint Electronic Device Engineering Council (JEDEC)
- D. Military Standard
  - 1. MIL-M-14F – Plastic Materials, Molding and Plastic-Parts Molded; Thermosetting
  - 2. MIL-STD-275 – Printed Wiring for Electronic Equipment
  - 3. MIL-STD-461E - Requirements For The Control Of Electromagnetic Field
- E. National Fire Protection Association (NFPA)
  - 1. NFPA 70 - National Electrical Code (hereinafter referred to as NEC)
- F. National Electrical Manufacturers Association (NEMA)
  - 1. NEMA Standards Publication 250, Enclosures for Electrical Equipment
- G. Society of Automotive Engineers (SAE)
  - 1. SAE Recommended Practice ARP 1393
- H. Urban Mass Transit Association (UMTA)
  - 1. UMTA-MA-06-0153-85-6 - Conductive Interference in Rapid Transit Signal Systems- Vol. II: Suggested Test Procedures

2. UMTA-MA-06-0153-85-8 - Inductive Interference in Rapid Transit Signal Systems – Vol. II: Suggested Test Procedures
3. UMTA-MA-06-0153-85-11 - Radiated Interference in Rapid Transit Signal Systems – Vol. II: Suggested Test Procedures

specific references to aid the Authority in replacement procurement.

6. Product information for special tools needed for assembly, maintenance, and testing.

C. Submittals for basic mechanical components and devices:

### 1.3 SUBMITTALS

A. Workmanship standards, practice, and procedures for assembly and installation shall be submitted at least 30 days prior to the earlier of:

1. The planned date for any assembly work.
2. The planned submittal date for installation drawings or procedures.
3. Shall include standards, practices and procedures applicable to:
  - a. Wiring, cabling, cable management, connectors and termination of wire and cable.
  - b. Color-coding standards.
  - c. Grounding
  - d. Labeling, including labels for:
    - 1) Equipment and material identification
    - 2) Operating and maintenance instructions and data
    - 3) Safety / Hazard warnings

1. At least 30 days prior to communications equipment installation, submit product information and specification sheets for all mechanical components, devices and associated appurtenances.

2. Identify external controls, indicators, test points, ports, terminals, and connectors. Identify product salient characteristics to the Authority for procurement of replacement components.

3. At least 30 days prior to communications equipment installation, submit the following information about each device, module, or similar item:

- a. General assembly outline drawings
- b. Internal circuitry schematic diagrams

D. Identification and numbering scheme, and use and format of labels, tags, sleeves, and equivalent, for all types of equipment and material identification shall be submitted at least 30 days prior to the planned date for any installation detailed documentation submittal.

E. Prior to issuing purchase specifications for any apparatus, submit an Electromagnetic Compatibility (EMC) and Electromagnetic Interface (EMI) Control Plan that outlines a strategy of ensuring compliance with the requirements of Paragraph 2.1.C of this Section.

B. At least 30 days prior to communications equipment installation, submit the following for each basic electrical and electronic assembly which is custom designed and fabricated:

1. Assembly bill of materials
2. All printed circuit board layouts
3. Enclosure and connector designs
4. Pertinent design details required for the complete assembly fabrication and its interfaces
5. Product information for all wiring and printed circuit components and standard assemblies shall be submitted to the Authority in an organized, sorted, and indexed listing. Contractor list shall include supplementary information or

## PART 2 - PRODUCTS

### 2.1 GENERAL

A. Equipment Maintainability. The design and construction of all systems provided shall be such to be routinely maintainable by Authority personnel, on site or at the Authority maintenance facilities. Replaceable and repairable assemblies and modules shall be provided to facilitate troubleshooting.

1. Equipment Assemblies

- a. Cable-connected or pullout modules shall be designed for direct access and quick replacement and shall weigh less than 15 pounds.

- b. Assemblies weighing 15 pounds or more shall be provided with rollout slides, hinges, or other devices to permit moving assemblies to test or maintenance positions without manual lifting.
  - c. Packages, which weigh more than 15 pounds, shall be provided with lifting devices.
  - d. Assemblies requiring removal for shop maintenance shall weigh less than 40 pounds.
  - e. Assemblies requiring removal for preventive maintenance or replacement shall have quick disconnect plug connectors and flexible cabled leads.
  - f. Assemblies and subassemblies shall be designed to be handled in normal work positions without damaging or displacing any component parts, and shall require no mechanical readjustment before installation.
  - g. All assemblies, subassemblies, and circuit or hardware components shall have permanently affixed labels giving manufacturer and part number. Color-coding to designate value and ratings of components shall be used only where it has been accepted as an industry standard.
  - h. All equipment shall be mounted in racks, cabinets or consoles, and shall be fabricated, finished, and arranged to present a uniform and coordinated appearance.
2. Equipment Accessibility. All components, modules, and subassemblies shall be accessible for testing, removal, or replacement without removal of other parts. Where this is not possible, other parts shall be of a pullout or plug-connected type.
- a. All components requiring adjustment or replacement shall be visible and identifiable.
  - b. Access openings shall be covered where required to protect internal parts, safeguard personnel, or restrict access for adjustments not normally performed in the field. Covers shall be labeled to indicate their purpose, or the hazard involved. Hardware or fasteners used to secure covers shall be captive.
- c. Structural braces, supports or enclosure sheets shall not hamper access to components or subassemblies. Overhanging edges or exposed corners that could hamper access or cause injury to personnel shall not be allowed.
  - d. All components, modules or subassemblies that may require maintenance access, shall be located with sufficient room for effective use of required tools and test equipment for required maintenance. Any installed security enclosures, frames, or cages shall allow the same access and shall be accessible for servicing by a single technician.
3. Test Points. Test points shall be provided to support troubleshooting and maintenance for checking essential voltages, wave forms, pulse codes, register content, software/firmware, or for injecting test signals or codes. All hardware related test points shall be permanently labeled with alphanumeric identifiers for reference.
- a. Selected test points or ports essential for regular in-service checks shall be accessible on a test sub-panel. Test points, for in-service or off-line tests of plug-in modules or assemblies, shall be readily accessible on the module or assembly in the operating position.
  - b. Test points shall be capable of accepting probes and connectors used with standard test equipment required for specified tests, except where special test equipment and connectors are provided by the Contractor. In lieu of test points, the Contractor may supply test sets that can plug into a subassembly to identify faults.
4. Recurring maintenance adjustments shall be minimized by the use of wide-tolerance circuits, stable components, and automatic re-calibration or adaptation. Components that are manually adjustable shall be used only if there is no other choice.
- a. When frequent observations or adjustments are required, built-in indicators, meters, or other readouts shall be provided. GO/NO-GO type indicators shall be

provided where practical. Where frequent adjustments are required, built-in readouts shall be placed near related devices so that one person is capable of making adjustments.

- b. Adjustable devices shall have locking screws or shall be self-locking to prevent inadvertent operation or drift.
- c. Wherever practicable, points requiring preventive maintenance adjustment together shall be located within 12 inches of each other so maintenance can be performed by one person. Interacting adjustments shall be avoided if possible.
- d. The replacement of a module or subassembly with a spare unit shall not require adjustment to the associated external input or output circuits or modules. If adjustments are required, such adjustments shall be provided on, and limited to, the device being replaced or repaired.

- 5. Safety and Hazard Warnings. Safety and hazard warnings shall be placed on equipment which, when installed, can pose a danger to maintenance personnel

B. Environmental Protection Design

- 1. Equipment and material covered by this Contract will be designed for indoor and outdoor locations along the Authority System right-of-way (ROW), at elevations of approximately sea level to 100 feet above sea level, in a suburban environment. The areas adjacent to Authority ROW are urban or suburban zones, some of which are occupied by industrial or commercial developments. Authority rail lines run parallel with major freeways along several lengthy sections, run through the downtown mall area and run through a tunnel on the North Central line.
- 2. The following particular climatic conditions shall be used as design guidelines and shall be considered as operational requirements. Actual localized temperatures and conditions within spaces and enclosures may be more severe than the ambient climatic conditions and the Contractor shall be responsible for evaluating these during the design effort. Additionally, the Contractor shall be responsible for advising the Authority if there are any special environmental

factors to which its equipment may be sensitive that are not listed below. Contractor shall insure that no equipment damage occurs during manufacture, storage, and shipment as a result of climatic conditions which differ from those below:

- a. Temperature and Solar Load:
  - 1) Minimum ambient air temperature external to equipment is 4 degrees F
  - 2) Maximum ambient air temperature external to equipment is 115 degrees F
  - 3) Maximum solar radiation: 275/BTU/hr\*ft<sup>2</sup>
  - 4) Maximum daily temperature range is 50 degrees F
  - 5) Average days under 32 degrees F is 38
- b. Precipitation:
  - 1) Maximum rainfall rate is 7 inches an hour and this rate may occur simultaneously with wind.
  - 2) Maximum snowfall is 12 inches in 24 hours
  - 3) Measurable quantities of ice infrequently occur
  - 4) Average relative humidity
    - a) Morning: 82 percent
    - b) Afternoon: 56 percent
    - c) Maximum average: 87 percent
- c. Wind:
  - 1) Average speed: 11 mph
  - 2) Maximum sustained for 1 minute: 73 mph
  - 3) Maximum gusting: 100 mph
- d. Air Contamination. The equipment shall operate as specified in the atmosphere commonly found in rail vehicle environments and the

Dallas Metropolitan region. These include the following:

- 1) Particulates:
  - a) Average: 0.175 mg/m<sup>3</sup>
  - b) Maximum: 0.324 mg/m<sup>3</sup>
- 2) Ozone: 0.200 ppm, max.
- 3) NO<sub>2</sub>: 0.25 ppm, max.
- 4) SO<sub>2</sub>: 262 g/m<sup>3</sup>
- 5) CO: 20 ppm, max.
- 6) Chloride: 13.9 mg/m<sup>3</sup>
- 7) Moisture Acidity pH: 4.41

3. Enclosures

a. Outdoor Locations:

- 1) Equipment and enclosures installed in outdoor locations shall be designed to operate properly in the extremes of local weather conditions, including heavy winds, rain, hail, outside air temperatures, and relative humidity up to 100 percent.
- 2) Where equipment is installed in outdoor enclosures and subject to temperature extremes caused by exposure to direct sunlight plus heat from internal electrical losses, the enclosures shall be equipped with sun shields and convection vents so that maximum internal temperature rise above ambient air does not exceed 25 degrees F. Equipment intended to be installed in outdoor enclosures shall be designed and tested for continuous service at 140 degrees F.
- 3) The design and construction of outdoor equipment enclosures shall include measures to protect against deterioration due to salt air, condensation, frost,

and temperature extremes, including control of fungus growth and metal corrosion. Outdoor communication equipment enclosures shall comply with NEMA 4 and shall have a stainless steel finish.

b. Indoor Wayside Locations:

- 1) Equipment and enclosures installed in indoor wayside locations shall be designed to operate continuously, properly, and safely in a temperature range of 32 degrees F to 120 degrees F, at relative humidity ranging up to 95 percent.

c. Cooling Devices:

- 1) Cooling devices shall be provided by the Contractor. Such devices shall be internal to the associated enclosures, and shall be included in the determination of conformance to reliability and maintainability requirements.
- 2) Unless otherwise specified, cooling devices shall be sized to maintain temperatures within enclosures between 60 degrees F to 80 degrees F while outside ambient temperatures are in the range specified previously in Paragraph 2.1.B.2.
- 3) More specific requirements for climate-controlled facilities may be found in these Specifications.

d. Heater Devices

- 1) Heater devices shall be provided by the Contractor.
- 2) Such devices shall be internal to the associated enclosures, rooms or houses, and shall be included in the determination of conformance to reliability and maintainability requirements.



- 3) Heating devices shall also meet the requirements of these Specifications.
  - e. All equipment shall be designed to operate in an environment subject to the following vibration limits:
  - f. Wayside equipment
    - 1) Equipment located adjacent to track on direct fixation or tie-and-ballast sections, and mounted anywhere within the Authority ROW except as indicated herein below, shall be designed to operate in an environment subject to the following vibration levels: all frequencies less than 12 Hz, 0.02 inches peak-to-peak amplitude; all frequencies from 12 Hz to 1000 Hz, 0.14 g peak or 0.1 g rms.
    - 2) Equipment located adjacent to and within 20 feet of special track work on direct fixation or tie-and-ballast construction shall be designed to operate in an environment subject to the following vibration levels: all frequencies less than 12 Hz, 0.2 inches peak-to-peak amplitude; all frequencies from 12 Hz to 1000 Hz, 1.4 g peak or 1.0 g rms.
  - g. Equipment located in communications equipment spaces at Operation Control Center (OCC), Communication Interface Cabinet's (CIC's), Communications Facilities, Signal Houses, or Yards:
    - 1) For all frequencies less than 12 Hz: 0.02 inches peak-to-peak amplitude; and
    - 2) For all frequencies from 12 Hz to 100 Hz: 0.14 g peak or 0.1 g rms.
- C. EMI Design. Contractor shall ensure that the electrical, electronic, and communications systems design can perform in the Authority transit system EMI environments with vehicles and other equipment without being functionally affected by them; and without affecting the system operation, safety, or other car borne or wayside installations because of conducted, induced, or radiated emissions.
- 1. Methods and Equipment. Contractor shall employ design techniques, construction methods, and whatever equipment is required to prevent interference caused by external and internal sources from affecting the proper operation of the equipment and systems specified herein. To contain EMI emissions wherever possible, the suppression of transients shall be at the source of the transient. The following design requirements shall be included in the Contractor's design:
    - a. In addition to coordinating frequencies, the Contractor shall provide required balancing, filtering, shielding, modulating techniques, and isolation to maintain signal to noise ratio (S/N) above limits required to operate all equipment installed under this contract. Shielding, isolating, balancing, and grounding shall be used, as required, to reduce the undesirable effect of interference.
    - b. Electrostatic and magnetic shielding methods shall be employed to minimize the effect of stray signals and transient voltages on interconnecting cables.
    - c. Interconnecting power and signal cables shall be physically separated.
    - d. Equipment and facilities shall be located and arranged to minimize voltage induction into circuits due to the Light Rail Transit (LRT) vehicle's propulsion system, auxiliary power, and overhead catenary system current transients.
    - e. Suppressors shall be incorporated across inductive devices to minimize switching transients.
    - f. All relay coils and contactor coils shall have freewheeling diode or metal-oxide varistor transient suppression. Other means of suppression or the absence of suppression for performance reasons shall be Authority approved prior to use.
    - g. The number of suppression device types shall be kept to a minimum.
    - h. Equipment design and enclosures shall shield equipment from any effects resulting from the operation

