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APPLICATION		REVISION HISTORY					
NEXT ASSY	USED ON	PART NO.	ZONE	REV	DESCRIPTION	DATE	APPROVAL
				A	01 78 00, 31 00 00, 33 11 00, 33 32 13.13, and 33 33 00 revised.	1-4-12	RL

TECHNICAL SPECIFICATIONS FOR DRAWING 79K38879 REVISION A

NASA KSC Export Control Office (ECO)
Export/SBU Determination Record
EDDR#

TITLE OF DOCUMENT:

SENSITIVE BUT UNCLASSIFIED (SBU)
INSTRUCTIONS: This item must be reviewed under the requirements for "Sensitive But Unclassified Information" as described in NPR 1600.1, Chapter 5.24 http://modis3.gsfc.nasa.gov/main_lib.html

	Yes	No	SBU Reviewer's Signature	Date
Document contains SBU?	☐	☒		12-9-11

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ECO Reviewer's Name and Organization	ECO Reviewer's Signature	Date
PING YU, NASA TA-B3A		12-9-11

	EXPORT DETERMINATION (☒ one box only)	
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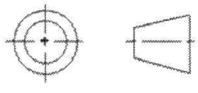
(Stamp Revision: (05-19-2009)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994. TOLERANCES ON:
FRACTIONS DECIMALS ANGLES

THIRD ANGLE PROJECTION



CAD MAINTAINED. CHANGES SHALL BE INCORPORATED ONLY BY THE DESIGN ACTIVITY.

ORIGINAL DATE OF DRAWING (YY/MM/DD)		
DRAFTSMAN	CHECKER	
SOFTWARE	ENGINEER	CHECKER
FILENAME	ENGINEER	STRESS
MATERIAL	ENGINEER	
HEAT TREATMENT	SUBMITTED	
FINAL PROTECTIVE FINISH	APPROVED	

JOHN F. KENNEDY SPACE CENTER, NASA
KENNEDY SPACE CENTER, FLORIDA

Revitalize Water/Wastewater Systems, Phase 4 - DP2 - KARS Park
PCN:96968.3

SIZE	CAGE CODE	DWG NO	REV
A		79K38880	A
SCALE		UNIT WEIGHT	SHEET 1 OF 520

KSC FORM 21-2C NS (REV. 06/04) PREVIOUS EDITIONS ARE OBSOLETE

Architect/Engineer of Record Certification

Project Title:	Revitalize Water/Wastewater Systems, Phase 4, DP 2
Project Control Number:	96968.3
Project Drawing Number:	79K38879
Project Specification Number:	79K38880
Project Calculations/Data Manual Number:	KSC-TA-11382

Discipline	Name	ST	License No.	Signature
Civil	Robert W. Best, Jr.	FL	69875	Robert W. Best, Jr.
Instrumentation	David P. Fitzgerald	FL	40976	David P. Fitzgerald
Structural	Wenjun Li	FL	56104	Wenjun Li
Mechanical	Robert W. Best, Jr.	FL	69875	Robert W. Best, Jr.
Electrical	Michael L. Clark	FL	48898	Michael L. Clark
Environmental	Kim E. Rivera	FL	65681	Kim E. Rivera

PROJECT TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

01 11 00 SUMMARY OF WORK
01 33 00 SUBMITTAL PROCEDURES
01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS
01 42 00 SOURCES FOR REFERENCE PUBLICATIONS
01 57 20.00 10 ENVIRONMENTAL PROTECTION
01 57 23 TEMPORARY STORM WATER POLLUTION CONTROL
01 78 00 CLOSEOUT SUBMITTALS
01 78 23 OPERATION AND MAINTENANCE DATA

DIVISION 02 - EXISTING CONDITIONS

02 41 00 DEMOLITION AND DECONSTRUCTION
02 82 13.00 98 ASBESTOS ABATEMENT
02 82 33.13 20 REMOVAL/CONTROL AND DISPOSAL OF PAINT WITH LEAD

DIVISION 03 - CONCRETE

03 30 00 CAST-IN-PLACE CONCRETE
03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION

DIVISION 05 - METALS

05 50 13 MISCELLANEOUS METAL FABRICATIONS

DIVISION 09 - FINISHES

09 90 00.00 98 PAINTING AND COATING
09 97 24 CONCRETE REPAIR AND HYDROGEN SULFIDE PROTECTIVE COATING

DIVISION 26 - ELECTRICAL

26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS
26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL
26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES
26 24 16.00 40 PANELBOARDS
26 43 00.00 99 SURGE PROTECTIVE DEVICE (SPD)
26 60 13.00 40 LOW-VOLTAGE MOTORS

DIVISION 27 - COMMUNICATIONS

27 13 23.00 40 COMMUNICATIONS OPTICAL BACKBONE CABLING

DIVISION 31 - EARTHWORK

31 00 00 EARTHWORK

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 31 13 CHAIN LINK FENCES AND GATES
32 92 23 SODDING

DIVISION 33 - UTILITIES

33 05 24 DIRECTIONAL DRILLING

33 11 00 WATER DISTRIBUTION
33 30 00 SANITARY SEWERS
33 32 13.13 SEWAGE LIFT STATIONS
33 35 00 ONSITE SEWAGE DISPOSAL SYSTEM ABANDONMENT
33 71 01.00 40 OVERHEAD TRANSMISSION AND DISTRIBUTION
33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION

DIVISION 40 - PROCESS INTEGRATION

40 95 00 PROCESS CONTROL SYSTEM

-- End of Project Table of Contents --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 REFERENCES
1.2 DEFINITIONS
1.3 SUBMITTALS
1.4 WORK COVERED BY CONTRACT DOCUMENTS
1.4.1 Project Description
1.4.2 Location
1.5 CONTRACT DRAWINGS
1.6 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

PART 2 PRODUCTS

PART 3 EXECUTION

-- End of Section Table of Contents --

SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 2114	(2008) Standard Terminology for Sustainability Relative to the Performance of Buildings

1.2 DEFINITIONS

Definitions pertaining to sustainable development are as defined in ASTM E 2114, Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION, and as specified.

a. "Environmentally preferable products" have a lesser or reduced effect on the environment in comparison to conventional products and services. This comparison may consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, or disposal of the product.

b. "Sustainability" is the balance of environmental, economic, and societal considerations.

1.3 SUBMITTALS

Not used.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

1.4.1 Project Description

The work consists of demolishing and replacing water and wastewater system components at KARS Park I. Demolition includes but is not limited to removing and abandoning of sewer septic systems. Replacement includes but is not limited to installing a DI water main, HDPE force mains, grinder pump lift stations, sewer systems, and associated appurtenances at KARS Park I, as well as abandoning the existing 4-inch PVC water main in place. The DI water main will be connected to the City of Cocoa WDS, and the force mains will be connected to the Brevard County wastewater collection system. Gravity sewers and manholes along 2nd Street between C and D Avenues will be replaced.

1.4.2 Location

The work shall be located at the KARS Park I, approximately as indicated on the drawings. The exact locations will be shown by the Contracting Officer.

1.5 CONTRACT DRAWINGS

The following drawings accompany this specification and are a part thereof.

Drawing No. 79K38879
Sheets 1 through 52

The publications of the issues of referenced documents in effect on the date of issuance of invitation for bids form a part of this specification and, where referred to herein by basic designation only, are applicable to the extent indicated by the references thereto. In the event of difference between this specification or its accompanying drawings and the referenced document, this specification and its accompanying drawings must govern to the extent of such difference.

1.6 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered recycled materials. These items, when incorporated into the work under this contract, must contain at least the specified percentage of recycled or recovered material.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 DEFINITIONS
1.1.1 Submittal Descriptions (SD)
1.1.2 Approving Authority
1.1.3 Work
1.2 SUBMITTALS
1.3 SUBMITTAL CLASSIFICATION
1.3.1 Government Approved (G)
1.3.2 Information Only
1.4 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL
1.4.1 Submittals Required from the Contractor
1.4.1.1 O&M Data
1.5 PREPARATION
1.5.1 Transmittal Form
1.5.2 Identifying Submittals
1.5.3 Format for SD-02 Shop Drawings
1.5.4 Format of SD-03 Product Data and SD-08 Manufacturer's Instructions
1.5.5 Format of SD-05 Design Data and SD-07 Certificates
1.5.6 Format of SD-06 Test Reports and SD-09 Manufacturer's Field Reports
1.5.7 Format of SD-10 Operation and Maintenance Data (O&M)
1.5.8 Format of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals
1.6 INFORMATION ONLY SUBMITTALS
1.7 VARIATIONS
1.7.1 Considering Variations
1.7.2 Proposing Variations
1.7.3 Warranting That Variations Are Compatible
1.7.4 Review Schedule Is Modified
1.8 SCHEDULING
1.8.1 Reviewing, Certifying, Approving Authority
1.8.2 Constraints
1.9 GOVERNMENT APPROVING AUTHORITY
1.9.1 Review Notations
1.10 DISAPPROVED SUBMITTALS
1.11 APPROVED SUBMITTALS
1.12 STATUS REPORT ON MATERIALS ORDERS

PART 2 PRODUCTS

PART 3 EXECUTION

-- End of Section Table of Contents --

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections.

Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

Contractor's Quality Control (CQC) System Manager and the Designer of Record, if applicable, to check and approve all items prior to submittal and stamp, sign, and date indicating action taken. Proposed deviations from the contract requirements are to be clearly identified. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

Submittals requiring Government approval are to be scheduled and made prior to the acquisition of the material or equipment covered thereby. Pick up and dispose of samples not incorporated into the work in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

1.1 DEFINITIONS

1.1.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

SD-01 Preconstruction Submittals

Submittals which are required prior to start of construction (work) issuance of notice to proceed or commencing work on site or the start of the next major phase of the construction on a multi-phase contract. Includes schedules, tabular list of data, or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work, submitted prior to start of construction work start of construction work contract notice to proceed or next major phase of construction.

Certificates of insurance

Surety bonds

List of proposed Subcontractors

List of proposed products

Construction Progress Schedule

Network Analysis Schedule (NAS)

Submittal register

Schedule of prices

Health and safety plan

Work plan

Quality control(QC) plan

Environmental protection plan

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

Design submittals, design substantiation submittals and extensions of design submittals.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared

for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and MSDS concerning impedances, hazards and safety precautions.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

Interim "DD Form 1354" with cost breakout for all assets 30 days prior

to facility turnover.

1.1.2 Approving Authority

Office or designated person authorized to approve submittal.

1.1.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, except those SD-01 Pre-Construction Submittals noted above, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.2 SUBMITTALS

Not used.

1.3 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.3.1 Government Approved (G)

Government approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Government approval is required for any deviations from the Solicitation or Accepted Proposal and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.3.2 Information Only

Submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.4 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL

1.4.1 Submittals Required from the Contractor

As soon as practical after award of contract, and before procurement of fabrication, forward to the Contracting Officer, submittals required in the technical sections of this specification, including shop drawings, product data and samples.

The Government will review and approve for the Contracting Officer those submittals reserved for Contracting Officer approval to verify submittals comply with the contract requirements.

1.4.1.1 O&M Data

The Government will review and approve for the Contracting Officer O&M Data to verify the submittals comply with the contract requirements; submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

In the event the Contractor fails to deliver O&M Data within the time

limits specified, the Contracting Officer may withhold from progress payments 50 percent of the price of the item with which such O&M Data are applicable.

1.5 PREPARATION

1.5.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels to office of approving authority. Transmit submittals with transmittal form prescribed by Contracting Officer and standard for project. On the transmittal form identify Contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled, "Identifying Submittals," of this section. Process transmittal forms to record actions regarding sample installations.

1.5.2 Identifying Submittals

When submittals are provided by a Subcontractor, the Prime Contractor is to prepare, review and stamp with Contractor's approval all specified submittals prior to submitting for Government approval.

Identify submittals, except sample installations and sample panels, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location.

b. Construction contract number.

c. Date of the drawings and revisions.

d. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other subcontractor associated with the submittal.

e. Section number of the specification section by which submittal is required.

f. Submittal description (SD) number of each component of submittal.

g. When a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission.

h. Product identification and location in project.

1.5.3 Format for SD-02 Shop Drawings

Shop drawings are not to be less than 8 1/2 by 11 inches nor more than 30 by 42 inches, except for full size patterns or templates. Prepare drawings to accurate size, with scale indicated, unless other form is required. Drawings are to be suitable for reproduction and be of a quality to produce clear, distinct lines and letters with dark lines on a white background.

Present 8 1/2 by 11 inches sized shop drawings as part of the bound volume for submittals required by section. Present larger drawings in sets.

Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph

entitled, "Identifying Submittals," of this section.

Number drawings in a logical sequence. Contractors may use their own number system. Each drawing is to bear the number of the submittal in a uniform location adjacent to the title block. Place the Government contract number in the margin, immediately below the title block, for each drawing.

Reserve a blank space, no smaller than 4 inches on the right hand side of each sheet for the Government disposition stamp.

Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Use the same unit of measure for shop drawings as indicated on the contract drawings. Identify materials and products for work shown.

Include the nameplate data, size and capacity on drawings. Also include applicable federal, military, industry and technical society publication references.

1.5.4 Format of SD-03 Product Data and SD-08 Manufacturer's Instructions

Present product data submittals for each section as a complete, bound volume. Include table of contents, listing page and catalog item numbers for product data.

Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.

Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for project, with information and format as required for submission of SD-07 Certificates.

Include the manufacturer's name, trade name, place of manufacture, and catalog model or number on product data. Also include applicable federal, military, industry and technical society publication references. Should manufacturer's data require supplemental information for clarification, submit as specified for SD-07 Certificates.

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal and marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will not be accepted for expedition of construction effort.

Submit manufacturer's instructions prior to installation.

1.5.5 Format of SD-05 Design Data and SD-07 Certificates

Provide design data and certificates on 8 1/2 by 11 inches paper. Provide a bound volume for submittals containing numerous pages.

1.5.6 Format of SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Provide reports on 8 1/2 by 11 inches paper in a complete bound volume.

Indicate by prominent notation, each report in the submittal. Indicate specification number and paragraph number to which it pertains.

1.5.7 Format of SD-10 Operation and Maintenance Data (O&M)

Comply with the requirements specified in Section 01 78 00 CLOSEOUT SUBMITTALS for O&M Data format.

1.5.8 Format of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

When submittal includes a document which is to be used in project or become part of project record, other than as a submittal, do not apply Contractor's approval stamp to document, but to a separate sheet accompanying document.

1.6 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

1.7 VARIATIONS

Variations from contract requirements require both Designer of Record (DOR) and Government approval pursuant to contract Clause FAR 52.236-21 and will be considered where advantageous to Government.

1.7.1 Considering Variations

Discussion with Contracting Officer prior to submission, after consulting with the DOR, will help ensure functional and quality requirements are met and minimize rejections and re-submittals. When contemplating a variation which results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

Specifically point out variations from contract requirements in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the

Government.

1.7.2 Proposing Variations

When proposing variation, deliver written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government, including the DOR's written analysis and approval. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

1.7.3 Warranting That Variations Are Compatible

When delivering a variation for approval, Contractor, including its Designer(s) of Record, warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.7.4 Review Schedule Is Modified

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the Government of submittals with variations.

1.8 SCHEDULING

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals.

a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.

b. Period of review for each resubmittal is the same as for initial submittal.

At the Preconstruction conference, provide, for approval by the Contracting Officer, the following schedule of submittals:

a. A schedule of shop drawings and technical submittals required by the specifications and drawings. Indicate the specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.

b. A separate schedule of other submittals required under the contract but not listed in the specifications or drawings. Schedule will indicate the contract requirement reference; the type or title of the submittal; the Contractor's anticipated submission date and the approved need date (if approval is required).

1.8.1 Reviewing, Certifying, Approving Authority

The Contractor is responsible for reviewing and certifying that submittals are in compliance with contract requirements. At each "Submittal"

paragraph in individual specification sections, a notation "G," following a submittal item, indicates Contracting Officer is approving authority for that submittal item.