- of an Authority handheld transceiver when said transceiver is within 18 inches of the enclosure.
- i. Equipment design and enclosures shall shield equipment from any effects resulting from the operation of cellular telephones, including when said telephones are operated in the vicinity of the equipment and on the passenger platforms.
2. EMI Sources. Known EMI sources along the Authority ROW include but are not limited to the following major sources of interference that could affect operation of the System:
    - a. Medium and low voltage power circuits, including the Authority's Traction Power AC source sub-transmission distribution system, operating at 60 Hz and carrying harmonics typical for the configuration and the loads served.
    - b. Direct-current traction power system:
      - 1) Substation thyristor rectifier apparatus
      - 2) Direct current power distribution to trains, via overhead power catenary circuits
      - 3) On-board propulsion equipment, including solid-state chopper and motor circuits
      - 4) Direct current arcing, catenary to pantograph
      - 5) Temporary faults on the AC or DC power circuits
    - c. Local ground mat voltage rise or drop at any communications equipment room site, caused by patterns of DC traction power currents in running rail and earth return paths, or by temporary AC or DC circuit fault conditions.
    - d. Authority Train Control System, which comprises a variety of discrete digital and digitally coded signal sources and receivers at the Operations Control Center (OCC) Building, in Signal Houses, in wayside cables, in running rails, and in rail vehicles. Coded signal sources are in the DC to 20 KHz range.
- e. The design shall provide surge arresters and other circuit protection devices required to protect equipment from lightning currents and voltages.
  - f. Authority, governmental, public, and private radio systems
  - g. Authority T-1 carrier terminals and copper cable circuits
  - h. Authority video multiplex terminals and coax cable circuits
  - i. Commercial 800 MHz cellular transmission facilities
3. To help avoid undesirable effects upon communications and control equipment or other installations along the ROW as caused by on-board LRT vehicle subsystems, electromagnetic emission limits have been specified and will not be exceeded. Meeting the emission limit requirements does not guarantee elimination of interference; it is the first level of defining the interface between the vehicles and their intended environment. Contractor shall work jointly with the vehicle supplier, wayside signal system supplier, and others designated by the Authority to ensure compatibility. Vehicle Emissions will be limited to the following:
    - a. Radiated Emissions Limits. Radiated emissions, as measured by the procedures in UMTA-MA-06-0153-85-11 will conform to the following limits:
      - 1) From 0.01 MHz to 30 MHz, the maximum permissible interference limit will not exceed 20 dB above the limit of Figure 22 (RE05) MIL-STD-461E.
      - 2) From 30 MHz to 88 MHz, the maximum permissible interference limit shall be 58 dB above 1 microvolt/meter/MHz bandwidth.
      - 3) From 88 MHz to 1000 MHz, the maximum permissible interference limit will be 68 dB above 1 microvolt/meter/MHz bandwidth.

- b. The limits in Paragraph 2.1.C.3.a will not be exceeded when measured at a distance of 100 feet from the track centerline (Reference: SAE Recommended Practice ARP 1393, 5/3/76).
  - c. Conductive Emissions Limits. Conductive emissions, as measured by the procedures from, UMTA-MA-06-0153-85-6, Method RT/CE02A, will have a current limit as follows:
    - 1) From 0 Hz to 80 Hz: 10A max.
    - 2) From 80 Hz to 90 Hz: 10 amperes decreasing logarithmically to 1 ampere max.
    - 3) From 90 Hz to 120 Hz: 1A max.
    - 4) From 120 Hz to 600 Hz: 10A max.
    - 5) 600 Hz to 1500 Hz: 1A max.
    - 6) 1500 Hz to 4 KHz: 0.02A max.
    - 7) 4 KHz to 20 KHz: 0.03A max.
    - 8) The limits above shall be met individually by each equipment apparatus as well as during the simultaneous operation of all equipment.
  - d. Inductive emissions, as measured by the procedures from "Inductive Interference in Rapid Transit Systems, Volume II: Suggested Test Procedures," UMTA-MA-06-0153-85-8, will be limited to a maximum of 20 millivolts, rms, rail-to-rail, at all frequencies between zero Hz to 1 KHz and a maximum of 10 millivolts from 1 KHz to 20 KHz. This condition shall be met by each individual equipment as well as the simultaneous operation of all equipment.
  - e. Conducted Disturbances. Contractor shall formulate a set of criteria governing both generation and tolerance of electrical disturbances on conductors between assemblies. The criteria shall distinguish the basic types of circuits present in the system and shall define a suitable comprehensive classification of disturbances, which may be present in each type of circuit. The criteria shall ensure that each connected assembly will be able to tolerate the disturbances introduced simultaneously by all of the other assemblies to which it could be connected. These criteria shall be a part of the EMC control plan.
- f. Contractor shall formulate a set of criteria governing generation and tolerance of magnetically coupled disturbances on or between assemblies. The criteria shall identify the basic types of circuits present on the vehicle and shall define a suitable comprehensive classification of disturbances, which could be present in each type of circuit. The criteria shall ensure that each connected assembly will be able to tolerate the disturbances introduced simultaneously by all of the other assemblies to which it is magnetically coupled. These criteria shall be a part of the EMC control plan and shall be submitted for approval prior to issuing purchase specifications for any apparatus.
- 4. Emissions. Contractor shall design and implement the system such that its equipment:
    - a. Does not electrically interfere with the proper operation of the LRT vehicles or wayside equipment
    - b. Complies with 47 CFR Part 15
  - 5. Overvoltage Protection
    - a. Overvoltage protection shall be provided for all outdoor Public Address (PA)/ Visual Message Board (VMB) equipment, and for new CIC's.
- D. Prohibited Materials and Methods
- 1. Extra-flexible, metallic or non-metallic, non-labeled conduit
  - 2. Plastic conduit for interior electrical use, except that Polyvinyl Chloride (PVC) conduit may be used for power circuits below basement concrete floors and for ground wires in any location. The transition from PVC to steel shall be made below the floor.

3. Steel Conduit shall not be used outside unless in concrete. Use Galvanized Rigid Steel (GRS) conduit outside and wet locations above grade.
4. Aluminum wiring shall not be used.
5. Non-insulated stranded wiring shall not be used for grounding.
6. Use of Incompatible Materials:
  - a. Aluminum fittings and boxes shall not be used with steel conduit.
  - b. All materials in a raceway system shall be compatible.
  - c. Dissimilar Metals. All dissimilar metals shall be properly insulated to prevent galvanic action.
  - d. When bronze and aluminum components come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with a heavy coat of a proper primer or asphalt paint.
  - e. When aluminum components come into contact with cement or lime mortar, exposed aluminum surfaces shall be painted with heavy bodied bituminous paint, water-white methacrylate lacquer, or zinc chromate.
  - f. Fasteners. All exposed fasteners shall be stainless steel.
7. Multi-use Suspension Systems: Piggyback suspension systems for conduits and fixtures are prohibited. All suspensions shall be hung independently from structure, or, in limited cases, from trapeze suspension systems.
8. Use of wire ties to support conduit.
9. Use of splices to join communications or electrical wiring within ductbanks and raceways.

**2.2 BASIC ELECTRICAL AND ELECTRONIC COMPONENTS**

- A. General. This section specifies the characteristics of basic electrical and electronic assemblies, which are custom designed and fabricated by the Contractor. Contractor shall not retain rights of royalty for future fabrication of these assemblies.
- B. Communications Power Cable. Power cables, rated 600 volts and below, used in

communications circuits shall be provided in accordance with these Specifications.

- C. Electronic Components. For all Contractor custom designed electrical and electronic assemblies, all electrical and electronic components provided shall be:
  1. New and free of manufacturing defects
  2. Free of damage due to aging, storage, handling, or exposure
  3. Clearly and permanently labeled with rating, value, and type identification; coding is acceptable on components that are too small to label
  4. Derated according to conservative practice in the industry, or as proposed in relevant standards or guides, or according to the manufacturer's advice
  5. Commercially available as spare or replacement parts
- D. Wiring and Printed Circuit Components
  1. Wiring Connections. Not more than 2 wires shall be connected to a single terminal
  2. Printed Circuit Cards
    - a. Cards shall be constructed of epoxy glass material, NEMA Type FR-4, Grade G-10
    - b. Cards shall be of sufficient thickness to permit easy insertion and removal without buckling or breaking.
    - c. Cards shall be mechanically keyed to prevent incorrect interchange.
    - d. Cards shall be equipped with a card puller.
    - e. Large computer-type cards shall be equipped with a lever or cam-type locking device.
    - f. Circuits shall be formed by etching.
    - g. Conductor material shall be copper.
    - h. Width and thickness of conductors shall be in accordance with IPC 2221B.
    - i. Complete printed circuit card assemblies shall be conformal

- coated in accordance with IPC-CM-770E.
- j. Card contacts shall have gold plating of at least 0.00005-inch thickness.
  - k. Component mounting and lead solder connections shall be in accordance with IPC-CM-770E.
  - l. Component side shall be silk screened on the component side to identify all printed circuit parts. Silk-screened labels shall not be covered by installed printed circuit parts.
3. Printed Circuit Card Connectors. Printed circuit card connectors shall have the following features:
- a. Unless otherwise Authority approved, contacts shall have gold plating of at least 0.00005-inch thickness.
  - b. Contacts shall be bifurcated.
  - c. Insulation resistance shall be 5,000 megohms minimum.
  - d. Insulation material shall be glass-filled diallyl phthalate per MIL-M-14F.
4. Printed Circuit Design. Printed card circuitry shall be designed in such a manner so that terminals assigned to a given power supply, common, or ground will be the same on all cards in each subsystem. Where practical, the remaining card circuitry shall be arranged in such a manner so that the terminals assigned to a given function will be the same on all cards in each subsystem.
- a. Cards containing circuits, which affect safety, shall be designed such that removal of the card shall not create an unsafe condition, or cause a failure of another component.
  - b. Printed circuit cards shall be replaceable under operating (power on) conditions without adverse effect or damage to components either on the card or connected electrically to the card.
5. Printed Circuit Modifications. All modifications to manufactured printed circuit card assemblies shall be subject to Authority approval and shall be in accordance with all applicable IPC Standards and Guidelines.
6. Printed Circuit Identification. Each type of printed circuit card assembly shall be permanently and legibly marked with a unique number identifying that type of card assembly. Each card containing vital circuitry shall be permanently and legibly marked with a unique serial number and revision level.
7. Printed Circuit Card Cages. Printed circuit cards shall be installed vertically in card cage slots that are permanently mounted and enclosed inside a chassis or module.
- E. Electronic Components
- 1. Resistors. Resistors provided as discrete components in electronic modules shall have a maximum tolerance within plus or minus 5 percent, or a narrower tolerance when prescribed by circuit design. Such resistors shall be rated at twice the maximum power that they will be subjected to in operation.
  - 2. Capacitors. Capacitors provided as discrete components in electronic modules shall have a maximum tolerance of plus or minus 10 percent, or a narrower tolerance when prescribed by circuit design. Capacitors shall be rated for at least 1.5 times the maximum peak voltage that they will be subjected to in operation.
  - 3. Inductors. Inductors provided in electronic modules shall have encapsulated windings and leads, and shall be rated to withstand at least twice the overall and internal winding peak voltages that they will be subjected to in operation.
  - 4. Transformers. Power-level transformers provided in electronic modules shall have a minimum inter-winding breakdown voltage of 1,000 Vdc. Such transformers shall not emit audible noise in excess of 40 dB, referenced to 0.0002 dynes/cm<sup>2</sup> at a distance of 2 feet, while operating at rated voltage and load and performing their intended function.
  - 5. Semiconductor Devices. All discrete semiconductor devices shall carry a Joint Electronic Device Engineering Council (JEDEC) number, or shall be available as standard products from more than one manufacturer. All semiconductor devices shall conform to the published specifications for such JEDEC number. All such semiconductor devices shall be the silicon type, unless the specific functions of certain circuits require another standard type.

- a. Zener Diodes. Zener diodes provided for voltage regulation or reference levels shall be rated such that the diodes shall not be damaged if the entire load is removed abruptly, and shall have a zener voltage tolerance within plus or minus 5 percent.
  - b. Transient Protection. Zener diodes provided for transient protection shall be rated such that the diodes shall not be damaged in performing their functions within all actual conditions encountered in the operating system.
6. Integrated Circuit Packages. All digital integrated circuits shall be of the Transistor-Transistor Logic (TTL), Metal Oxide Semiconductor (MOS), or Complimentary Metal Oxide Semiconductor (CMOS) logic families. They shall be packaged in DIP or equivalent industry standard units, and identified with clear and permanent labels.
- 1. Each I.D. stenciled text shall consist of 2 lines; the first line to show cabinet number, and the second line to show specific name of the cabinet, as indicated. Cabinet name and number shall correspond with the cabinet terminology indicated on the Contract Drawings.
- F. Junction and Pull Boxes. Each junction and pull box shall have a unique number stenciled on the cover with black epoxy enamel. Lettering height shall be 1 inch. Numbers shall identify the service of circuits within the box and the location of the box by civil stationing. Pull boxes shall be stenciled to show unique identification and civil stationing.
  - G. Relays. Relays shall be provided with nametags or engraved plastic "lamicord" engraving. Tags shall be of stamped or engraved metal plates. Information on tags or engraving shall include type, rating, part number, date and place of manufacture.

### 2.3 IDENTIFICATION

- A. Labeling Components, Subassemblies, and Assemblies. All components, subassemblies, and assemblies shall require labels so that they shall be readily identified. Part reference designations shall be assigned in accordance with ANSI Standard Y32.16 and shall be marked on the product unless otherwise Authority approved. Reference designations for parts unique to an indicated location shall be preceded by the location control number
- B. Controls and Adjustments. Controls and adjustments shall be clearly identified as to function and shall be marked or indexed so that the control position or direction of rotation can be readily identified. Fixed guide marks on controls or adjustments shall be provided if the controls or adjustments require presetting for a standard maintenance operation.
- C. Indexing. Mechanical assemblies subject to maintenance disassembly shall be indexed to ensure proper relative positioning of parts after reassembly.
- D. Access Labeling. Labeling at accesses shall be provided and shall include, but not be limited to essential maintenance information, including but not limited to names of items inside; reference to schematic wiring diagrams and servicing procedures; and warning of hazardous or critical operations.
- E. Equipment Cabinets. Each equipment cabinet shall have a unique I.D. located top center front and rear on exterior of cabinet frame, stenciled

### PART 3 - EXECUTION

#### 3.1 INSTALLATION REQUIREMENTS

- A. Install electrical materials, equipment, appurtenances, and accessories in locations as indicated, rigid and secure, plumb and level, and in alignment with related and adjoining Work to provide a complete and operable system. Do not weld electrical materials for attachment or support.
- B. Provide anchor bolts and anchorage items as required, and field check to ensure proper alignment and location. Provide templates, layout drawings, and supervision at the job site to ensure correct placing of anchorage items in concrete. Check embedded items for correctness of location and detail before concrete is placed.
- C. Install supporting members, fastenings, framing, hangers, bracing, brackets, straps, bolts, and angles as required to set and connect the work rigidly.
- D. Control erection tolerance requirements so as to not impair the strength, safety, serviceability, or appearance of the installations. Determine exact locations of conduit. Route conduit parallel to building lines unless otherwise indicated.
- E. The trade size, type, and general routing and location of conduits, raceways, and boxes shall be as indicated or specified.
- F. Install exposed conduit so as to avoid conflicts with other Work. Install horizontal raceways close to the ceiling or ceiling beams, and above water or other piping wherever possible.