1.8.2 Constraints

Conform to provisions of this section, unless explicitly stated otherwise for submittals listed or specified in this contract.

Submit complete submittals for each definable feature of work. Submit at the same time components of definable feature interrelated as a system.

When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, submittal will be returned without review.

Approval of a separate material, product, or component does not imply approval of assembly in which item functions.

1.9 GOVERNMENT APPROVING AUTHORITY

When approving authority is Contracting Officer, the Government will:

a. Note date on which submittal was received from the Contractor.

b. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

c. Identify returned submittals with one of the actions defined in paragraph entitled, "Review Notations," of this section and with markings appropriate for action indicated.

Upon completion of review of submittals requiring Government approval, stamp and date approved submittals.

1.9.1 Review Notations

Contracting Officer review will be completed within 14 calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "approved" or "accepted" authorize the Contractor to proceed with the work covered.

b. Submittals marked "approved as noted" "or approved except as noted, resubmittal not required," authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.

c. Submittals marked "not approved" or "disapproved," or "revise and resubmit," indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.

d. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an

explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

1.10 DISAPPROVED SUBMITTALS

If changes are necessary to submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.11 APPROVED SUBMITTALS

The Contracting Officer's approval or acceptance of submittals is not be construed as a complete check, and indicates only that the general method of construction, materials, detailing and other information are satisfactory design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal.

Approval or acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work.

After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.12 STATUS REPORT ON MATERIALS ORDERS

Within 30 calendar days after notice to proceed, submit, for approval by the Contracting Officer, an initial material status report on all materials orders. This report will be updated and re-submitted every 30 calendar days as the status on material orders changes.

Report to include list, in chronological order by need date, materials orders necessary for completion of the contract. The following information will be required for each material order listed:

a. Material name, supplier, and invoice number.

b. Bar chart line item or CPM activity number affected by the order.

c. Delivery date needed to allow directly and indirectly related work to be completed within the contract performance period.

d. Current delivery date agreed on by supplier.

e. When item d exceeds item c, the effect that delayed delivery date will have on contract completion date.

f. When item d exceeds item c, a summary of efforts made by the Contractor to expedite the delayed delivery date to bring it in line with the needed delivery date, including efforts made to place the order (or subcontract) with other suppliers.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 DEFINITIONS
1.4 REGULATORY REQUIREMENTS
1.5 SITE QUALIFICATIONS, DUTIES AND MEETINGS
1.5.1 Personnel Qualifications
1.5.1.1 Site Safety and Health Officer (SSHO)
1.5.1.2 Construction Safety Hazard Awareness Training
1.5.1.3 Competent Person for Confined Space Entry
1.5.1.4 Crane Operators
1.5.2 Personnel Duties
1.5.2.1 Site Safety and Health Officer (SSHO)
1.5.3 Meetings
1.5.3.1 Preconstruction Conference
1.5.3.2 Safety Meetings
1.6 CRANE CRITICAL LIFT PLAN
1.7 DISPLAY OF SAFETY INFORMATION
1.8 SITE SAFETY REFERENCE MATERIALS
1.9 EMERGENCY MEDICAL TREATMENT
1.10 REPORTS
1.10.1 Accident Reports
1.10.2 Accident Notification
1.10.3 Crane Reports
1.10.4 Certificate of Compliance
1.11 HOT WORK
1.12 FACILITY OCCUPANCY CLOSURE
1.13 WELDING
1.14 HIGH NOISE LEVEL PROTECTION
1.15 SEVERE STORM PLAN
1.16 CONFINED SPACE ENTRY REQUIREMENTS

PART 2 PRODUCTS

2.1 CONFINED SPACE SIGNAGE
2.2 FALL PROTECTION ANCHORAGE

PART 3 EXECUTION

3.1 CONSTRUCTION AND/OR OTHER WORK
3.2 PRE-OUTAGE COORDINATION MEETING
3.3 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)
3.3.1 Tag Placement
3.3.2 Tag Removal
3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

3.4.1 Training
3.4.2 Fall Protection Equipment and Systems
3.4.2.1 Personal Fall Arrest Equipment
3.4.3 Existing Anchorage
3.4.4 Horizontal Lifelines
3.4.5 Guardrails and Safety Nets
3.4.6 Rescue and Evacuation Procedures
3.5 EQUIPMENT
3.5.1 Material Handling Equipment
3.5.2 Weight Handling Equipment
3.5.3 Equipment and Mechanized Equipment
3.5.4 USE OF EXPLOSIVES
3.6 EXCAVATIONS
3.6.1 Utility Locations
3.6.2 Utility Location Verification
3.6.3 Shoring Systems
3.6.4 Trenching Machinery
3.7 UTILITIES WITHIN CONCRETE SLABS
3.8 ELECTRICAL
3.8.1 Conduct of Electrical Work
3.8.2 Portable Extension Cords
3.9 WORK IN CONFINED SPACES

-- End of Section Table of Contents --

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B30.22	(2005) Articulating Boom Cranes
ASME B30.3	(2009) Tower Cranes
ASME B30.5	(2007) Mobile and Locomotive Cranes

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA NPG 8621.1	(2004a) NASA Mishap Reporting, Investigating and Record Keeping Policy
NASA NSS 1740.12	(1993) NASA Safety Standard For Explosives, Propellants and Pyrotechnics

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2010) Standard for Portable Fire Extinguishers
NFPA 51B	(2009; TIA 09-1) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2011) National Electrical Code
NFPA 70E	(2009; Errata 09-1) Standard for Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.500	Fall Protection

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Government acceptance is required for submittals with a "G, A" designation.

SD-01 Preconstruction Submittals

Safety and Health Plan; G

Crane Critical Lift Plan; G

Proof of qualification for Crane Operators; G

SD-06 Test Reports

Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."

Crane Reports

1.3 DEFINITIONS

a. Competent Person for Fall Protection. A person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as their application and use with related equipment, and has the authority to take prompt corrective measures to eliminate the hazards of falling.

b. High Visibility Accident. Any mishap which may generate publicity and/or high visibility.

c. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

d. Operating Envelope. The area surrounding any crane. Inside this "envelope" is the crane, the operator, riggers and crane walkers, rigging gear between the hook and the load, the load and the crane's supporting structure (ground, rail, etc.).

e. Qualified Person for Fall Protection. A person with a recognized degree or professional certificate, and with extensive knowledge, training and experience in the field of fall protection; who is capable of performing design, analysis, and evaluation of fall protection systems and equipment.

f. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:

(1) Death, regardless of the time between the injury and death, or the length of the illness;

(2) Days away from work (any time lost after day of injury/illness onset);

(3) Restricted work;

(4) Transfer to another job;

(5) Medical treatment beyond first aid;

(6) Loss of consciousness; or

(7) A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

h. Weight Handling Equipment (WHE) Accident. A WHE accident occurs when any one or more of the six elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; and/or collision, including unplanned contact between the load, crane, and/or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, roll over, etc.)

1.4 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with the most recent addition of federal, state, and local laws, ordinances, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

1.5 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.5.1 Personnel Qualifications

1.5.1.1 Site Safety and Health Officer (SSHO)

The contractor shall provide a Safety oversight team that includes a minimum of one (1) Competent Person at each project site to function as the Site Safety and Health Officer (SSHO). The SSHO shall be at the work site at all times, unless specified differently in the contract, to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor, and their training, experience, and qualifications shall be as required. A Competent Personal shall be provided for all of the hazards identified in the Contractor's Safety and Health Program in accordance with the accepted Accident Prevention Plan, and shall be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. The credentials of the Competent Persons(s) shall be approved by the Contracting Officer in consultation with the Safety Office.

1.5.1.2 Construction Safety Hazard Awareness Training

The training requirements for the Site Safety and Health Officer (SSHO) must meet the General Construction Safety training requirements of 29 CFR 1926 and must include the successful completion of the course entitled "Construction Safety Hazard Awareness Training for Contractors" or the course entitled "Construction Industry Requirements; Awareness of Major Hazards and Prevention Strategies (OSHA 7415)". If the SSHO does not have a current certification, they must obtain the course certification within sixty (60) calendar days from award.

1.5.1.3 Competent Person for Confined Space Entry

Provide a competent person for confined space.

1.5.1.4 Crane Operators

For mobile cranes with Original Equipment Manufacturer (OEM) rated capacitates of 50,000 pounds or greater, designate crane operators as qualified by a source that qualifies crane operators (i.e., union, a government agency, or and organization that tests and qualifies crane operators). Provide proof of current qualification.

1.5.2 Personnel Duties

1.5.2.1 Site Safety and Health Officer (SSHO)

a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily production report.

b. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 and Daily Production reports for prime and sub-contractors.

c. Maintain applicable safety reference material on the job site.

d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.

e. Implement and enforce accepted Safety and Health Plan.

f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. Post a list of unresolved safety and health deficiencies on the safety bulletin board.

g. Ensure sub-contractor compliance with safety and health requirements.

h. Maintain a list of hazardous chemicals on site and their material safety data sheets.

Failure to perform the above duties will result in dismissal of the superintendent, QC Manager, and/or SSHO, and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

1.5.3 Meetings

1.5.3.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, or any other assigned safety and health professionals who participated in the development of the APP Safety and Health Plan.

b. Discuss the details of the submitted Safety and Health Plan.

c. Deficiencies in the submitted Safety and Health Plan will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted Safety and Health Plan.

1.5.3.2 Safety Meetings

Conduct and document meetings daily as required. Attach minutes showing contract title, signatures of attendees and a list of topics discussed to the Contractors' daily quality control report.

1.6 CRANE CRITICAL LIFT PLAN

Prepare and sign weight handling critical lift plans for lifts over 75 percent of the capacity of the crane or hoist (or lifts over 50 percent of the capacity of a barge mounted mobile crane's hoists) at any radius of lift; lifts involving more than one crane or hoist; lifts of personnel; and lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks. Submit 15 calendar days prior to on-site work and include the requirements of USACE EM 385-1-1, paragraph 16.H. and the following:

(1) For lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.550(g).

(2) For barge mounted mobile cranes, barge stability calculations identifying barge list and trim based on anticipated loading; and load charts based on calculated list and trim. The amount of list and trim shall be within the crane manufacturer's requirements.

1.7 DISPLAY OF SAFETY INFORMATION

Within 1 calendar days after commencement of work, erect a safety bulletin board at the job site. Where size, duration, or logistics of project do not facilitate a bulletin board, an alternative method, acceptable to the Contracting Officer, that is accessible and includes all mandatory information for employee and visitor review, shall be deemed as meeting the requirement for a bulletin board. Additional items required to be posted include:

a. Confined space entry permit.

b. Hot work permit.

1.8 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

1.9 EMERGENCY MEDICAL TREATMENT

Emergency medical treatment is available to the Contractor by calling 321-867-7911. Medical facilities are located in the VAB area and Industrial Area as shown below.

Medical	
Occupational Health Facility 2nd and C Avenue Hours: 7:00 a.m. to 5:00 p.m., Mon-Fri	321-867-3346
LC 39 Area Clinic Utility Road and VAB Road Hours: 7:00 a.m. to 3:30 p.m., Mon-Fri	321-867-3360

1.10 REPORTS

1.10.1 Accident Reports

a. Conduct an accident investigation for recordable injuries and illnesses, as defined in 1.3.h and property damage accidents resulting in at least $2,000 in damages, to establish the root cause(s) of the accident and provide the report to the Contracting Officer within 5 calendar day(s) of the accident.

b. Conduct an accident investigation for any weight handling equipment accident (including rigging gear accidents) to establish the root cause(s) of the accident, complete the WHE Accident Report (Crane and Rigging Gear) form and provide the report to the Contracting Officer within 30 calendar days of the accident. Do not proceed with crane operations until cause is determined and corrective actions have been implemented to the satisfaction of the contracting officer.

1.10.2 Accident Notification

Notify the Contracting Officer as soon as practical, but not later than four hours, after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than $2,000, or any weight handling equipment accident in accordance with NASA NPG 8621.1. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted.

1.10.3 Crane Reports

Submit crane inspection reports required in accordance with USACE EM 385-1-1,

Appendix I and as specified herein with Daily Reports of Inspections.

1.10.4 Certificate of Compliance

A Certificate of Compliance is required for each crane entering an activity under this contract. State within the certificate that the crane and rigging gear meet applicable OSHA regulations (with the Contractor citing which OSHA regulations are applicable, e.g., cranes used in construction, demolition, or maintenance comply with 29 CFR 1926. Certify on the Certificate of Compliance that the crane operator(s) is qualified and trained in the operation of the crane to be used.

1.11 HOT WORK

Submit and obtain a written permit prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, from the Fire Division. A permit is required from the Explosives Safety Office for work in and around where explosives are processed, stored, or handled. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The Contractor will provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency Fire Division phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED IMMEDIATELY.

1.12 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the Contracting Officer.

1.13 WELDING

Paints containing heavy metals or hazardous materials may exist on metals. The Contractor shall require employees to wear the proper PPE during welding activities.

1.14 HIGH NOISE LEVEL PROTECTION

Operations performed by the Contractor that involve the use of equipment with output of high noise levels (jackhammers, air compressors, and explosive-actuated devices) shall be scheduled with the Facility Manager. Use of any such equipment shall be approved in writing by the Contracting Officer prior to commencement of work.

1.15 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

1.16 CONFINED SPACE ENTRY REQUIREMENTS

Contractors entering and working in confined spaces performing general industry work are required to follow the requirements of OSHA 29 CFR 1926.

PART 2 PRODUCTS

Not used.

2.1 CONFINED SPACE SIGNAGE

Provide permanent signs integral to or securely attached to access covers for new permit-required confined spaces. Signs wording: "DANGER--PERMIT-REQUIRED CONFINED SPACE - DO NOT ENTER -" in bold letters a minimum of one inch in height and constructed to be clearly legible with all paint removed. The signal word "DANGER" shall be red and readable from 5 feet.

2.2 FALL PROTECTION ANCHORAGE

Leave in place fall protection anchorage, conforming to 29 CFR 1926, installed under the supervision of a qualified person in fall protection, for continued customer use and so identified by signage stating the capacity of the anchorage (strength and number of persons who may be tied-off to it at any one time).

PART 3 EXECUTION

3.1 CONSTRUCTION AND/OR OTHER WORK

Comply with Federal and/or State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply for utility outages at least 14 days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the Contracting Officer to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Contractor shall ensure that each employee is familiar with and complies with these procedures.

Contracting Officer will, at the Contractor's request, apply

lockout/tagout tags and take other actions that, because of experience and knowledge, are known to be necessary to make the particular equipment safe to work on for government owned and operated systems.

No person, regardless of position or authority, shall operate any switch, valve, or equipment that has an official lockout/tagout tag attached to it, nor shall such tag be removed except as provided in this section. No person shall work on any energized equipment including, but not limited to activities such as erecting, installing, constructing, repairing, adjusting, inspecting, un-jamming, setting up, trouble shooting, testing, cleaning, dismantling, servicing and maintaining machines equipment of processes until an evaluation has been conducted identifying the energy source and the procedures which will be taken to ensure the safety of personnel.

When work is to be performed on electrical circuits, only qualified personnel shall perform work on electrical circuits.

A supervisor who is required to enter an area protected by a lockout/tagout tag will be considered a member of the protected group provided he notifies the holder of the tag stub each time he enters and departs from the protected area.

Identification markings on building light and power distribution circuits shall not be relied on for established safe work conditions.

Before clearance will be given on any equipment other than electrical (generally referred to as mechanical apparatus), the apparatus, valves, or systems shall be secured in a passive condition with the appropriate vents, pins, and locks.

Pressurized or vacuum systems shall be vented to relieve differential pressure completely.

Vent valves shall be tagged open during the course of the work.

Where dangerous gas or fluid systems are involved, or in areas where the environment may be oxygen deficient, system or areas shall be purged, ventilated, or otherwise made safe prior to entry.