- G. Install individual conductors and multiple-conductor sheathed cables in conduits, raceways, cable trays, ducts, and trenches as indicated to complete the wiring systems.
- H. Install switches, receptacles, special purpose outlets, and cover plates complete in a neat manner in accordance with the NEC and local electrical codes. Plug unused openings in boxes, cabinets, and equipment.
- I. Use of explosive fasteners is prohibited.
- J. All electrical equipment, panels, telephone, and fire alarm panels shall be sealed against dust, whenever dusty conditions are present inside the rooms or outside, during the construction period.

**3.2 CONDUIT AND FITTINGS**

- A. Provide as indicated and required in accordance with these Specifications.

**3.3 EQUIPMENT, APPURTENANCES, AND INSTALLATION ACCESSORIES**

- A. Provide conduit hangers and inserts, pull cords, outlet boxes, junction and pull boxes, metal and plastic cable tray systems, and under floor duct work as indicated and required in accordance with these Specifications.

**3.4 ELECTRICAL WIRING**

- A. Wiring Requirements
  - 1. Provide wiring as indicated and required in accordance with the requirements of these Specifications.
  - 2. Furnish wires and cables to the site in unbroken standard coils or reels to which shall be attached a tag bearing the manufacturer's name, trade name of the wire, and the UL label for 600 V wire and cable.
  - 3. Provide wiring complete as indicated. Provide ample slack wire for motor loops, service connections, and extensions. In outlet or junction boxes provided for installation of equipment by others, tape ends of wires and install blank covers.
  - 4. Measure insulation resistance of the wiring system before connection to terminal blocks, motors, switchboards, motor control centers, transformers, panel boards, and control cabinets.
  - 5. Do not bend cables during installation, either permanently or temporarily, to radii less than 10 times the outer diameters, except where conditions make the specified radius impracticable and shorter

radii are permitted by the National Electrical Code and NEMA WC 7, Appendix N.

- 6. Secure and neatly bundle cables inside panel boards, control cabinets, switchboards, motor control centers, and pull boxes with nylon straps.
- 7. Identify wiring as specified in these Specifications.
- B. Cable Supports: Install cable supports for vertical feeders in accordance with the National Electrical Code.
- C. Splices and Terminations

- 1. Make wire and cable splices only in outlet, junction or pull boxes, or in equipment cabinets. Splices in conduit, trough, or raceway will not be permitted. Make splices by means of compression type connectors on stranded cables, and cover with tape to an insulation level equal to that of the cable.
- 2. For stranded copper wire, compression-type, insulated terminals in accordance with the wire and cable manufacturers' recommendations shall be used. The terminals shall be installed only with tools and techniques recommended by the terminal manufacturer.
- 3. Solid wire shall be terminated by wire eyes. The use of compression-type terminals for solid wires is prohibited.
- 4. Wires and cables shall be terminated at terminal blocks. Compression-type insulated terminal connections to terminal blocks shall use a single washer on top of the terminal. Wire eyes require 2 washers for 1 eye, 3 washers for 2 eyes. Connections shall be completed with double nuts torqued to the rated value of the nut.
- 5. Use positive type connector installation tools as recommended by the manufacturer.
- 6. Mechanical hand tools, with dies for each conductor size as recommended by the manufacturer, may be used on conductor sizes through No. 6 AWG.
- 7. For conductor sizes larger than No. 6 AWG, use hydraulic tools with hexagonal or circumferential installing dies for each conductor size, as recommended by the manufacturer.
- 8. For inspection purposes, clearly mark die numbers on the installed connectors.

9. Before installation, apply anticorrosion electrical joint compound to conductors and terminal bolting pads.
10. Wire and cable shall be continuous from power source to equipment. Where splices are required, they shall be made only in approved fittings or junction boxes and shall be subject to Authority approval. Follow manufacturer's instructions in splicing wire and cable.
11. Fixture Wire: Make splices in lighting circuits with insulated crimp-type connectors.
12. Use approved manufacturer tools to strip off cable or wire insulation.

MDF terminal blocks shall meet the requirements of these Specifications.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. The Work specified in this Section will not be measured separately for payment.

**4.2 PAYMENT**

- A. All costs connected herewith shall be considered incidental to the Work specified under Section 16801 "Basic Technical Requirements - Communications System."

**3.5 WIRING DEVICES**

END OF SECTION 16850

- A. Locate switches 4 feet above finished floor and general-purpose duplex convenience receptacles 15 inches minimum above finished floor, except as otherwise indicated.
- B. Attach receptacles rigidly to outlet boxes by means of 2 stainless steel screws.
- C. For exterior and damp locations, surface or embedded, mount receptacles in watertight cast metal outlet boxes with threaded hubs or bosses and equipped with gasketed spring cover.

**3.6 COMMUNICATIONS WIRING AND TERMINATION**

- A. All communications cable entering a facility from an outside environment shall be prevented from transmitting induced transient voltages harmful to the attached equipment through the use of gas discharge or Zener type protection blocks integral to Local or Main Distribution Frames (MDF). Cable shields and armor jackets shall be directly connected to signal ground at the Communications Facility. For cables running between Communications Facilities, the ground shall be applied at the facility closest to the OCC. In no case shall the cable shield be grounded at both ends. Protector blocks shall meet the requirements of these Specifications.
- B. All voice frequency (VF) communications cabling connecting from end devices to Communication Transmission Subsystem (CTS) equipment shall terminate to the applicable terminal blocks in the facility's Local Distribution Frame (LDF) or MDF unless otherwise shown on the Contract Drawings. CTS VF channel equipment shall terminate to the LDF or MDF on 25 pair telephone style connectors. Connection from the equipment to the CTS shall be accomplished by installing cross-connecting wires from the associated equipment block to the CTS transmission equipment block. Cross Connects shall be twisted pair solid No. 22 AWG wire. LDF and



**SECTION 16876**  
**GROUNDING AND BONDING – COMMUNICATIONS SYSTEM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. This Section describes the detailed technical requirements for the Grounding and Bonding for communications systems to be designed, provided, installed, and tested under this Contract. See the Contract Drawings for more details on Grounding and Bonding for communications systems. Work scope includes:

1. Designing, providing, installing and testing Grounding and Bonding for all communications systems at Communications Facilities, Communication Interface Cabinets (CIC's), Traction Power Substation (TPSS) and Signal Houses in accordance with these Specifications and Contract Drawings.

**1.2 REFERENCE STANDARDS**

A. ASTM International (Formerly known as American Society for testing and Materials) (ASTM)

1. ASTM B187/ B 187 M - Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar and Shapes
2. ASTM B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
3. ASTM C653 - Standard Guide for Determination of the Thermal Resistance of Low-Density Blanket-Type Mineral Fiber Insulation
4. ASTM D5 - Standard Test Method for Penetration of Bituminous Materials
5. ASTM D149 Rev A- Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
6. ASTM D257 – Standard Test Methods for DC Resistance or Conductance of Insulating Materials
7. ASTM D570 - Standard Test Method for Water Absorption of Plastics

B. Institute of Electrical & Electronics Engineers (IEEE)

1. IEEE 80/81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

C. Lightning Protection Institute (LPI)

1. LPI 175 – Standard of Practice

2. LPI 176 – Components Standards

D. National Fire Protection Association (NFPA)

1. NFPA – 70 National Electrical Code

E. National Electrical Safety Code (NESC)

F. Telecommunications Industries Association (TIA)/ Electronic Industries Alliance (EIA)

1. TIA/EIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications-Replaced by J-STD-607

G. Underwriters Laboratories (UL)

1. UL 467 - Safety Grounding and Bonding Equipment

**1.3 SUBMITTALS**

A. Submittal format and content shall comply with the general requirements of these Specifications and the specific technical requirements further listed herein.

B. Preliminary Design Review (PDR) Technical Requirements

1. Contractor shall include the following information as part of the PDR for the Grounding and Bonding of communications systems:

a. Manufacturer's catalog data for all proposed materials with installation recommendations.

b. Drawings showing grounding arrangement for communications facility and CIC, including locations of ground rods, cables and connectors.

c. Drawings showing details of ground connections, terminations and access points, including details of all daisy chain connections of panels and its end connection to the Chassis Main Grounding Busbars (CMGB).

d. Drawing showing mounting details of all ground busbars (CMGB, TMGB, CGB and TGB).

e. Grounding calculations to demonstrate the installation meets the Specification requirement of the 3 ohms.

C. Final Design Review (FDR) Technical Requirements

1. Contractor shall include the following information as part of the FDR submittal

package for the Grounding and Bonding of communications systems:

- a. Updated PDR information. All drawings, calculations and design information shall reflect a final design.
- b. Final installation details.

D. Installation Work Plans

- 1. The Contractor shall submit the following installation document for each site no later than 60 days prior to the scheduled installation activity in accordance with these Specifications. The installation Work plan shall include the following:
  - a. Locations of ground rods, connectors, cables, and details of connections, terminations and access points.
  - b. Manufacturer's installation recommendations.

E. Certifications

- 1. Certified test reports verifying that ground resistance of each ground grid when installed and each ground bus when connected to the ground grid does not exceed specified values.

F. Product Samples

- 1. Product samples shall be provided and demonstrated when requested by the Authority.

G. Test Plan and Procedures

- 1. Submit, no later than 75 days prior to the scheduled date of the corresponding test, procedures and equipment for testing resistances and electrical continuity for each location.

H. Test Records

- 1. Contractor shall submit the Test Records and Results for review one week after the completion of each test, in accordance with these Specifications.

I. As-Built Documentation

- 1. Contractor shall submit complete As-Built documentation and drawings for the Grounding and Bonding of all communications systems completed in this Contract.

**1.4 QUALITY ASSURANCE**

- A. Contractor's design, fabrication, inspection, installation and testing shall comply with all applicable Standards and Codes as listed herein. All equipment and methods shall comply with the latest version of the standards as applicable in paragraph 1.2 in this Section.
- B. Material and Workmanship Requirements.
  - 1. All equipment and material provided under this Section shall be UL listed.
  - 2. All grounding shall be in accordance with local standards, and specifications required by this Contract except as modified herein. Each piece of equipment shall be grounded in accordance with the recommendations of the manufacturer.
  - 3. Discontinued product models, refurbished equipment, products at their end-of-life, end-of-sale, or end-of-service shall not be used.
- C. All products specified herein shall be subject to the Authority approval based on the Contractor's ability to demonstrate adherence to the specified requirement and approval of the manufacturer's quality process.

**PART 2 - PRODUCTS**

**2.1 GENERAL DESIGN REQUIREMENTS**

- A. Subsystem
  - 1. Facilities Lightning Protection
    - a. A lightning protection system shall be provided for all outdoor communications equipment and wayside facilities including Communications Facilities, outdoor Public Address/Visual Message Board (PA/VMB) equipment, Wayside Telephones, Passenger Emergency Call (PECs) and CICs. The lightning protection system shall be in accordance with the requirements of ANSI/NFPA 780, Lightning Protection Code. The lightning protection system shall consist of multiple rooftop/facility/equipment air (lightning) terminals, down conductors, equalizing conductors, and ground terminals. This hardware shall surround the Communications Facility for the purposes of intercepting, diverting, and dissipating direct lightning strikes.
    - b. The spacing and interconnection of the lightning protection system with the communications system grounds shall be in accordance with ANSI/NFPA 780. Communications grounds shall

be bonded to the lightning protection system grounding within 12 feet of the base of the building. Communications conductors shall not be routed closer than 6 feet from any lightning protection system conductors. The Contractor shall submit an assessment for Lightning Protection System and bonding requirements as part of the Electromagnetic Interference (EMI) and Electromagnetic Compatibility (EMC) Control and Test Plan to the Contracting Officer.

- c. Lightning protection systems and installers shall be certified to the Lightning Protection Institute's LPI-175 and LPI-176 standards.

**2.2 GROUND RODS**

- A. Ground rods shall be copper-clad steel, of the non-rusting type as manufactured by Copperweld Corporation, or approved equal. The rod shall be at least ten feet in length and at least 0.75-inch in diameter.
- B. Ground rod clamps shall be made of a cast bronze clamp body with non-ferrous setscrews as manufactured by Copperweld Corporation or an approved equal.

**2.3 EXOTHERMIC WELDS**

- A. Welding material shall consist of copper exothermic mixture employing tin-metal in an amount to effectively constitute 4.5 percent to 5.5 percent of the resulting weld metal. The resulting weld metal shall be of high electrical conductivity and shall have a minimum tensile strength of 39,000 pounds per square inch (psi).
- B. Coating Materials for Thermite Welded Connections; Use black, rubber based compound coating materials, which are soft, permanently pliable, moldable, and unbacked, not less than 1/8 inch thick, with properties as follows:
  - 1. Solids: 100 percent
  - 2. Density: 12.0 pounds per gallon minimum
  - 3. Penetration: 90-130 ASTM D5
  - 4. Water Absorption: 0.10 percent maximum ASTM D570
  - 5. Dielectric Strength: 500 volts/mil ASTM D149
  - 6. Volume Resistivity: 2,000 megohms-inches ASTM D257 5,000 megohms-cm ASTM D257
  - 7. Service Temperature: -40 degrees F to +160 degrees F

- 8. Chemical Resistance: Melting point, none; flammability, slow burning (ASTM C653); resists alcohol, water, aqueous hydrochloride and sodium hydroxide; dissolved by carbon tetrachloride, naphtha gasoline, mineral, spirits, ketones, and benzene.

- C. Highly cohesive and adheres strongly to metals and adhesive concrete and to itself.

**2.4 GROUND GRID CONDUCTORS**

- A. No. 2 AWG bare solid tinned copper conductor, or as shown on Contract Drawings.

**2.5 GROUND ELECTRODE CONDUCTORS**

- A. Insulated stranded copper conductor, as shown on Contract Drawings, in accordance with these Specifications, for single-conductor cable, 600 volts.

- B. Size unless otherwise shown:

- 1. For use in connecting ground grid to CMGB and Telecommunications Main Grounding Busbars (TMGB) at Communications Facilities: insulated No. 2 AWG or as shown on drawings.
- 2. For use in connecting ground grid to Chassis Grounding Busbars (CGB) and Telecommunications Grounding Busbars (TGB) at CICs: insulated No. 4 AWG or as shown on drawings.
- 3. For other grounding electrode conductors: In accordance with NEC Table 250-94.