3.3.1 Tag Placement

Lockout/tagout tags shall be completed in accordance with the regulations printed on the back thereof and attached to any device which, if operated, could cause an unsafe condition to exist.

If more than one group is to work on any circuit or equipment, the employee in charge of each group shall have a separate set of lockout/tagout tags completed and properly attached.

When it is required that certain equipment be tagged, the Government will review the characteristics of the various systems involved that affect the safety of the operations and the work to be done; take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the system and equipment safe to work on; and apply such lockout/tagout tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is referred to as "Providing Safety Clearance."

3.3.2 Tag Removal

When any individual or group has completed its part of the work and is clear of the circuits or equipment, the supervisor, project leader, or individual for whom the equipment was tagged shall turn in his signed lockout/tagout tag stub to the Contracting Officer. That group's or individual's lockout/tagout tags on equipment may then be removed on authorization by the Contracting Officer.

3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

Establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.

3.4.1 Training

Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with 29 CFR 1926.

3.4.2 Fall Protection Equipment and Systems

Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in 29 CFR 1926. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926.500, Subpart M.

3.4.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet 29 CFR 1926. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 6 feet. The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

3.4.3 Existing Anchorage

Certified (or re-certified) by a qualified person for fall protection

existing anchorages, to be used for attachment of personal fall arrest equipment in accordance with 29 CFR 1926. Existing horizontal lifeline anchorages must be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

3.4.4 Horizontal Lifelines

Design, install, certify and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

3.4.5 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with 29 CFR 1926 Subpart M.

3.4.6 Rescue and Evacuation Procedures

When personal fall arrest systems are used, the contractor must ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Fall Protection and Prevention (FP&P) Plan and the Safety and Health Plan.

3.5 EQUIPMENT

3.5.1 Material Handling Equipment

a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.

c. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

3.5.2 Weight Handling Equipment

a. Notify the Contracting Officer 15 days in advance of any cranes entering the activity so that necessary quality assurance spot checks can be coordinated. Contractor's operator shall remain with the crane during the spot check.

b. Comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in ASME B30.5). Perform all testing in accordance with the manufacturer's recommended procedures.

c. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes.

d. Under no circumstance shall a Contractor make a lift at or above 90 percent of the cranes rated capacity in any configuration.

e. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and follow the requirements of OSHA and ASME B30.5 or ASME B30.22 as applicable.

f. Do not crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane.

g. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.

h. All employees must keep clear of loads about to be lifted and of suspended loads.

i. Use cribbing when performing lifts on outriggers.

j. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

k. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.

l. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by Contracting Officer personnel.

m. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by Contracting Officer personnel.

n. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

o. Take steps to ensure that wind speed does not contribute to loss of control of the load during lifting operations. Prior to conducting lifting operations set a maximum wind speed at which a crane can be safely operated based on the equipment being used, the load being lifted, experience of operators and riggers, and hazards on the work site. This maximum wind speed determination shall be included as part of the activity hazard analysis plan for that operation.

3.5.3 Equipment and Mechanized Equipment

a. Proof of qualifications for operator shall be kept on the project site for review.

b. Manufacture specifications or owner's manual for the equipment shall be on-site and reviewed for additional safety precautions or requirements that are sometimes not identified by OSHA.

3.5.4 USE OF EXPLOSIVES

Explosives shall not be used or brought to the project site without prior written approval from the Contracting Officer. Such approval shall not

relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

Storage of explosives, when permitted on Government property, shall be only where directed and in approved storage facilities. These facilities shall be kept locked at all times except for inspection, delivery, and withdrawal of explosives.

Explosive work shall be performed in accordance with NASA NSS 1740.12. This document is available at:

http://www.hq.nasa.gov/office/codeq/doctree/871912.htm

3.6 EXCAVATIONS

Perform soil classification by a competent person in accordance with 29 CFR 1926.

3.6.1 Utility Locations

Prior to digging, the appropriate digging permit must be obtained. All underground utilities in the work area must be positively identified by a private utility locating service in addition to any station locating service and coordinated with the station utility department. Any markings made during the utility investigation must be maintained throughout the contract.

3.6.2 Utility Location Verification

The Contractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. Digging within 2 feet of a known utility must not be performed by means of mechanical equipment; hand digging shall be used. If construction is parallel to an existing utility expose the utility by hand digging every 100 feet if parallel within 5 feet of the excavation.

3.6.3 Shoring Systems

Trench and shoring systems must be identified in the accepted safety plan. Manufacture tabulated data and specifications or registered engineer tabulated data for shoring or benching systems shall be readily available on-site for review. Job-made shoring or shielding must have the registered professional engineer stamp, specifications, and tabulated data. Extreme care must be used when excavating near direct burial electric underground cables.

3.6.4 Trenching Machinery

Operate trenching machines with digging chain drives only when the spotters/laborers are in plain view of the operator. Provide operator and spotters/laborers training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating. Keep documentation of the training on file at the project site.

3.7 UTILITIES WITHIN CONCRETE SLABS

Utilities located within concrete slabs are extremely difficult to identify

due to the reinforcing steel used in the construction of these structures. Whenever contract work involves concrete chipping, saw cutting, or core drilling, the existing utility location must be coordinated with utility departments. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

3.8 ELECTRICAL

3.8.1 Conduct of Electrical Work

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the Contracting Officer and Station Utilities for identification. The Contracting Officer will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers will be permitted to enter. When work requires the Contractor to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. In addition, provide electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's Safety and Health Plan.

3.8.2 Portable Extension Cords

Size portable extension cords in accordance with manufacturer ratings for the tool to be powered and protected from damage. Immediately removed from service all damaged extension cords. Portable extension cords shall meet the requirements of NFPA 70E and OSHA electrical standards.

3.9 WORK IN CONFINED SPACES

Comply with the requirements in OSHA 29 CFR 1910.146 and OSHA 29 CFR 1926.21(b)(6). Any potential for a hazard in the confined space requires a permit system to be used.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. All hazards pertaining to the space shall be reviewed with each employee during review of the Safety and Health Plan.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.

c. All underground structures require continuous atmosphere monitoring with audible alarm for toxic gas detection.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES
1.2 ORDERING INFORMATION

PART 2 PRODUCTS

PART 3 EXECUTION

-- End of Section Table of Contents --

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B 564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

ACI INTERNATIONAL (ACI)
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Fax: 248-848-3701
E-mail: bkstore@concrete.org
Internet: http://www.concrete.org

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)
2111 Wilson Blvd, Suite 500
Arlington, VA 22201
Ph: 703-600-0355
Fax: 703-562-1942
E-mail: fdietz@ahrinet.org
Internet: http://www.ahrinet.org

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)
1200 G Street, NW, Suite 500
Washington, D.C. 20005
Ph: 202-628-6380
Fax: 202-393-5453
E-mail: doccenter@atis.org
Internet: http://www.atis.org

ALUMINUM ASSOCIATION (AA)
National Headquarters
1525 Wilson Boulevard, Suite 600
Arlington, VA 22209
Ph: 703-358-2960

Fax: 703-358-2961
Internet: http://www.aluminum.org

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
444 North Capital Street, NW, Suite 249
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Ph: 202-624-5800
Fax: 202-624-5806
E-Mail: info@aashto.org
Internet: http://www.aashto.org

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)
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Fax: 202-367-2155
E-mail: info@americanbearings.org
Internet: http://www.abma-dc.org

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)
1303 W. Walnut Hill Lane, Suite 305
Irving, TX 75038-3008
Ph: 972-506-7216
Fax: 972-506-7682
E-mail: info@concrete-pipe.org
Internet: http://www.concrete-pipe.org

AMERICAN IRON AND STEEL INSTITUTE (AISI)
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Washington, DC 20036
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E-mail: webmaster@steel.org
Internet: http://www.steel.org

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
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Washington, DC 20036
Ph: 202-293-8020
Fax: 202-293-9287
E-mail: info@ansi.org
Internet: http://www.ansi.org/

AMERICAN PETROLEUM INSTITUTE (API)
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Internet: http://www.api.org

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Internet: http://www.awwa.org