- C. Equipment Grounding Conductors

- 1. Size in accordance with NEC article 250-95, unless otherwise shown on Contract Drawings.
- 2. Equipment grounding insulated conductor: Single conductor stranded copper as specified in these Specifications.

- D. Static Dissipative Tile

- 1. Static Dissipative Tile (SDT) shall be used in Communications Facilities to prevent equipment damage due to static discharge. Ground SDT ground strips to the CMGB in accordance with the manufacturer's instructions using a minimum of No.12 AWG copper wire.

**2.6 CHASSIS AND TELECOMMUNICATIONS GROUNDING BUSBARS**

- A. CMGB and Telecommunications Main Grounding Busbars (TMGB), located in Communications Facilities shall be as follows:

1. Predrilled electrotin plated copper busbar provided with standard NEMA bolthole sizing and spacing for the type of connectors to be used.
2. Sized in accordance with the immediate requirements of the application and with consideration for future growth (provide approximately 50 percent spare holes).
3. Minimum dimensions shall be 1/4 inch thick x 4 inches wide and variable in length.

B. CGB and TGB, located in CICs and in the bottom of Communication Transmission Subsystem (CTS) cabinets in various locations, shall be as follows:

1. Predrilled electrotin plated copper busbar provided with standard NEMA bolthole sizing and spacing for the type of connectors to be used.
2. Sized in accordance with the immediate requirements of the application and with consideration for future growth (provide approximately 50 percent spare holes).
3. Minimum dimensions shall be 1/4 inch thick x 2 inches wide and variable in length, or as shown on Contract Drawings.

**2.7 TERMINAL LUGS**

- A. For No. 4/0 AWG and smaller conductors, use copper compression terminal lugs.
- B. For No. 250 MCM and larger, use long barrel, copper, double-compression terminal lugs.

**2.8 GROUND CONNECTOR**

- A. O-Z Gedney, Type KG or approved equal.
- B. Two-piece, designed for connecting grounding conductor to bus bar.
- C. Copper alloy body and silicon bronze bolt, nut and washer with interlocking clamp.
- D. Exothermic weld: Size and type per manufacturer's recommendations.

**2.9 JUMPERS**

- A. Jumpers shall be insulated copper braided or leaf-type flexible jumper, size as required.

**2.10 BUSBAR INSULATORS**

- A. Fibrous glass reinforced polyester insulator with 1/2 inch diameter by 2 inches length, threaded holes at both ends for CMGB, TMGB, CGB, and TGB installation.

**2.11 COAL TAR EPOXY**

- A. Polyamide cured coal tar epoxy, Dupont Corlar 823 CTE, Koppers Company No. 300M, PPG Industries 97-640 or 97-641 or approved equal, applied to a dry film thickness of 8 mils. per coat.

**2.12 EPOXY RESIN ENCAPSULATION**

- A. Two-component epoxy resin type with plastic snap mold, as manufactured by Duriron Company, 3-M Company or approved equal.

**2.13 COMMUNICATIONS FACILITY ROOM HALO GROUND RING**

- A. The halo shall be No. 4 AWG bare stranded copper conductor. It shall encircle the perimeter of the interior walls of the Communications Facility at a uniform height of 3 inches to 12 inches from the ceiling. The halo shall be bonded to the CMGB also using a No. 4 AWG bare stranded copper conductor and approved ground connector.

**2.14 COMMUNICATIONS CIRCUIT PROTECTION**

- A. Copper cables shall enter all Communications Facilities, CIC's and Wayside Telephones at a Local Distribution Frame (LDF). All signal cables shall terminate on Protected Terminal Blocks (PTBs) located within the LDF, which shall conform to these specifications. Cable sheath shall be neatly trained and soldered to a No. 8 AWG insulated ground conductor and grounded at the TMGB or TGB.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Grounding Connections
  1. Weld buried ground connections exothermically, in accordance with manufacturer's recommendations. Clean and coat with coal tar epoxy applied with a 32 mils dry film thickness using multiple coats. Allow drying between coats and before backfilling. Encapsulate with epoxy resin all buried ground connections of grounding electrode conductors running to ground buses.
  2. Use terminal lug to connect grounding conductor to equipment enclosure. Secure connector or terminal lug to the conductor so as to engage all strands equally by using tools and pressure recommended by the manufacturer.
  3. Exothermically weld connections for ground rods in manholes and handholes, or as shown.
  4. Splices in grounding conductors are not permitted.

B. Ground Grid

1. Install ground grid consisting of bare solid tinned copper conductors and ground rods buried in earth in the pattern and at the locations shown on Contract Drawings. Install ground rods vertically if possible. If this is impossible, rods may be at an angle or (as a last resort) buried horizontally 30 inches (minimum) below grade.
2. Bury top of ground rod 30 inches minimum below grade or as shown on Contract Drawings.
3. Provide 24-inches minimum horizontal separation between ground rods and concrete structures.
4. Interconnect ground rods using bare solid tinned copper conductors as shown on Contract Drawings.
5. For Communications Facilities and CICs, unless otherwise shown, provide two pigtailed of grounding electrode conductor of sufficient length above finished floor for connection to the TMGB and CMGB or TGB and CGB. The two pigtailed shall be exothermically welded or bonded in an approved manner to the grounding grid at a single point.

C. Grounding Bars

1. Install separate CMGBs and TMGBs, CGBs and TGBs in Communications Facilities, CIC's and other locations as shown on Contract Drawings.
2. Mount Communications Facility TMGB's and CMGB's on insulators 2 feet above finished floor using cap screws and expandable threaded anchors, unless shown otherwise on Contract Drawings.
3. Install CIC and CTS cabinet TGBs and CGBs in the bottom of the cabinet, on insulated spacers which electrically isolate them from the cabinet.
4. Provide insulator support at each end of grounding busbars and at intervals not exceeding three feet.
5. Bond the grounding electrode conductors to the grounding busbar using an approved ground connector in accordance with this Section.

D. Grounding of Separately Derived AC Power System

1. Bond the safety ground conductor (green wire) to the CMGB using a minimum of No. 4 AWG insulated stranded copper wire, as shown on

Contract Drawings. For additional guidance refer to the NEC.

E. Grounding for Personnel Safety

1. In Communications Facilities, CICs, bond equipment enclosures and racks, ductwork, conduit, metal cable trays, the LDF ground bolt, PTB grounds, and the room halo ground ring to the local CMGB or CGB using a minimum of No. 6 AWG insulated stranded copper conductor or as specified on Contract Drawings.
2. Wayside metal equipment including, but not limited to, cabinets, poles, pullboxes, equipment enclosures, and junction boxes: bond and ground each item using No. 6 AWG (minimum) copper conductor to one or more ground rods to provide 3 ohms or less resistance to ground. Wayside metal equipment on a bridge structure should be attached to the structure using a minimum of No. 6 AWG (minimum) copper conductor.

F. Electronic Equipment Signal Grounding

1. Where electronic equipment is provided with separate 'Signal' or 'Telecommunications' ground connections, a separate isolated TGB shall be provided in the equipment rack or enclosure. These connections shall be grounded to the TGB using a minimum of No. 10 AWG insulated stranded copper conductor.
2. Within the Communications Facility or other electronic equipment room, a separate TMGB shall be provided. All individual equipment rack or enclosure TGBs shall be grounded to the TMGB using a minimum of No. 8 AWG insulated stranded copper conductor.
3. The TMGB shall be grounded to the same point on the ground grid (or to the structural steel) as the CMGB using the same AWG grounding electrode conductor. Both grounding electrode conductors shall be insulated.

G. Cable Shield Grounding

1. One end of all cable shields shall be grounded to the TMGB or TGB. Use the following guidelines to determine which end of the cable to ground:
  - a. When a cable goes between Communications Facilities, ground the shield at the southern most facility.
  - b. When a cable goes between a Communications Facility and any other facility (TPSS, Signal House, and CIC), ground the shield at the Communications Facility.

- c. When a cable goes between the CIC and station equipment, ground the shield at the CIC.

H. Fiber Optic Cable Jacket Grounding

- 1. Armored jackets on all fiber optic cables shall be grounded to the CBG or CMGB using a minimum of No. 8 AWG insulated stranded copper conductor.

**3.2 TESTING AND INSPECTION**

- A. The Contractor shall perform the following inspections and tests on Grounding and Bonding. The Authority shall be given at least 10 days written notification prior to each test and inspection so that the Authority may be present as desired.

- 1. Factory Test and Inspection: Not Required.
- 2. Field Test and Inspection. The Contractor shall make the following Field Inspections and Tests:
  - a. Inspect ground grid installation, installation depth, conductor sizes, connections to ground rods and foundation rebars prior to backfill, for conformance to Specification requirement.
  - b. Inspect installation of all main ground busbars for proper mounting.
  - c. Test ground resistance of each ground grid after installation and each ground bus when connected to ground grid, using approved test procedure.
  - d. Resistance to ground for Communications Facilities and CIC's is not to exceed three ohms.
  - e. To meet resistance requirements, install additional ground rods. If resistance requirements can still not be met, install a sacrificial anode to be Authority approved.
  - f. Test metal conduit and raceways, equipment enclosures, metal cable troughs, fences, metal structures, and light poles for ground resistance not to exceed three ohms.

- B. End-To-End acceptance Test:

- 1. Not required.

- C. System Integration Test:

- 1. Not required.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. The Work specified in this Section will not be measured separately for payment.

**4.2 PAYMENT**

- A. All costs connected herewith shall be considered incidental to the Work specified under Section 16801 "Basic Technical Requirements - Communications System."

END OF SECTION 16876

**SECTION 16879  
POWER SUPPLIES AND DISTRIBUTION - COMMUNICATIONS SYSTEM**

**PART 1 - GENERAL**

**1.3 SUBMITTALS**

**1.1 DESCRIPTION**

- A. This Section describes the detailed technical requirements for Power Supplies and Distribution to be designed, provided, installed and tested under this Contract. See the Contract Drawings for more details on Power Supplies and Distribution. Scope of Work for the Authority Light Rail Communications System includes:
1. Design, provide, install and test Alternating Current (AC) and Direct Current (DC) power supplies for communication equipment in Communications facilities, Communication Interface Cabinets (CIC), signal houses and Traction Power Substations (TPSS) as described in these Specifications.
  2. Provide and install all power distribution related cables in accordance with these Specifications.
  3. Provide and install grounding for all power supply equipment in accordance with these Specifications.

**1.2 REFERENCED STANDARDS**

- A. Institute of Electrical and Electronics Engineers (IEEE):
1. IEEE 446 – Recommended Practices for Emergency Standby Power System for Industrial and Commercial Applications.
  2. IEEE 1100 - Powering and Grounding Sensitive Electronic Equipment
- B. International Organization for Standardization
1. ISO 9001 – Quality Management Systems - Requirements
- C. National Fire Protection Association (NFPA):
1. NFPA 70 - National Electric Code (herein after referred to as NEC)
  2. NFPA 75 - Standard for Protection of Electronic Computer/Data Processing Equipment
- D. Underwriters Laboratories, Inc. (UL):
1. UL 1778 – UL Standards for Uninterruptible Power Supply Systems

- A. Submittal format and content shall comply with the general requirements of these Specifications.

1. Manufacturer Qualifications

- a. Any manufacturer differing from those specified herein shall require the Authority prequalification and approval.
- b. Acceptability of the manufacturer shall be based on the manufacturer's experience, qualifications, certifications, (i.e. ISO 9001), equipment reliability, and compliance with referenced standards, and full compatibility with the Authority's current system.

2. Preliminary Design Review (PDR) Technical Requirements. Contractor shall include the following information as part of the PDR submittal package for the Power Supplies and Distribution:

- a. Manufacturer Data Sheets for Uninterruptible Power Supply (UPS), including batteries, battery charger, transformer, transfer switch, inverter and converter.
- b. Manufacturer Data Sheets for DC Power Supplies.
- c. A description of the power supply for each equipment site, including:
  - 1) Configuration including dimensions, plan and elevation.
  - 2) Power Draw.
  - 3) Standby Time.
  - 4) Battery dimensions and weight.
- d. Schematic diagram of UPS components including, but not limited to the AC to DC converter, batteries and battery charger, inverter, transformer, transfer switch and ground connections.
- e. Drawings showing the layout and rack mounting details of the UPS equipment.
- f. Detailed drawings of connections to Chassis Main Grounding Buss

- bar (CMGB) and Chassis Ground Buss bar (CGB) showing routing of ground wires and mechanical details of connections.
- g. Single line diagrams for communications house/ Facility and CIC. Drawings shall show utility feeds, transfer switches, generator connections, UPS, and all power panels.
  - h. Calculations for each power supply demonstrating the capability of the proposed equipment to adequately serve the load demands of the connected equipment.
3. Final Design Review (FDR) Technical Requirements. Contractor shall include the following information as part of the FDR submittal package for the Power Supplies and Distribution:
    - a. Updated PDR information. All drawings, calculations and design shall reflect a final design.
    - b. Final and detailed wiring drawings ready for construction and installation.
    - c. Final equipment list.
    - d. Final equipment installation details.
    - e. Final cable and equipment ID.
  4. Installation Plan. Contractor shall submit the following installation document for each site no later than 60 days prior to the scheduled installation activity:
    - a. Step-by-step plan for installing each piece of equipment, interconnecting raceway and cabling details, including estimated time required for the installation.
  5. Calculations and Certifications
    - a. Calculations as listed in the PDR and FDR.
    - b. Certifications: Copy of the following certifications shall be included:
      - 1) ISO certification for all proposed manufacturers.
  6. Product Samples: Product samples shall be provided and demonstrated when requested by the Authority.
  7. Test Plan and Procedures. In accordance with the format and requirements described in these Specifications, as a minimum, the Contractor shall submit the following plan and procedures to satisfy the Power Supplies and Distribution testing requirements:
    - a. Test program plan: Contractor shall include all the required information for the communications Power Supplies and Distribution in the Test Program Plan as outlined in these Specifications.
    - b. Factory and Inspection Test Procedure: Contractor shall submit a complete factory test and inspection procedure to satisfy all the requirements outlined in Article 3.2 of this Specification.
    - c. Field Test Procedure: Contractor shall submit a complete field test procedure to satisfy all the requirements outlined in Article 3.2 of this Specification.
    - d. End-To-End Acceptance Test: There is no requirement for an End-to End Test performed.
    - e. System Integration Test (SIT): Contractor shall provide qualified staff to support this test as described in Article 3.2 of this Specification. SIT will be directed by the Authority.
  8. Test Records: Contractor shall submit the Test Records and Results for review 1 week after the completion of each test, in accordance and format in these Specifications.
  9. As-Built Documentation: Contractor shall submit complete As-Built documentation and drawings for the communications Power Supplies and Distribution, and the contents.