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Internet: http://www.aws.org

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Birmingham, AL 35236-1784
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Internet: http://www.awpa.com

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Ph: 800-854-7179 or 800-843-2763
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E-mail: infocentral@asme.org
Internet: http://www.asme.org

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959
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Fax: 610-832-9555
E-mail: service@astm.org
Internet: http://www.astm.org

COMPRESSED GAS ASSOCIATION (CGA)
4221 Walney Road, 5th Floor
Chantilly, VA 20151
Ph: 703-788-2700
Fax: 703-961-1831
E-mail: cga@cganet.com
Internet: http://www.cganet.com

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)
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Schaumburg, IL 60173-4758
Ph: 847-517-1200 or 800-328-6306
Fax: 847-517-1206
Internet: http://www.crsi.org/

ELECTRONIC INDUSTRIES ALLIANCE (EIA)
2500 Wilson Boulevard
Arlington, VA 22201-3834
Ph: 703-907-7500
Fax: 703-907-7501
E-mail: infor@ecaus.org
Internet: http://www.eia.org

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1000 Independance Ave. SW
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Ph: 800-342-5363
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Internet: http://www.eh.doe.gov/

FLORIDA ADMINISTRATIVE CODE (FAC)
R.A. Gray Building, Room 101
500 South Bronough Street
Tallahassee, FL 32399-0250
Ph: 850-245-6270
Fax: 850-245-6282
Email: lcloud@dos.state.fl.us
Internet: https://www.flrules.org/

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION (FDEP)
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Fax: 850-245-2128

FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT)
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Internet:

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Internet: http://www.leg.state.fl.us/statutes/

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)
University of South California
Kaprielian Hall 200
Los Angeles, CA 90089-2531
Ph: 213-740-2032 or 866-545-6340
Fax: 213-740-8399

E-mail: fccchr@usc.edu
Internet: http://www.usc.edu/dept/fccchr

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 Hoes Lane or 2001 L Street, NW. Suite 700
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Ph: 732-981-0060 or 800-701-4333
Fax: 732-562-6380
E-mail: onlinesupport@ieee.org or ieeeusa@ieee.org
Internet: http://www.ieee.org

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
P.O. Box 1568
Carrollton, GA 30112
Ph: 1 800 447 3352
Fax: 1 303 397 2599
E-mail: global@ihs.com
Internet: http://www.icea.net

INTERNATIONAL CODE COUNCIL (ICC)
5360 Workman Mill Road
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Ph: 562-699-0541
Fax: 562-699-8031
E-mail: webmaster@iccsafe.org
Internet: www.iccsafe.org

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)
3166 South River Road, Suite 132
Des Plaines, IL 60018
Ph: 847-827-0830
Fax: 847-827-0832
Internet: http://www.icri.org

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

3050 Centre Ave. Suite 102
Portage, MI 49024
Ph: 269-488-6382
Fax: 269-488-6383
E-mail: neta@netaworld.org
Internet: http://www.netaworld.org

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
1, ch. de la Voie-Creuse
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CH-1211 Geneve 20 Switzerland
Ph: 41-22-749-01-11
Fax: 41-22-733-34-30
E-mail: central@iso.ch
Internet: http://www.iso.org

ISA - INTERNATIONAL SOCIETY OF AUTOMATION (ISA)
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Kennedy Space Center
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Internet: http://www.mss-hq.com

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Internet: http://www.paintinfo.com/mpi

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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
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Fax: 703-841-5900
Internet: http://www.nema.org/

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
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Ph: 617-770-3000 or 800-344-3555
Fax: 617-770-0700
E-mail: webmaster@nfpa.org
Internet: http://www.nfpa.org

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)
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Fax: 513-533-8285
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Internet: http://www.cdc.gov/nchs/products.htm

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)
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Ph: 301-975-NIST (6478
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Internet: http://www.nist.gov

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Internet: www.precast.org

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Internet: http://www.nsf.org

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Philadelphia, PA 19111-5094
Ph: 215-697-6396 - for account/password issues
Internet: http://assist.daps.dla.mil/online/start/; account registration required
Obtain Unified Facilities Criteria (UFC) from:
Whole Building Design Guide (WBDG)
National Institute of Building Sciences (NIBS)
1090 Vermont Avenue NW, Suite 700
Washington, CD 20005
Ph: 202-289-7800
Fax: 202-289-1092
Internet: http://www.wbdg.org/references/docs_refs.php

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)
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E-mail: helpdesk@Huduser.org
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U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
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Washington, DC 20004
Ph: 202-272-0167
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Internet: http://www.ntis.gov

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Internet: http://assist.daps.dla.mil/online/start/; account registration required

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Internet: http://www.gpoaccess.gov

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not used

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 57 20.00 10

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 REFERENCES
1.2 DEFINITIONS
1.2.1 Environmental Pollution and Damage
1.2.2 Environmental Protection
1.2.3 Contractor Generated Hazardous Waste
1.2.4 Land Application for Discharge Water
1.2.5 Surface Discharge
1.2.6 Waters of the United States
1.2.7 Wetlands
1.2.8 Universal Waste
1.3 GENERAL REQUIREMENTS
1.4 SUBCONTRACTORS
1.5 SUBMITTALS
1.6 ENVIRONMENTAL PROTECTION PLAN
1.6.1 Compliance
1.6.2 Contents
1.6.3 Appendix
1.7 PROTECTION FEATURES
1.8 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS
1.9 NOTIFICATION

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 LAND RESOURCES
3.1.1 Work Area Limits
3.1.2 Landscape
3.1.3 Erosion and Sediment Controls
3.1.4 Contractor Facilities and Work Areas
3.2 WATER RESOURCES
3.2.1 Cofferdams, Diversions, and Dewatering Operations
3.2.2 Wetlands
3.3 AIR RESOURCES
3.3.1 Particulates
3.3.2 Odors
3.3.3 Sound Intrusions
3.3.4 Burning
3.4 MATERIALS MANAGEMENT AND WASTE DISPOSAL
3.4.1 Solid Wastes
3.4.2 Chemicals and Chemical Wastes
3.4.3 Hazardous Materials and Universal Waste/Contractor General Hazardous Wastes

3.4.4 Fuel and Lubricants
3.4.5 Wastewater
3.4.6 PCB Management
3.5 RECYCLING AND WASTE MINIMIZATION
3.6 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT
3.7 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES
3.8 BIOLOGICAL RESOURCES
3.9 SOLID WASTE MANAGEMENT UNIT (SWMU)
3.10 PREVIOUSLY USED EQUIPMENT
3.11 MAINTENANCE OF POLLUTION FACILITIES
3.12 TRAINING OF CONTRACTOR PERSONNEL
3.13 POST CONSTRUCTION CLEANUP

-- End of Section Table of Contents --

SECTION 01 57 20.00 10

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

WETLAND MANUAL	Corps of Engineers Wetlands Delineation Manual Technical Report Y-87-1

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

33 CFR 328	Definitions of Waters of the United States
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 273	Standards For Universal Waste Management
40 CFR 279	Standards for the Management of Used Oil
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
40 CFR 68	Chemical Accident Prevention Provisions
49 CFR 171 - 178	Hazardous Materials Regulations

1.2 DEFINITIONS

1.2.1 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.2.2 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of

land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners,excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

1.2.4 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor must discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" must occur. Land Application must be in compliance with all applicable Federal, State, and local laws and regulations.

1.2.5 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers,creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.2.6 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.2.7 Wetlands

Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with WETLAND MANUAL.

1.2.8 Universal Waste

Universal Waste means any of the following hazardous wastes that are managed under the universal waste requirements 40 CFR 273:

(1) Batteries as described in Sec. 273.2 of this chapter;
(2) Pesticides as described in Sec. 273.3 of this chapter;
(3) Thermostats as described in Sec. 273.4 of this chapter; and
(4) Lamps as described in Sec. 273.5 of this chapter.

1.3 GENERAL REQUIREMENTS

Minimize environmental pollution and damage that may occur as the result of

construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work must be protected during the entire duration of this contract. Comply with all applicable environmental Federal, State, and local laws and regulations. Any delays resulting from failure to comply with environmental laws and regulations will be the Contractor's responsibility.