#### 1.4 QUALITY ASSURANCE

- A. Contractor's design, fabrication, inspection, installation and testing shall comply with all applicable Standards and Codes as listed herein. All equipment and methods shall comply with the latest version of the standards as applicable in Article 1.2, Reference Standards.
- B. Material and Workmanship Requirements:
  1. All equipment provided under this Section shall be UL listed.



- 2. All grounding shall be in accordance with local standards, and specifications required by this Contract except as modified herein. Each piece of equipment shall be grounded in accordance with the recommendations of the manufacturer.
  - 3. Discontinued product models, refurbished equipment, products at their end-of-life, end-of-sale, or end-of-service shall not be used.
  - 4. All products specified herein shall be subject to the Authority approval based on the Contractor's ability to demonstrate adherence to the specified requirement and approval of the manufacturer's quality process.
  - 5. Any manufacturer differing from those specified herein shall require the Authority prequalification and approval. Acceptability of the manufacturer shall be based on the manufacturer's experience, qualifications, certifications (i.e. ISO-9001), equipment reliability, and compliance with standards specified herein, and full compatibility with the Authority's current system.
- Facilities. Redundancy shall be provided as shown on the Contract Drawings.
- 2. Power supplies shall provide DC power to equipment during normal operation. All DC power supplies used for communications equipment shall receive power from a UPS power source.
- C. AC Power Supply
- 1. AC power for the Communications Houses and Facilities shall be provided either from a Station Electrical Panel, a TPSS, or Texas Utility.
    - a. One 125A circuit shall provide power to all Communications equipment at each location.
    - b. AC power distribution within the Communications House and Facility shall be in accordance with Contract Drawings.
    - c. Contractor shall provide and install all required cables and connections between the TPSS breaker and the Communications House.
  - 2. AC Power for Station CIC shall be provided from the Station electrical panel and distributed as shown on the Contract Drawings.
    - a. A minimum of 3 separate circuits (UPS, AC Unit, and Non-Essential loads) from the Station electrical enclosure panel shall be provided for each CIC.
    - b. Contractor shall provide and install all required cables and connections between the Station electrical enclosure panel and the CIC.

**PART 2 - PRODUCTS**

**2.1 GENERAL DESIGN REQUIREMENTS**

- A. Uninterruptible AC Power Supply
- 1. This type of power supply shall be utilized to provide conditioned AC power to equipment during normal operation and to provide temporary backup AC power in case of a failure of normal AC.
  - 2. UPS shall be provided at Communications Houses and Facilities, and CICs to supply power for all of the vital systems at locations shown on the Contract Drawings.
    - a. Batteries shall provide 8 hours of backup power at Communication Houses and Facilities. If the communications house or facility is provided with an 8 hour backup generator with an automatic transfer switch, then backup time for the UPS may be reduced to 1 hour.
    - b. Batteries shall provide 1 hour of backup power at CICs.
- B. DC Supply
- 1. DC supplies shall be provided and installed at Communications Houses and

- D. Grounding
- 1. Equipment within Communications House and Facility, and CIC shall be grounded to the building CMGB and CGB respectively, independent of the power supply ground or neutral connections.
  - 2. The safety ground for UPS and power supplies shall be bonded to the CMGB or CGB, which provides a single point earth ground.

**2.2 UPS SYSTEM**

- A. Each UPS system shall be sized for a minimum of 125 percent of the peak load connected. The

backup time shall be for full load, or as specified for the particular site.

B. Each UPS shall include a ferroresonant transformer, battery float charger, batteries, static inverter, and microprocessor controlled switch circuitry.

1. The load shall normally be powered from the secondary of the ferroresonant transformer; the primary of the transformer shall normally be powered from one of 120/208/240 VAC, 60 Hz sources, from either a TPSS, a station electrical power panel or the Texas Utility for a Communications House or Facility, and from a station electrical power panel for the CIC.

a. Manual bypass switch shall be provided and installed as shown in Contract Drawings for the UPS such that the load can be powered from the normal source for maintenance without service interruption.

b. Manual AC Disconnect Switch shall be provided as shown in Contract Drawings, if it is not an integral part of the UPS, to facilitate disconnecting the equipment for maintenance service.

c. In the event of a UPS failure, the load shall revert to the normal AC source (even if that source is unavailable).

2. The static inverter shall normally be off, but shall be switched on automatically upon detection of a failure or irregularity in the normal power input and shall then supply power to the transformer primary. The batteries shall power the inverter.

3. The batteries shall be maintained at full charge by the battery charger. The battery charger shall be powered from the normal AC source in parallel with the transformer primary.

4. The microprocessor controlled switch circuitry shall monitor the AC input and output and the DC voltage and current levels. Switching from normal to battery power and back to normal shall be automatic and shall not affect output voltage and current waveforms.

C. Each UPS system shall provide power quality consistent with the equipment connected. In addition, the UPS shall meet or exceed the following specifications:

1. Input Voltage: 120 VAC, Nominal

2. Output Voltage: 120 VAC, Nominal

3. Voltage Regulation: within plus or minus 3 percent with input 96V AC to 138 VAC

4. Spike Attenuation: 2000:1 (up to 6000 V and 200 A)

5. Noise Attenuation: 120 dB Common Mode, - 60 dB Transverse Mode

6. Output Frequency: 60 within plus or minus 0.005 Hz

7. Input AC Overload Capacity: 125 percent Rated (10 Min), 150 percent (Surge)

8. Output Waveform Distortion: 3 percent (Max) Single Harmonic, 5 percent Total Harmonic Distortion

9. Operating Temperature: 32 degrees F to 104 degrees F

10. Operating Humidity: Up to 95 percent Relative Humidity (R.H.)

11. Line Powered Efficiency: 88 percent

12. Audible Noise: 51dB

13. Mean Time Between Failures: 100,000 Hours

D. Transformer: The ferroresonant transformer shall provide complete isolation from input to output. It shall be rated for continuous supply of 125 percent of the maximum draw of the communications equipment with input voltages in the range 96 to 138V.

E. Inverter: The inverter shall utilize all solid state components and be rated for 125 percent of the continuous output required such that the transformer coupled output, as specified above, shall be realized when the inverter is on. There shall be no interruption of service to the load when the inverter is switched on or off.

F. Batteries: The battery shall be a multi-cell bank composed of sealed maintenance free cells. The battery bank shall be rated to provide power to the inverter such that 125 percent of the current draw of the protected equipment can be provided upon complete failure of the AC input for a period as stated in Paragraph 2.1A.2 of this Specification. The battery life shall be at least 200 charge/discharge cycles and 10 years.

G. Battery Charger: The battery charger shall utilize all solid-state components and shall be rated to fully charge the batteries within 24 hours from a fully discharged state while the normal load is connected. The battery charger shall include automatic tapering and floating controls.

- H. Microprocessor Control: The microprocessor control and switching circuitry shall continually monitor the AC input voltage, current, and frequency. If one of these parameters is outside the range where the output voltage or frequency remains within the specified tolerances, the inverter shall be switched on-line within 8 milliseconds and the AC line disconnected. If the AC input comes back within range, the inverter shall be disconnected and the AC line re-connected automatically.
- I. Light Emitting Diode (LED) indications for the following shall appear on the front panel of the unit: AC Line, Ready, Charging, Battery Power, and Alarm. In addition, the following functions shall be available on a keypad with Liquid Crystal Display (LCD) that shall be mounted on the front panel of the UPS, or plugs into a diagnostics output port:
  - 1. Meter Functions
    - a. AC Volts Output
    - b. AC Volts Input
    - c. Battery Voltage
    - d. AC Current Input
    - e. AC Current Output
    - f. VA Load
    - g. DC Current Input
    - h. Frequency
    - i. Heat Sink Temperature
    - j. Projected Run Time Available
    - k. Log of Power Outages and Alarms
  - 2. Alarm Messages
    - a. Low Battery
    - b. Near Low Battery
    - c. High Battery
    - d. Low Run Time
    - e. Low AC Output
    - f. High AC Output
    - g. Output Overload
    - h. Ambient Temperature High
    - i. Heat Sink Temperature High
  - 3. Operating Modes
    - a. Off
    - b. Automatic
    - c. Line Conditioning
    - d. Inverter On
  - 4. Set Operating Parameters
    - a. High AC Voltage
    - b. Low AC Voltage
    - c. High Battery Voltage
    - d. Low Battery Voltage
    - e. Near Low Battery
    - f. High Ambient Temperature
    - g. Frequency Tolerance
    - h. Battery Capacity (run time)
- J. Relay Alarm Contacts. Each UPS shall include 2 sets of alarm contacts (2 NO and 2 NC) rated at 125 VDC and 1 Amp. The following outputs shall be wired to the Remote Terminal Unit (RTU) equipment, to be provided by others, at the corresponding Communications House or Facility.
  - 1. UPS Trouble: This relay shall change state when any of the parameters listed above move beyond the pre-established range. In addition, any faults with the battery chargers, batteries, or inverters shall cause this alarm to activate.
  - 2. Loss of Primary AC: This relay shall change state when the primary 120 VAC power is lost and reset when it is restored.

**2.3 DC POWER SUPPLIES**

- A. Communication equipment that requires other than -48 VDC shall be provided by manufacturer recommended power supplies. Data sheets for such power supplies shall be provided with the equipment data sheets for approval.

- B. The DC power supplies shall be grounded in accordance with the manufacturer recommendations and the system designer to allow proper operation of all the equipment powered by the -48VDC, including use of investigative tools or equipment (such as laptops).
- C. If DC power is required, the power supply cabinet shall be equipped with a fuse panel. Each panel shall have a minimum of 8 separately fused power output positions. The fuse current ratings shall be in accordance with equipment manufacturer recommendations. The fuses shall be indication type.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Each power supply, including batteries shall be provided and installed as shown on the approved Contract Drawings.
- B. All cabling from the power supplies to communications equipment and the power panel shall be routed as Authority approved and so as not to interfere with other cables or equipment.
- C. All cabling from the AC breaker panel to the power supply, where both are located within the same building, shall be installed within Electrical Metal Tubing (EMT) conduit.
- D. Grounding
  - 1. General Equipment Grounding: Within each Communications Facility, and CIC, power supply equipment and racks shall be grounded to the CMGB and CGB per these Specifications. A power source neutral lead shall not be used as a ground.
  - 2. Power Supply Grounding: The safety ground for all UPS and power supplies shall be bonded to the CMGB or CGB per these Specifications and Contract Drawings.

**3.2 EQUIPMENT MOUNTING**

- A. Cabinets and Racks
  - 1. The UPS components, exclusive of batteries shall be mounted within a freestanding cabinet with removable panels (except in the CIC, where UPS and batteries shall be mounted within the CIC). The cabinet shall include a ventilation opening for convection cooling such that the unit shall operate within the specified temperature range. The cabinet shall have an enamel finish, in a color that shall be Authority approved.

- 2. Equipment racks for mounting 19 inch EIA Standard equipment shall be in accordance with these Specifications.

- B. Battery Racks: The batteries shall be mounted in a rack, or as recommended by the battery manufacturer. The battery rack shall be made of channel steel with an acid resistant gray paint finish. The battery racks shall allow access to all battery terminals without removing batteries from the rack.
- C. Power Plug Mold Strip – Equipment Cabinets:
- D. Contractor shall provide the required sized and rated UL power plug mold strip in each equipment rack or cabinet. The power plug mold strip shall be powered from the UPS AC source that is shown on the Contract Drawings. The plug mold strip shall be mounted vertically in the cabinet and contain a minimum of 10 power outlets.
- E. Standard Power Source – Equipment Cabinets:
- F. Quad receptacles home run from the non-UPS AC power source shall be installed in equipment racks or cabinets to provide access for non-essential or battery powered equipment such as test equipment or laptop computers.
- G. Grounding Wire: Ground wire shall be a minimum of No. 6 AWG, or as specified on the Contract Drawings, stranded copper wire with insulating jacket. The insulation shall be rated for 600V minimum, and shall be colored green.

**3.3 TESTING**

- A. Testing of each power supply shall be conducted in accordance with these Specifications. Tests shall verify the following:
  - 1. Output Power Levels
  - 2. Output Quality
  - 3. Transfer of load to standby source.
  - 4. DC equipment holdup in the event of single rectifier failure.
  - 5. Backup power holdup times under full load.
  - 6. Accuracy of all meters.
  - 7. Proper grounding connections and levels.
  - 8. Functionality of all alarms, indications, and controls.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. The Work specified in this Section will not be measured separately for payment.

**4.2 PAYMENT**

- A. All costs connected herewith shall be considered incidental to the Work specified under Section 16801 "Basic Technical Requirements - Communications System."

END OF SECTION 16879

**SECTION 16880**  
**VIDEO IP SYSTEM - COMMUNICATIONS SYSTEM**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. This Section provides an overview of technical requirements, engineering guidelines, technical constraints, and general conditions to be followed by the Contractor throughout the design installation, and testing under this Contract. Scope of work for the Trinity Metro Parking Lot Project includes the furnishing and installation of an IP Video System for general safety and security throughout the parking lot area. Contractor to coordinate with Trinity Railway Express (TRE) regarding interconnecting to TRE's (henceforth, the Owner) existing or dedicated recording system through network connections
- B. The video IP System including the following as applicable:
1. Rugged PoE+ network switches.
  2. Network multi-directional and 180-degree cameras.

**1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all addendums and change bulletins apply to this Section.
- B. Related Sections.
1. 02780 Underground Electrical and Communications Distribution Systems
  2. 16110 Conduit and Raceways
  3. 16801 Basic Technical Requirements
  4. 16837 Miscellaneous Components and Products
  5. 16841 Communications Cable
  6. 16845 Fiber Optic Cable System

7. 16850 Basic Electrical Materials and Methods
8. 16876 Grounding and Bonding
9. 16879 Power Supplies and Distribution
10. 16897 Manuals and Training
11. 16899 Technical Support and Spares

**1.3 SUMMARY**

- A. Video Surveillance System
1. Provide an IP video surveillance integrated solution based on an Ethernet communication platform using Network Video Recorders (NVRs) and Network Internet Protocol (IP) cameras as required to meet quality performance and recording specifications.
  2. Integrate local IP cameras to the Owner's existing recording system.
  3. Cameras provided shall be an assembly including mounting, housing, lens and power supply for a complete assembly.
  4. Video IP cameras or Engineer approved equivalent, to ensure functionality with the Owner's existing VMS, shall be of manufacturer's official product line designed for commercial/industrial 24/7/365 use.
  5. Provide a Rugged Network PoE+ Switch as needed per system design.
    - a. Wire Management for fiber and CAT 6 cabling
  6. Video IP camera integration to other systems shall be performed within the communications facility. The Owner's existing VMS contractor to coordinate with this station programming and test control.

## VIDEO IP SYSTEM - COMMUNICATIONS SYSTEM

- a. Integrate all parking lot cameras for video recording of alarmed events.
  - b. Integrate the video IP cameras to the Owner's central monitoring center system for system monitoring at the Fort Worth Central Station.
  - c. Add appropriate MaxPRO licensing to TEXRail's existing "Primary System Only".
- B. Video Camera Coverage and Requirements.
1. Provide video IP cameras at both parking lots, walkways, crosswalks, and pedestrian transportation waiting area locations as shown on the security plans.
- C. System Infrastructure.
1. All of the video IP cameras shall be routed to the outdoor network nema enclosure as located on the security drawings.
  2. Fiber backbone from the communication facility to the Nema enclosure shall be existing and utilized for communication.
  3. The power provided to the Nema enclosure shall be on the backup power supply (UPS) capable of full system support during a complete power failure, including generator failure.
  4. Each field IP camera shall be connected to the video surveillance system's dedicated network Power over Ethernet (PoE) switch located in the network cabinet using CAT6 cable and the Axis PoE extenders. Each network switch will be connected to the dedicated system's backbone with a one (1) Gigabit fiber optic cable (FOC) which will then interconnect the Owner's backbone. Where FOC is used for a field camera's communication method, a UL Listed 120VAC outdoor weatherproof enclosure must be utilized and mounted in close proximity of the camera location to provide a Fiber to Ethernet conversion point and from the enclosure a CAT6 cable shall be ran to the camera and connected. Coordination with the electrical contractor will be required to provide power to the enclosure.
- D. Miscellaneous Items.
1. Provide all documentation as required for field installation by subcontractors and integrators technical staff.
  2. Provide training and familiarization to selected Owner's personnel. Training shall include setup of equipment firmware, hardware, and/or software and thereafter preventative maintenance (if any), maintenance troubleshooting, and repair/replacement how-to guide/support.
  3. Coordinate all elements of the system's installation with the General Contractor.
  4. Coordinate installation of devices with the related subcontractors. Other non-related contractors shall be restricted from the security details and this contractor shall seek General Contractor approval and Owner's approval before releasing security detail to any project contractor that is not related to the security work scope.
  5. Provide complete software support and system maintenance for two (2) years with options for post warranty service.

## VIDEO IP SYSTEM - COMMUNICATIONS SYSTEM

### 1.4 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- B. Shop Drawings: Schematic of system components with physical space requirements.

### 1.5 QUALITY ASSURANCE

- A. Qualification of Integrator
  - 1. A firm certified or licensed by the video equipment manufacturer as experienced and with sufficient trained staff to install manufacturer's products to specified requirements.
- B. Qualification of Installers
  - 1. All camera installations, configurations, setups, program and related work shall be performed by technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
- C. Regulatory Requirements: Comply with all applicable laws, ordinances, and regulatory requirements.
- D. Certifications: Provide the following written certifications.
  - 1. Certify that technicians and subcontracted person(s) conducting terminations, or systems programming, have been subjected to a criminal

background evaluation consisting of arrest records check for jurisdiction of residence for a minimum period of five (5) years from the date of contract award. Personnel convicted of criminal offenses within the past five (5) years shall not be assigned to perform work on this system.

- 2. Certify that the Integrator is an authorized representative of the video equipment being proposed for this project and that the Integrator is authorized to sell, install and service the system.
- 3. Submit certification of completion for manufacturer-supplied factory training on the systems proposed for this project.
- E. All of the equipment provided shall be warranted for a minimum of one (1) year and all manufacturers' warranties shall be transferred to the Owner.
- F. Pre-Installation Meetings.
  - 1. Attend a pre-construction meeting with Integrator's Project Manager and others as required to review expectations, work quality, schedule and other issues.
- G. Meetings.
  - 1. Attend progress meetings to discuss issues that arise during that course of the work and to coordinate the work effort.
  - 2. Comply with requirements for safety meetings.
  - 3. During this time, conduct brief work progress inspections to determine and gauge potential conflicts with the project schedule.
- H. Familiarization of Installation Personnel.
  - 1. All on-site Integrator's personnel shall be provided with copies of drawings and specifications,



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including Related Sections indicated herein. Do not permit any installer to work on this project until they have reviewed all such materials and have a thorough familiarization with the products and installation methods on the contract documents.

2. This provision is subject to jobsite inspection at any time. Those not meeting the above criteria are subject to dismissal from the jobsite.
- I. Observations by Project Coordinator, the Security Consultant or the Owner designated representatives.
    1. Periodic and occasional observations of the Work in progress will be made by Project Coordinator, the Security Consultant or the Owner designated representatives as deemed necessary to review progress of Work and general conformance with design intent.
  - J. Inspections and test by manufacturer's representatives.
    1. Inspections and Tests by Manufacturer's Representatives: Contractor shall cause all test and inspections specified to be conducted by equipment or systems manufacturers, to be made. Additionally, all tests and inspections required by equipment or systems manufacturers as condition of warranty or certification of Work shall be made, the cost of which shall be included in the Contract Sum.

### **1.6 PRE-INSTALLATION MEETINGS**

- A. Convene minimum two weeks prior to starting work of this section.

### **1.7 DELIVERY, STORAGE AND HANDLING**

- A. Deliver system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturer's labels identifying product and manufacturer, date of manufacture, lot number, and other characteristics required for placement.
- B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminates or other causes.

### **1.8 PROJECT CONDITIONS**

- A. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

### **1.9 REFERENCES**

- A. Applicable Building Codes and requirements of regulatory agencies.
- B. Underwriters Laboratories
- C. Provide products that are UL Listed and Labeled as indicated in product descriptions.
- D. Refer to product descriptions for additional standards requirements.
- E. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

### **1.10 PROJECT SEQUENCING**

- A. Ensure that products of this section are supplied to affected trades in

## VIDEO IP SYSTEM - COMMUNICATIONS SYSTEM

time to prevent interruption of construction progress.

documents unattended or permit use by person not in the employ of the Integrator.

### 1.11 SECURITY AND SAFETY

#### A. Installation Personnel

1. Certify that technicians and subcontracted person(s) conducting terminations, or systems programming, have been subjected to a criminal background evaluation consisting of arrest records check for jurisdiction of residence for a minimum period of five (5) years from the date of contract award. Personnel convicted of criminal offenses within the past five (5) years shall not be assigned to perform work on this system.

#### B. Security of Documents

1. Documents associated with this project represent detailed depictions of a "security system" and special handling procedures to ensure their security shall be provided by the Integrators and all subcontractors involved. The term "Sensitive Documents" as used herein is defined as:
  - a. Notes, documents and copies thereof depicting wiring information and locations in detail regarding the building security system including, but not limited to, shop drawings, technical data, mark-up drawings, sketches and technical information.

#### C. Observe the following precautions regarding Sensitive Documents:

1. Secure Sensitive Documents in locked containers when not in use.
2. Maintain control of Sensitive Documents while the documents are in use. Do not leave such

#### D. Divulging Information.

1. No employee of Contractor, Subcontractor or Sub-subcontractor involved in or with the installation of this system shall discuss, display, demonstrate technical intricacies or divulge technical information to person except the following:
  - a. The Owner's designated technical personnel including the System Administrator.
  - b. Consultants employed by the Owner
  - c. Architect/Electrical Engineer
  - d. Personnel as permitted by the Owner and authorized by the Owner
  - e. Manufacturers of product used in the system
  - f. Technical personnel employed by the Integrator or Sub-subcontractors who have a legitimate need for such information.

#### E. Network Security.

1. Comply with the Owner's IT procedures required to protect the Owner's network from unauthorized intrusion (i.e. firewalls, VPN's, strong passwords, etc.).
2. Review security provisions with Owner's IT staff to ensure such protocols are observed.

### 1.12 CURRENCY OF TECHNOLOGY

- A. Integrator recognizes the period between Contracting, Beneficial Use

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and Final Completion and understands that technology; particularly those items related to security and information technology (including software and hardware) will advance from its present level. Integrator to maintain currency, as new technology develops, to include all software and firmware provided with this system.

- B. All equipment, software, devices and components used on this project shall be new and of the most recent models and software revisions that have been manufactured within the last year prior to installation.

### 1.13 WARRANTY

- A. Warranty covering all equipment firmware, hardware, and/or software issues for a minimum of five years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Video IP Camera Manufacturers (Axis or Engineer approved equivalent):
  1. Axis Communications, which is located at: 433 E. Las Colinas Blvd, Suite 600, Irving, TX 75039; Toll Free Tel: 800-444-2947; Web: [www.axis.com](http://www.axis.com)

### 2.2 GENERAL

- A. Equipment and materials used shall be standard components, regularly manufactured, regularly utilized in the manufacturer's system.
- B. Systems and components shall have been thoroughly tested and proven in actual use.
- C. Equipment must meet National Defense Authorization (NDAA) compliance requirements.

- D. Meet "Buy America" requirements.
- E. Systems and components shall be provided with the availability of a toll free 24-hour immediate technical assistance for either the dealer/installer or the end user at no charge.
- F. Systems and components shall be provided with an explicit manufacturer warranty.
- G. Installation of specified IP cameras at the locations identified in the project drawings.
- H. This project shall provide all components required for a complete and operable system and to accommodate all functions mentioned.
- I. The video IP camera system shall be integrated into the Owner's existing system for alarm video response and automatic tagging of alarm event.

### 2.3 VIDEO IP CAMERAS

- A. Video IP cameras shall be integrated into the Owner's existing Video Management System (VMS) Software.
- B. Cameras
  1. IP PoE and/or PoE+ cameras shall be utilized throughout this project and must integrate into the Owner's existing VMS system and network.
  2. High Resolution 180-degree IP Network Outdoor Dome Cameras. (Function Code: 180-pl-d)
    - a. Axis P3818-PVE Network Outdoor Dome Camera (or Engineer approved equivalent).

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- b. Camera brackets utilized shall be from the camera manufacturers current product line including:
    - 1) Axis T91B47 Pole Mount Bracket
  - c. Camera shall be powered via PoE or PoE+.
  - d. High Resolution 180-degree cameras shall be utilized as depicted on the drawings.
3. High Resolution Multi-directional IP Network Outdoor Cameras. (Function Code: md-pl-d and md-c-d)
- a. Axis P3719-PLE Network Outdoor Dome Camera (or Engineer approved equivalent).
  - b. Camera brackets utilized shall be from the camera manufacturers current product line including:
    - 1) Axis T91B47 Pole Mount Bracket
    - 2) Axis T91B51 Ceiling Swivel Mount
  - c. Camera shall be powered via PoE or PoE+.
4. Mounting Brackets for IP Cameras: Type matched to items supported and mounting conditions. Mounting brackets shall be made of aluminum and the finish shall match the camera's housing. Mounting brackets and hardware for wall, pole and ceiling mounted cameras shall be factory finished using manufacturer's standard finishing process suitable for the environment. Mounting hardware including the banding straps for pole mounted cameras shall be stainless steel.
- a. Fix-wb-d: Fixed (fix) wall bracket mounted (wb) dome (d) camera.
  - b. Fix-pl-d: Fixed (fix) pole mounted (pl) dome (d) camera.
  - c. 180-pl-d: 180-degree (180) pole mounted (pl) dome (d) camera.
  - d. Md-c-d: Multi-directional (md) ceiling mounted (c) dome (d) camera.
  - e. MD-pl-d: Multi-directional (md) pole mounted (pl) dome (d) camera.
- C. Long Range PoE Extender Kits.
- 1. Axis Long Range PoE Extender Kits (or Engineer approved equivalent).
    - a. Supports IEEE 802.3af, IEEE 802.3at compliant devices.
    - b. NEMA TS2 Compatible.
- D. Rugged (24 port) Network Switch.
- 1. Cameras to utilize an 802.3at PoE Plus with a 10GB uplink.
- E. Wires, Cables and Connectors
- 1. Reference Section 16841 Communications Cables.
- F. Surge Protection
- 1. Reference Section 16837 Miscellaneous Components and Products.
- G. Battery Backup Systems
- 1. Reference Section 16879 Power Supplies and Distribution.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. General Installation Requirements.
  - 1. Coordinate connector types and backbone connections with Trinity Metro IT Department.
  - 2. Inspect locations where components are to be installed and ensure suitability of

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- mounting surfaces and conditions prior to installation.
3. Install additional conduit as required to accommodate devices and functional requirements and to comply with conduit requirements.
  4. Wiring from each camera shall be home run to the dedicated Network PoE Switch.
  5. Install components and equipment in accordance with manufacturer's instructions using new material and the highest standard of workmanship.
  6. Wire shall be continuous from device to device. Splices, where permitted shall occur inside secured pull boxes and electrical junction boxes only. Do not splice wires inside conduit or inside other component cabinets. Make all wire splices mechanically secure and equipped with clamp plate electrical connectors. Insulate splices equal to or exceeding the wire insulation rating.
  7. Identify cables at both ends using printed cable labeling system and protect label from scuffing or being pulled from the cable by manufacturer's standard protective film. Coded labeling schemes shall be accompanied by interpretive documents installed at the central server unit.
  8. Provide means to indicate where terminations are located.
  9. Ensure a pull string remains intact in each conduit where new conduits are provided.
  10. Take precautions to prevent tampering with cables, conduit, components, and other items. Use security fasteners for removable covers and access on pull boxes or junction boxes except in locked mechanical spaces or completely concealed wall surfaces.
11. Prior to making CAT6 connections, test and certify that the CAT6 line can pass a one (1) Gigabit connection. Do not permit untested cables to be connected to the system without ensuring wiring is correct.
  12. Do not employ double back tape to attach devices, wires or any other components. Use screws to fasten such items.
  13. Inspect connections prior to concealing or closing cover to insure cables are properly connected and not in danger of breaking.
  14. Bench test equipment prior to installation in the field.
  15. Protect installed products until completion of project.
  16. Keep job site clean of debris.
- B. Wire, cable and conduit.
1. Verify cable and conduit distances to determine if CAT6 cable runs exceed 300 feet in length. If CAT6 cable runs exceed 300 feet and PoE long range extenders are not utilized or approved, fiber optic cable and fiber hardened switches will be required.
  2. Pull cables, including spares, to locations as required. Verify wire count and conduit dimensions.
  3. Pull cables to locations avoiding over-tensions and chaffing of insulating materials.
  4. Check all cable runs for shorts and continuity and verify location prior to connection.
  5. Label all cables in a logical and orderly convention that is consistent throughout the entire system. Provide sample of cable labeling scheme as part of shop drawing submittal. Label all

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spare cables as spare with locations served.