1.4 SUBCONTRACTORS

Ensure compliance with this section by subcontractors.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G

The environmental protection plan.

1.6 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, submit an Environmental Protection Plan for review and approval by the Contracting Officer. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern must be defined within the Environmental Protection Plan as outlined in this section. Address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but are considered necessary, must be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, meet with the Contracting Officer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Environmental Protection Plan must be current and maintained onsite by the Contractor.

1.6.1 Compliance

No requirement in this Section will relieve the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor will be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.6.2 Contents

Include in the environmental protection plan, but not limit it to, the following:

a. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental

Protection Plan.

b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

d. Description of the Contractor's environmental protection personnel training program.

e. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan must include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.

f. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.

g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

h. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.

i. Drawing showing the location of borrow areas.

j. Include in the Spill Control plan the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The Spill Control Plan supplements the requirements NASA KSC policy. Include in this plan, as a minimum:

1). The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual will immediately notify the Contracting Officer and NASA Environmental. Include in the plan a list of the required reporting channels and telephone numbers.

2). The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.

3). Training requirements for Contractor's personnel and methods of accomplishing the training.

4). A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential

hazard(s) identified.

5). The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

6). The methods and procedures to be used for expeditious contaminant cleanup.

k. A hazardous waste disposal plan identifying methods and locations for hazardous waste and universal waste collection and disposal.

l. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris and schedules for disposal.

1). Identify any subcontractors responsible for the transportation and disposal of solid waste. Submit licenses or permits for solid waste disposal sites that are not a commercial operating facility.

2). Evidence of the disposal facility's acceptance of the solid waste must be attached to this plan during the construction. Attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. Submit the report for the previous quarter on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted (e.g. the first working day of January, April, July, and October).

3). Indicate in the report the total amount of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted.

m. A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. Detail in the plan the Contractor's actions to comply with and to participate in Federal, State, Regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.

n. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

o. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. A copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be onsite at any given time must be included in the contaminant prevention plan. Update the plan as new hazardous materials are brought onsite or removed from the site.

p. A wastewater management plan that identifies the methods and procedures for management and/or discharge of wastewaters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water,

hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan must include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the wastewater, the plan must include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, include a copy of the permit and associated documents as an attachment prior to discharging the wastewater. If disposal is to a sanitary sewer, the plan must include documentation that the Wastewater Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

q. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. Include in the plan methods to assure the protection of known or discovered resources, identifying lines of communication between Contractor personnel and the Contracting Officer.

1.6.3 Appendix

Attach to the Environmental Protection Plan, as an appendix, copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents.

1.7 PROTECTION FEATURES

Prior to the start of any onsite construction activities, the Contractor and the Contracting Officer will make a joint condition survey. Immediately following the survey, the Contractor will prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report will be signed by both the the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor must protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the work under the contract.

1.8 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations from the drawings, plans and specifications, requested by the Contractor and which may have an environmental impact, will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

1.9 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. After receipt of such notice, the Contractor will inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions will be granted or equitable adjustments allowed for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 LAND RESOURCES

Confine all activities to areas defined by the drawings and specifications. Identify any land resources to be preserved within the work area prior to the beginning of any construction. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval, except in areas indicated on the drawings or specified to be cleared. Ropes, cables, or guys will not be fastened to or attached to any trees for anchorage unless specifically authorized. Provide effective protection for land and vegetation resources at all times, as defined in the following subparagraphs. Remove stone, soil, or other materials displaced into uncleared areas.

3.1.1 Work Area Limits

Mark the areas that need not be disturbed under this contract prior to commencing construction activities. Mark or fence isolated areas within the general work area which are not to be disturbed. Protect monuments and markers before construction operations commence. Where construction operations are to be conducted during darkness, any markers must be visible in the dark. The Contractor's personnel must be knowledgeable of the purpose for marking and/or protecting particular objects.

3.1.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved must be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. Restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.1.3 Erosion and Sediment Controls

Providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations is the Contractor's responsibility. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. Construct or install

temporary and permanent erosion and sediment control best management practices (BMPs) as indicated on the drawings and as specified in Section 01 57 23 TEMPORARY STORM WATER POLLUTION CONTROL. BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. The Contractor's best management practices must also be in accordance with the National Pollutant Discharge Elimination System (NPDES) Storm Water Pollution Prevention Plan (SWPPP) which may be reviewed at NASA Environmental . Remove any temporary measures after the area has been stabilized.

3.1.4 Contractor Facilities and Work Areas

Place field offices, staging areas, stockpile storage, and temporary buildings in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities will be made only when approved. Erosion and sediment controls must be provided for onsite borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas must be controlled to protect adjacent areas.

3.2 WATER RESOURCES

Monitor all water areas affected by construction activities to prevent pollution of surface and ground waters. Do not apply toxic or hazardous chemicals to soil or vegetation unless otherwise indicated. For construction activities immediately adjacent to impaired surface waters, the Contractor must be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

3.2.1 Cofferdams, Diversions, and Dewatering Operations

Construction operations for dewatering shall be controlled at all times to maintain compliance with existing State water quality standards and designated uses of the surface water body. Comply with NASA KSC policy.

3.2.2 Wetlands

Do not enter, disturb, destroy, or allow discharge of contaminants into any wetlands.

3.3 AIR RESOURCES

Equipment operation, activities, or processes will be in accordance with all Federal and State air emission and performance laws and standards.

3.3.1 Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphaltic batch plants; must be controlled at all times, including weekends, holidays and hours when work is not in progress. Maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an

approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. Provide sufficient, competent equipment available to accomplish these tasks. Perform particulate control as the work proceeds and whenever a particulate nuisance or hazard occurs. Comply with all State and local visibility regulations.

3.3.2 Odors

Odors from construction activities must be controlled at all times. The odors must be in compliance with State regulations and/or local ordinances and may not constitute a health hazard.

3.3.3 Sound Intrusions

Keep construction activities under surveillance and control to minimize environment damage by noise. Comply with State regulations and local ordinances.

3.3.4 Burning

Burning is prohibited on the Government premises.

3.4 MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes will be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.4.1 Solid Wastes

Solid wastes (excluding clearing debris) shall be handled in accordance with NASA KSC policy.

3.4.2 Chemicals and Chemical Wastes

Dispense chemicals ensuring no spillage to the ground or water. Perform and document periodic inspections of dispensing areas to identify leakage and initiate corrective action. This documentation will be periodically reviewed by the Government. Collect chemical waste in corrosion resistant, compatible containers. Collection drums must be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with NASA KSC policy.

3.4.3 Hazardous Materials and Universal Waste/Contractor General Hazardous Wastes

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. Manage and store hazardous waste and universal waste in compliance with 40 CFR 262 and NASA KSC policy. Take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing.

3.4.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles must be conducted in a manner that affords the maximum protection against spill and evaporation. Manage and store fuel, lubricants and oil in accordance with

all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded must be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations and NASA KSC policy.

3.4.5 Wastewater

Disposal of wastewater will be as specified below.

a. Wastewater from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. shall be in accordance with NASA KSC policy.

b. For discharge of ground water, the Contractor shall land apply on the project site in accordance with all Federal, State, Regional, and/or Local laws and regulations for pumping and land applying ground water as well as NASA KSC policy.

c. Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing will be land applied in accordance with all Federal, State, and local laws and regulations for land application.

3.4.6 PCB Management

Polychlorinated Biphenyl (PCB) wastes shall be managed in accordance with NASA KSC policy.

3.5 RECYCLING AND WASTE MINIMIZATION

Participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project. Recycle material in accordance with NASA KSC policy. For further information, please contact the NASA/KSC Recycling Manager.