6. Wiring shall be accomplished in a neat and workmanlike manner.

### C. Video Surveillance

1. Verify the camera's model number and its specified mounting location prior to installation.
2. Use the camera manufacturer's mounting brackets and fasteners when installing each camera.
3. Test and certify each CAT6 cable prior to connecting the camera to the system.
4. Verify and confirm with the Owner each camera's focal point to make certain the area of coverage is being obtained.
5. Install and verify proper operation of the cameras mounted in their designated location.
6. Verify connection to each local field camera for proper operation.
7. Install and verify connectivity of the Owner's existing VMS to each of the remote IP devices including cameras.
8. Test and verify each camera input being integrated from the intrusion detection system is operating properly as required.

### D. Surge Protection

1. Install surge protection devices on all powered components with inductive type loads, or where suggested by the manufacturer, or where dictated by industry practice.
2. Install surge protection equipment on all 120 VAC circuits at the point of connection with the equipment served.

## 3.2 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

## 3.3 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommend by the manufacturer for achieving the best result for the substrate under the project conditions.

## 3.4 INSPECTION

- A. Inspect and test the physical security devices, equipment and site protection measures in accordance with manufacturer's specifications.
- B. The inspection and testing shall demonstrate, without exception that the quality and operations of the systems comply with the contract requirements. This demonstration shall include comparing "As-Built" conditions of the security measures to requirements outlined in the project specification, item by item.
- C. Inspection of the video surveillance system shall include worst-case testing of each of the security systems including operation on standby power and under abnormal conditions, to verify total system operation and capabilities. Moreover, testing and commissioning will include user application of the system in order to confirm users' comprehensive understanding of operating policies, procedures and system knowledge intended by the Owner.
- D. Verify that all cabling and equipment have been labeled and documented.

END OF SECTION 16880

**SECTION 16897  
MANUALS AND TRAINING - COMMUNICATIONS SYSTEM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The manuals and training provided under this Section shall provide the Authority personnel with the knowledge to operate, maintain, troubleshoot, and repair the equipment provided by these Specifications.
- B. Existing Manuals
  - 1. Rail Operations Controller (ROC) Manuals
  - 2. Applications System Management Manuals (ASMM)
  - 3. Distributed System Management Manuals
  - 4. Operations and Maintenance (O&M) Manuals
  - 5. Remote Terminal Unit (RTU) Operation and Maintenance Manuals
  - 6. Communications System Maintenance Manuals (CSMM)
- C. New Work: Provide new and customized information corresponding to the Authority's design and equipment being provided under this Contract.
- D. Manuals
  - 1. General requirements and specifications for all manuals required under this Contract can be found in these Specifications.
  - 2. Specific content requirements for Communications and Control System elements or subsystems shall be contained in this section.
  - 3. The information to be provided shall include all required information required for the operation, maintenance, troubleshooting, repair, and restore of the equipment and systems.
  - 4. Original manufacturers' data sheets shall be included to supplement the manuals' text.
  - 5. Manuals and all training material shall be written in English.

**E. Training Program**

- 1. The Authority will assign supervisory, maintenance, and other personnel to the Contractor's training classes as required.
- 2. Training will be held at an Authority location. The Authority will provide the required facilities, adequate seating, and required lighting.
- 3. Each training course shall be held on consecutive days, excluding weekends and holidays. Each day's training shall be for 8 hours, unless otherwise specified. Training schedule shall accommodate all personnel on all shifts. Specific training days and availability shall be coordinated with the Authority at least 2 weeks prior to commencement. Instructors present at the class location shall conduct training.
- 4. Courses shall include hands-on training. The Authority will provide transportation to the field locations to allow for hands-on training if required.
- 5. Course instructors shall be certified professional instructors and shall have performed training in similar systems before, and shall be adept in the use of the training and test equipment employed in the training program.
- 6. The Authority reserves the right unto itself to videotape all training sessions for its own use. Video taped training material will become the property of the Authority and shall not be subject to Contractor copyright protection.
- 7. In addition to the personnel specified to receive training herein, up to 2 additional personnel may observe and participate on any or all training classes, including hands-on training.

**1.2 SUBMITTALS**

**A. Manuals**

- 1. Preliminary copies of all manuals shall be submitted for approval no later than 90 days following Final Design Review (FDR) submittal Authority approval.
- 2. Final copies of all manuals shall be submitted for Authority approval. Contractor developed manuals shall be provided in an Authority approved machine-readable format. When available, manufacturer manuals and

technical data shall be provided in an Authority approved machine-readable format, suitable for microfilming. Final copies of all manuals shall also be provided electronically, in both their native software format and PDF format, complete with any associated appendices.

3. Refer to Section 01786, "Operations and Maintenance Instructions", for the O&M Manual submittal requirements.
  4. The Training Manual shall be submitted as an electronic copy prior to training for record purposes. The printed quantities for the Training Manual to be provided shall be as described in Part 2 of this Specification.
- B. Training Plan. Contractor shall submit a complete training plan for Authority approval. The training plan shall include the following information:
1. A proposed schedule for each course, including syllabus for training and lesson plan
  2. Resumes of personnel proposed to be instructors for each course
  3. A statement of the purpose of the training
  4. An overview of the subjects to be covered in each course
  5. An overview of the hands-on experience to be included as part of each course
  6. A list of the manuals, As-Built Documentation, and other printed materials to be utilized as training aides
  7. A description of the pre-requisite knowledge for each course
- C. Training Course Program. Contractor shall submit 6 copies of a complete program for each course, at least 60 days prior to the scheduled start of the course for Authority approval. Each training program shall contain the following information:
1. A detailed outline of the material to be covered in the course and the duration in hours of the training for each topic
  2. Course scheduling plan to cover all shift personnel.
  3. Copies of all visual aides, manuals, As-Built Documentation, and other printed materials to be used during the course.

4. Detailed descriptions of the procedures to be performed by students during hands-on training, including test equipment to be used
5. Specific pass/fail criteria for the course, including a sample test, and a statement of the knowledge and skills students should possess at the conclusion of the course
6. Instructor Evaluation Survey

- D. Training Materials. Contractor shall deliver all training materials to the Authority 5 days prior to the commencement of the associated training class.
1. Delivery location of associated materials shall be coordinated with the Authority personnel.
  2. Sufficient copies shall be provided to accommodate all class attendees as well as auditors.
  3. The Authority reserves the right to duplicate all training material to accommodate additional personnel.
  4. Additional personnel may be added to the attendance roster at no additional cost to the Authority.

## PART 2 - PRODUCTS

### 2.1 CONTRACTOR FURNISHED MATERIALS

- A. Contractor shall provide new custom manuals for each subsystem provided under this Contract. Specific manual volumes are listed in Sections 2.2 and 2.3 of this Specification.
- B. General requirements in addition to those specified in other sections of this contract include:
1. Manufacturer's standard O&M Manuals, documentation, and configuration software provided with each piece of equipment furnished under this Contract.
  2. Manufacturer's Contact Information
  3. Manufacturer's Basic Product Information, including;
    - a. Literature describing each piece of equipment, including major assemblies and subassemblies, and giving manufacturer's model number and drawing number.



- b. Catalogue cut sheets, illustrated parts list and parts breakdowns.
- 4. Release notes for new revisions of any software product provided, upgraded, or modified in any subsystem.
- 5. Safety Procedures and Precautions
  - a. Ensure safety procedures and precautions are included and highlighted.
  - b. These shall include procedures and precautions required to prevent damage to equipment, injury to personnel, or unsafe operational conditions.
- 3. Pre-operation Checkout: Include the required steps or tasks to completely check out the system and prepare it for operation following a shutdown condition.
- 4. Operator's instructions covering startup, shutdown and all procedures required to ensure safe operation. Repeat these instructions in a durable printed notice and mount in the operator's area.
- 5. Preventive Maintenance: Describe all maintenance to be performed on a periodic basis, e.g., inspection, calibration, voltages and amperage. Prepare scheduled maintenance checklists for each unique type of maintenance significant equipment. Submit the checklists to the Authority approval prior to implementation.

**2.2 O&M MANUALS**

- A. O&M manuals shall include each make and model of equipment installed or modified under this contract.
- B. Identify O&M tasks including recommended periodic maintenance, precautions to be observed during maintenance work, degree of on-line repairs, numbers, qualifications and skills of personnel, special tools and test equipment, and estimates of maintenance time.
- C. Prepare O&M manuals providing detailed instruction for the operation of each system condition; maintenance and safety actions required to ensure the operational requirements of the systems, subsystems, and equipment. Identify any safety markings, tags or similar identifiers to be maintained on any equipment.
- D. Prepare the O&M manuals for each system and supplement with vendor instructions and data covering the O&M of individual items and equipment provided. This includes all configuration and software documents or CDs supplied with the equipment. Use this data as the training material for the individuals tasked to operate the installed equipment and systems.
- E. Include in the manuals system-level step-by-step O&M procedures to be performed by journeyman operators or technicians, and provide the following elements, as required:
  - 1. Complete description of all systems with data sheets, bill of materials, flow, control and electrical circuit and wiring diagrams
  - 2. System Operation: This information describes the system operation, including operating parameters, interfaces with other systems, major equipment, and their physical and operating characteristics.
- 6. Fault Isolation: Describe the procedures to be followed in determining the cause of a failure or malfunction. Base fault identification on monitoring devices and visual observations. Progressively order fault isolation, with the most likely fault listed first.
- 7. Maintenance: Describe all maintenance that can be performed on installed equipment, including removal, replacement, and repairs that can be performed.
- 8. System Restore: Describe step-by-step procedures for complete system restore in case of a catastrophic failure. Identify any specific tools required for system restore. Provide details of all user configurable settings for each piece of equipment.
- F. Organize the O&M procedures in such a manner that all required preventive maintenance activities be accomplished without interference with operations. Emphasize in these procedures accessibility, ease of equipment or component removal and replacement, visual indications of component deterioration, and localization of failures. Where practical, configure subsystems so that failed components may be removed and operable replacements installed. Minimize requirements for repair-in-place activities.
- G. Provide all like assemblies having identical characteristics interchangeable without altering unit or adjacent equipment except for adjustment. Provide assemblies interchangeable without selection for fit of performance, and without modification.

- H. Logistics Data:
- 1. Provide a logistics plan of O&M, which encompasses the following aspects:
    - a. Provide the required data on requirements for O&M logistics, support and procedures. Include the following:
      - 1) Identification of the extent to which preventive maintenance is performed on installed equipment as opposed to corrective maintenance performed at a maintenance facility.
      - 2) Identification of equipment requiring special handling or unique maintenance procedures.
      - 3) Determination of procurement lead times based on total order and shipping time to site for critical equipment and spares, and minimum and maximum inventory requirements.
      - 4) Identification of O&M personnel skills levels.
      - 5) Identifications of training requirements.
      - 6) Formulate and recommend operating rules for personnel.
    - b. Vendor Data: Submit the following types of data and incorporate in the O&M manuals:
      - 1) Manufacturers' brochures, catalogs, charts, performance curves, and parts bulletins
      - 2) Complete vendor list for each system subassembly
      - 3) Installation, operations, and service instructions
      - 4) Service bulletins.
      - 5) Shop drawings and other special drawings such as wiring diagrams, system schematics, assembly drawings, and inter-connection diagrams.
  - 2. Provide a list of special tools and test equipment for each equipment item, including tools and equipment designated specifically for use with the item, or usual tools and equipment required for operation maintenance of the
    - 6) Illustrated breakdowns.
    - 7) Installation drawings.
    - 8) Performance data, e.g., maximum, minimum, and recommended speeds, capacities, voltage, amperage, wattage, temperatures, and other related operating information.
    - 9) Operating procedures.
    - 10) Preventive maintenance and inspection requirements and procedures
    - 11) Emergency operating procedures
    - 12) Removal and installation procedures
    - 13) Disassembly and assembly procedures
    - 14) Calibration instructions, including points of application, frequency, method of calibration, and special tools required.
    - 15) Troubleshooting procedures.
    - 16) Repair and overhaul instructions.
    - 17) Cleaning instructions.
    - 18) Include industry or generic part numbers with component parts.
    - 19) Special tools and test equipment.
    - 20) Hazards from unsafe operations, emergency release/stop functions

items but not normally available to maintenance journeyman. Include the following data on the list for each item:

- a. Nomenclature
- b. Purpose
- c. Manufacturer's part number or drawing number
- d. Manufacturer's name and address
- e. Quantity recommended by manufacturer
- f. Unit price
- g. Recommended source of supply
- h. Estimated lead-time

**2.3 TRAINING MANUALS**

- A. The Training Manuals shall supplement the O&M manuals. The Training Manuals shall focus on guiding technicians in identifying the source of a problem to a specific subsystem and a specific replaceable element as well as identifying, and describing interrelationships and with other subsystems. References to required replacement procedures within manufacturer's manuals shall be provided.
- B. Provide a printed copy of the Training Manuals for each trainee and auditor attending training classes per Part 3 of this Section.
- C. The Training Manuals shall at a minimum include the following sections and information:
  - 1. Safety Procedures and Precautions: This section shall cover safety procedures and precautions required to prevent damage to equipment, injury to personnel, or unsafe operational conditions. Items to be addressed shall include:
    - a. Safety with AC Power Sources.
    - b. Safety with and verification of polarity of DC sources and batteries.
    - c. Electrostatic procedures for handling circuit cards.
    - d. Necessity for grounding of equipment.
    - e. Procedures and tests that should only be done on unpowered or de-activated equipment

- 2. Test Equipment and Tools: This section shall contain an overview of the test equipment and tools required to troubleshoot and maintain the system.
  - a. Tests performed by each piece of test equipment shall be described.
  - b. Typical values for tests shall be provided.
  - c. Sensitivity ranges and polarity checks of test equipment shall be discussed.
- 3. Public Address/Visual Message Board (PA/VMB) Remote Components: This section shall contain a discussion on the operation and maintenance of the PA/VMB components that are included in the Communications House and at Stations. This section shall identify and describe interrelationships between other subsystems and troubleshooting methods spanning between related or dependent subsystems.
- 4. Communications Transmission Subsystem: This section shall contain an overview of procedures for tracing circuit continuity from end to end, isolating noise sources, measuring levels at interfaces, determining bit error rates and cleaning equipment. This section shall identify and describe interrelationships between other subsystems and troubleshooting methods spanning between related or dependent subsystems.
- 5. Fire Detection and Alarms: This section shall contain an overview of procedures for checking detector circuits, checking detector sensitivity, cleaning detectors, verifying operation of control panels and batteries, maintenance of fire suppression systems, verifying operation of sensors, and verifying IP Communicator interfaces and RTU interfaces to the supervisory control system. This section shall contain detailed programming and wiring information for each Fire Alarm Control Panel (FACP) provided. This section shall identify and describe interrelationships between other subsystems and troubleshooting methods spanning between related or dependent subsystems.
- 6. Intrusion Alarms: This section shall contain an overview of procedures for checking detector circuit, alignment and sensitivity, cleaning detector, verifying operation of detector, alarm panel, keypad and batteries, and verifying RTU interfaces.

- 7. Telephones: This section shall contain an overview of procedures for testing and isolating problems with all telephone equipment and circuits provided and provisioned. This section shall identify and describe interrelationships between other subsystems and troubleshooting methods spanning between related or dependent subsystems.
- 8. Central Control System: This section shall be processed as a supplement to the existing DART manuals providing information regarding modifications to the DART CCS and the associated RTU's.
- 9. CCTV: Provide an overview of the expansion of the DART CCTV system to include the new stations.
- 4. Support additions to and expansions of any new or modified subsystem.
- 5. Coordinate with equipment manufacturers support personnel for obtaining warranty support and troubleshooting support.
- D. Topics: Training shall include familiarization with system modifications, upgrades, or additions made to the following subsystems and equipment as a result of Work performed under this Contract:
  - 1. Updated CTS topology and functional description with emphasis on issues that may impact network maintenance. Include complete description of the Gb/s Ethernet network configuration and its interface to the existing SONET.
  - 2. Fiber optic communications equipment including Gb/s Ethernet Network switches, 100 Mb/s network switches, VoIP gateways and routers, , optical modems, media converters, data switches ,power supplies, and any other communications equipment provided under this Contract
  - 3. Fiber optic cable, connectors, distribution panels and splicing
  - 4. Communications cable, interface cabinets, junction boxes and terminations
  - 5. Fire and intrusion alarm control panels, IP-based DACT, IP based Fire Alarm Reporting unit (DACR), sensors, and annunciation devices
  - 6. PA and VMB subsystem and detailed description for all stations.
  - 7. Telephone subsystem.
  - 8. Changes to the Central Control System and new PLC equipment.
  - 9. Additions to the CCTV system for the new stations.

**PART 3 - EXECUTION**

**3.1 SUPERVISOR FAMILIARIZATION AND OPERATIONS TRAINING REQUIREMENTS**

- A. Contractor shall develop and provide Familiarization and Operations Training thoroughly describing the modifications and additions made to each communications subsystem.
- B. Personnel and Course Composition
  - 1. Training shall consist of at least 2 classes, each class designed for 3 operational personnel supervisors, 3 maintenance personnel supervisors, and 2 auditors [16 total personnel]. Each class shall be at least 8 hours in length, unless otherwise Authority approved.
  - 2. Auditors shall be provided the same class materials, handouts, and access to the instructor, hands-on activity or demonstration as class participants.
- C. Training Goals: The goal of the Initial Familiarization and Operations Training is to provide the O&M supervisors with a high-level understanding of the subsystems provided under this Contract, sufficient for the supervisors to perform the following functions
  - 1. Assign maintenance personnel required for routine maintenance and troubleshooting.
  - 2. Assist maintenance personnel with use of manuals and As-Built Documentation.
  - 3. Evaluate actual system performance vs. intended system performance.

**3.2 TECHNICIAN FAMILIARIZATION AND OPERATIONS TRAINING REQUIREMENTS**

- A. Contractor shall develop and provide Familiarization and Operations Training thoroughly describing the modifications and additions made to each communications subsystem under this Contract.

- B. Personnel and Course Composition
1. Training shall consist of at least 2 classes, each class typically designed for 12 maintenance technician personnel and 2 auditors for a minimum total of 28 total personnel. Each class shall be at least 16 hours in length, unless otherwise Authority approved.
  2. Auditors shall be provided the same class materials, handouts, and access to the instructor, hands-on activity or demonstration as class participants.

C. Training Goals: Initial Familiarization and Operations Training goal shall be to provide O&M technicians with a high-level understanding of the subsystems provided under this Contract, sufficient to perform the following functions

1. Perform routine maintenance and troubleshooting.
2. Identify single points of failure and restore the affected subsystem in case of a catastrophic failure or incident.
3. Become familiar with the use of manuals and As-Built Documentation.
4. Test and evaluate actual system performance vs. intended system performance.
5. Support additions to and expansions of the CTS subsystem.
6. Coordinate with equipment manufacturers support personnel for obtaining warranty support and troubleshooting support.

D. Topics: Training shall include familiarization with system modifications, upgrades, or additions made as a result of Work performed under this contract.

**3.3 OTHER O&M TRAINING REQUIREMENTS**

A. For equipment for which a Part Number or Model Number is not expressly specified for use in these Specifications, or if equipment is provided in lieu of that for which a Part Number or Model Number is specified in these Specifications, the Contractor shall provide both Familiarization and Operations Training as well as product or subsystem specific Operations and Maintenance Training.

B. Course Goals: Each training course shall provide maintenance personnel with the knowledge and skills required to:

1. Gain a thorough understanding of the operation of the equipment.
2. Gain familiarity with the specific components and their role.
3. Gain familiarity with drawings and other design and installation documentation.
4. Gain familiarity with and use procedures in the corresponding maintenance manual.
5. Be adept at using all tools, test equipment and built-in diagnostics and monitors.
6. Be adept at performing preventative maintenance.
7. Be adept at identifying the root cause of a subsystem failure and restoring the affected subsystem in the event of a catastrophic failure or incident.
8. Gain familiarity with system safety procedures and the potential for creating unsafe conditions during operation or maintenance.
9. Be adept at performing first level maintenance (to the Field Replaceable Unit), including.
  - a. Using facilities, tools, test equipment and troubleshooting strategies and procedures to efficiently recognize problems, troubleshoot equipment in the field, isolate the problem, and determine units which have failed or are operating incorrectly.
  - b. Removing failed or incorrectly operating equipment from service safely and with minimal impact on continued operation of the system.
  - c. Capturing and recording supporting diagnostic data to help further troubleshooting of the FRU.
  - d. Planning and implementing temporary workarounds.
  - e. Ensuring candidate replacement units are operating correctly, and have correct settings.

- f. Installing replacement units safely and correctly, checking that the replacement unit is operating correctly, and introducing the replacement unit into the operating system with minimal impact.
10. Be adept at performing shop maintenance to the Lowest Level Replaceable Unit and including:
- a. Using tools and test equipment to efficiently isolate the problem within the subject FRU, troubleshoot, and determine which replaceable unit has failed or is operating incorrectly.
  - b. Removing replaceable units from the field replaceable units.
  - c. Capturing and recording diagnostic data.
  - d. Coordinating with manufacturer's support staff and information centers as needed, including actions such as downloading, installing and testing new firmware.
  - e. Rebuilding, configuring and verifying correct operation of higher-level replaceable units; up through and including field replaceable units.

#### **PART 4 – MEASUREMENT AND PAYMENT**

##### **4.1 GENERAL**

- A. The Work specified in this Section will not be measured separately for payment.

##### **4.2 PAYMENT**

- A. All costs connected herewith shall be considered incidental to the Work specified under Section 16801 "Basic Technical Requirements - Communications System."

END OF SECTION 16897

**SECTION 16899**  
**TECHNICAL SUPPORT AND SPARES - COMMUNICATIONS SYSTEM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies the technical support services, materials, and equipment to be provided:
1. Maintenance Until Final Acceptance
  2. Warranty and Extended Services
  3. Test Equipment
  4. Spares

**1.2 SUBMITTALS**

- A. Recommended Spare Equipment Listing
1. Contractor shall submit a list of recommended spares for a period extending from installation of the equipment to 1 year of operation of the equipment following Final Acceptance.
  2. The list shall include all spare parts, by manufacturer and model number that the Contractor intends to provide in accordance with the minimum spares requirements defined below. In addition, the proposed quantities, unit prices, and total prices for spares shall be provided.
  3. The submittal shall also include recommendations for changing quantities of spares, adding and/or deleting items in order to meet the Authority's goals of having spares for 1 full year of operation after system acceptance. Complete descriptions, part numbers, and prices for spare equipment, recommended to be added, shall be provided.
- B. Specific Spare Parts: Contractor shall provide the specific spare parts listed in this Specification.
- C. Recommended Test Equipment Listing
1. Contractor shall submit a list of required and recommended test equipment and special tools for performing maintenance and trouble shooting on the communications system.
  2. The list shall include itemized pricing for all test equipment and tools.
  3. The submittal shall also include a list of any additional test equipment that the Contractor recommends for the long-term maintenance and trouble shooting of the system in order to meet the system Mean Time to Repair (MTTR) goals. Complete descriptions, part numbers and itemized pricing for recommended test equipment shall be provided.

D. Specific Test Equipment: Contractor shall provide the specific test equipment listed in this Specification.

E. Warranty

1. Contractor shall submit warranty information as described in this Specification.
2. Contractor shall submit point-of-contact information as described in this Specification.

**PART 2 - PRODUCTS**

**2.1 MAINTENANCE UNTIL FINAL ACCEPTANCE**

A. Maintenance

1. Contractor shall perform all maintenance on the Communication Transmission Subsystem (CTS) and all other installed subsystems, equipment and software, from the time that the equipment is installed until Final Acceptance.
  - a. Contractor shall maintain inventory records of all spare equipment utilized in maintenance and the replacement of spare equipment for items covered under the manufacturers warranty or the warranty specified herein.
    - 1) Any equipment removed from service shall be made available to the Authority for inspection prior to return to manufacturer.
    - 2) Equipment that is removed from service and is not returned to the manufacturer for replacement or repair shall be delivered to the Authority.
2. The maintenance to be performed shall include repair and/or replacement of all communications elements that fail prior to final system acceptance by the Authority.
  - a. Contractor shall commence repair of any CTS component that fails within 4 hours of notification of the failure by the Authority or discovery of the failure by the Contractor's personnel. For all other equipment elements, the Contractor shall commence within 24 hours of notification of the failure by the Authority or discovery of the failure by the Contractor's personnel. Contractor shall notify the Authority immediately upon discovery of an equipment failure and shall provide written notification within 24 hours.
  - b. Contractor shall perform all routine and preventive maintenance and clean all

installed equipment, in accordance with the equipment manufacturer's recommendations.

- c. Contractor shall repair any equipment that is damaged by vandalism.

**2.2 WARRANTY AND EXTENDED SERVICES**

A. Contractor shall warrant all equipment (including spares and test equipment), materials, software, and installation Work for a period starting upon installation and ending 1 year after Final Acceptance. This period is also referred to as the "Warranty Period."

- 1. Contractor shall maintain all manufacturer warranties, prior to final acceptance. Contractor shall warranty any equipment if manufacturers' warranty runs out prior to end of the Warranty Period.
- 2. Where a manufacturer's warranty extends beyond the Warranty Period, the balance of manufacturer's warranty shall be transferred to the Authority (at no cost to the Authority) at the end of the Contractor's Warranty Period. Contractor shall provide complete warranty documentation to the Authority upon completion of the Warranty Period.
- 3. Contractor shall replace or repair any item that fails, at no additional cost to the Authority, during the Warranty Period.
- 4. Contractor shall provide the Authority with the name, address and telephone numbers of the warranty-period firm and of the primary contact person.

B. On-Call Support. During the Warranty Period, the Contractor shall provide on-call technical support.

- 1. Calls initiated by the Authority between 8:00 AM and 5:00 PM Central time shall be answered within 2 hours.
- 2. Calls initiated by the Authority between 5:00 PM and 8:00 AM Central time shall be answered no later than 10:00 AM Central time.

C. On-Site Support

- 1. If during the warranty period, the Authority determines the system is not meeting the equipment reliability requirement or system availability requirement, the Contractor shall provide on-site technical support to fully understand the problems identified and to correct the deficiencies.
- 2. Contractor shall coordinate all Work with the Authority in order to avoid any existing warranty disqualification on any component or system.

- 3. Contractor shall be responsible for reinstating or otherwise providing warranty for any component or system whose original warranty has been voided due to lack of coordination.

**2.3 TEST EQUIPMENT – SPECIFIC**

Not Used

**2.4 SPARES – SPECIFIC**

A. Ethernet Switches

- 1. Contractor shall provide 1 spare 1 Gb/s Ethernet switch of each type provided under this contract. The Ethernet switch shall include fiber optic interface and copper Ethernet ports as equipped for each station.
- 2. Contractor shall provide 1 spare 100Mb/s Ethernet switch of each type provided under this contract.

B. Fiber Optic Patch Cables

- 1. Contractor shall provide the following equipment, which shall conform to these requirements:
  - a. A total of 24 SC to SC, singlemode duplex, 1 meter length patch cables.
  - b. A total of 24 SC to SC, multimode, duplex, 1 meter length patch cables.

2. Media Converters

- a. Contractor shall provide 1 spare media converter of each type for every 10 installed under this Contract.

C. Public Address (PA) Subsystem Spares. Contractor shall provide the following PA subsystem spares:

- 1. One audio processor.
- 2. Two audio power amplifiers of each type.
- 3. One digital signal processor.
- 4. One speech processor.
- 5. Twelve speakers with backboxes.
- 6. One microphone.

D. Visual Message Board (VMB) Subsystem Spares. Contractor shall provide the following VMB subsystem spares:

- 1. One Local Video Message (LVM) (Laptop PC) equipped with proper software to maintain, program and troubleshoot the PA/VMB system.



2. One RS-232 to RS-422 converter if applicable.
3. Two strobes.
4. Six LED modules.
5. Six power supplies.

E. Power Supplies Spares

1. Contractor shall provide 1 spare power supply of each voltage rating, current rating, and application power supply that the Contractor provides in accordance with these Specifications.
2. Contractor shall provide 1 complete spare UPS of each type provided in accordance with these Specifications.

F. Protected Terminal Blocks (PTB) and Modules

1. Contractor shall provide 1 spare PTB, including enclosure, of each type and size, per these Specifications.
2. Contractor shall provide 100 spare protector modules of each type provided, per these Specifications.

G. Miscellaneous

1. Contractor shall provide 1 spare CCTV camera of each type for every 20 installed. A minimum of 1 spare of each type is required.
2. Contractor shall provide spare connectorized cables sufficient for complete wiring of 1 drop and insert node
3. Contractor shall provide 1 set of spare fire alarm equipment, sufficient to completely replace the fire alarm equipment at one Communications House.
4. Contractor shall provide 1 set of spare intrusion alarm equipment, sufficient to completely replace the intrusion alarm equipment at one Communications House.
5. Contractor shall provide 1 spare intrusion detection magnetic door switch for every 10 switches installed in CICs in accordance with these Specifications.
6. Contractor shall provide 1,000 feet of 50 pair cable if 50 pair is required per design plans. The cable shall in be in accordance with these Specifications.

**PART 4 – MEASUREMENT AND PAYMENT**

**4.1 GENERAL**

- A. The Work specified in this Section will not be measured separately for payment.

**4.2 PAYMENT**

- A. All costs connected herewith shall be considered incidental to the Work specified under Section 16801 "Basic Technical Requirements - Communications System."

END OF SECTION 16899

**PART 3 - EXECUTION**

Not Used