3.6 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT

Maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris. Submit a report to the Environmental Program Branch through the Contracting Officer on the first working day after each fiscal year quarter, starting the first quarter that non-hazardous solid waste has been generated. Include the following in the report:

a. Construction and Demolition (C&D) Debris Disposed = _____ in cubic yards or tons, as appropriate.

b. Construction and Demolition (C&D) Debris Recycled = _____ in cubic yards or tons, as appropriate.

c. Total C&D Debris Generated = _____ in cubic yards or tons, as appropriate.

d. Waste Sent to Waste-To-Energy Incineration Plant (This amount should not be included in the recycled amount) = _____ in cubic yards or tons, as appropriate.

e. Metal Recycled = _____ in tons, as appropriate.

3.7 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

Refer to NASA KSC policy.

3.8 BIOLOGICAL RESOURCES

Minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The protection of threatened and endangered animal and plant species, including their habitat, is the Contractor's responsibility in accordance with Federal, State, Regional, and local laws and regulations. The Contractor shall comply with NASA KSC policy.

3.9 SOLID WASTE MANAGEMENT UNIT (SWMU)

Portions of this project are located within the boundaries of various identified Solid Waste Management Unit (SWMU)/Potential Release Location (PRL) sites being managed by the Remediation Group of NASA Environmental. A SWMU/PRL designation means that the site has had historical operations which had the potential to impact the environment.

The systems being modified are located within various SWMU or PRL sites. These sites contain groundwater contamination, soil contamination, or both. Return soil excavated from the land surface to any depth to the area of excavation from which it was removed. Collect, containerize, sample, and dispose of excavated soil that cannot be returned to the area from which it was removed in accordance with the Process Waste Questionnaire (PWQ)/Technical Response Packet (TRP) process. Wear proper PPE when working in soil and groundwater. Use best management practices to prevent erosion and removal of soil from site.

Discharge dewatering effluent to grade upland of the excavated area and allow to percolate back into the pervious ground surface. Use best management practices to prevent dewatering effluent from entering surface waters. There is a potential that dewatering effluent from SWMU or PRL sites may not be discharged to grade. Coordinate with the Contracting Officer and NASA Environmental for approval of the Dewatering Plan within the boundary of a SWMU or PRL 14 days before the Notice to Proceed.

3.10 PREVIOUSLY USED EQUIPMENT

Clean all previously used construction equipment prior to bringing it onto the project site. Ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. Consult with the USDA jurisdictional office for additional cleaning requirements.

3.11 MAINTENANCE OF POLLUTION FACILITIES

Maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.12 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel must be trained in all phases of environmental protection and pollution control. Conduct environmental protection/pollution control meetings for all personnel prior to commencing

construction activities. Additional meetings must be conducted for new personnel and when site conditions change. Include in the training and meeting agenda: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.13 POST CONSTRUCTION CLEANUP

The Contractor will clean up all areas used for construction. Unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area must be graded, filled and the entire area seeded unless otherwise indicated.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 57 23

TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 GENERAL

1.1 REFERENCES
1.2 SYSTEM DESCRIPTION
1.3 EROSION AND SEDIMENT CONTROLS
1.3.1 Stabilization Practices
1.3.1.1 Unsuitable Conditions
1.3.1.2 No Activity for Less Than 21 Days
1.3.1.3 Burnoff
1.3.1.4 Protection of Erodible Soils
1.3.2 Erosion, Sediment and Stormwater Control
1.3.3 Stormwater Drainage
1.3.4 Structural Practices
1.3.4.1 Silt Fences
1.3.5 Vegetation and Mulch
1.4 SUBMITTALS
1.5 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

2.1 COMPONENTS FOR SILT FENCES
2.1.1 Filter Fabric
2.1.2 Silt Fence Stakes and Posts

PART 3 EXECUTION

3.1 INSTALLATION OF SILT FENCES
3.2 FIELD QUALITY CONTROL
3.2.1 Silt Fence Maintenance
3.3 INSPECTIONS
3.3.1 General
3.3.2 Inspections Details
3.3.3 Erosion and Sediment Control Inspection Reports

-- End of Section Table of Contents --

SECTION 01 57 23

TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 4439	(2004) Geosynthetics
ASTM D 4491	(1999a; R 2004e1) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2004) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 2003) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4873	(2002) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 832-R-92-005	(1992) Storm Water Management for Construction Activities Developing Pollution Preventions and Plans and Best Management Practices

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 122.26	Storm Water Discharges (Applicable to State NPDES Programs, see section 123.25)

1.2 SYSTEM DESCRIPTION

The work consists of implementing the storm water pollution prevention measures to prevent sediment from entering streams or water bodies as specified in this Section in conformance with the requirements of Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION, and the requirements of the National Pollution Discharge Elimination System (NPDES) permit.

1.3 EROSION AND SEDIMENT CONTROLS

The controls and measures required of the Contractor are described below.

1.3.1 Stabilization Practices

The stabilization practices to be implemented include temporary seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, erosion control mats, protection of trees, preservation of mature vegetation, etc. On the Daily Report, record the dates when the major grading activities occur, (e.g., clearing, excavation, and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs UNSUITABLE CONDITIONS and NO ACTIVITY FOR LESS THAN 21 DAYS, stabilization practices must be initiated as soon as practicable, but no more than 14 days, in any portion of the site where construction activities have temporarily or permanently ceased.

1.3.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after construction activity temporarily or permanently ceases or is precluded by unsuitable conditions caused by the weather, stabilization practices shall be initiated as soon as practicable after conditions become suitable.

1.3.1.2 No Activity for Less Than 21 Days

When the total time period in which construction activity is temporarily ceased on a portion of the site is 14 days minimum, stabilization practices do not have to be initiated on that portion of the site until 14 days have elapsed after construction activity temporarily ceased.

1.3.1.3 Burnoff

Burnoff of the ground cover is not permitted.

1.3.1.4 Protection of Erodible Soils

Immediately finish the earthwork brought to a final grade, as indicated or specified, and protect the side slopes and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils.

1.3.2 Erosion, Sediment and Stormwater Control

a. Storm Water Notice of Intent for Construction Activities

b. Submit a Storm Water Notice of Intent for NPDES coverage under the general permit for construction activities and a Storm Water Pollution Prevention Plan (SWPPP) for the project to the Contracting Officer prior to the commencement of work. The SWPPP shall meet the requirements of the State of Florida general permit for storm water discharges from construction sites. Submit the SWPPP along with any required Notice of Intents, Notice of Termination, and appropriate permit fees, via the Contracting Officer, to the appropriate State agency for approval, a minimum of 14 calendar days prior to the start of any land disturbing activities. Maintain an approved copy of the SWPPP at the construction on-site office, and continually update as regulations require, to reflect current site conditions. Include within the SWPPP:

(1) Identify potential sources of pollution which may be reasonably expected to affect the quality of storm water discharge

from the site.

(2) Describe and ensure implementation of practices which will be used to reduce the pollutants in storm water discharge from the site.

(3) Ensure compliance with terms of the State of Florida general permit for storm water discharge.

(4) Select applicable best management practices from EPA 832-R-92-005.

(5) Include a completed copy of the Registration Statement, BMP Inspection Report Template and Notice of Termination except for the effective date.

(6) Storm Water Pollution Prevention Measures and Notice of Intent 40 CFR 122.26, EPA 832-R-92-005. Provide an SWPPP for the project.

(7) Install, inspect, and maintain best management practices (BMPs) as required by the general permit. Prepare and submit to the Contracting Officer, BMP Inspection Reports as required by the general permit.

(8) Once construction is complete and the site has been stabilized with a final, sustainable cover, submit the Notice of Termination to the Contracting Officer and NASA Environmental within 30 days after all land disturbing activities end.

(9) At the time of submittal to the Contracting Officer, concurrently forward copies of the SWPPP, Registration Statement, BMP Inspection Reports, and Notice of Termination to the Contracting Officer and to NASA Environmental.

1.3.3 Stormwater Drainage

There will be no discharge of excavation ground water to the sanitary sewer, storm drains, or to the river without prior specific authorization from the Contracting Officer and NASA Environmental. Discharge of hazardous substances will not be permitted under any circumstances. Construction site runoff will be prevented from entering any storm drain or the river directly by the use of silt fence or other method suitable to the Contracting Officer and NASA Environmental. Provide erosion protection of the surrounding soils.

1.3.4 Structural Practices

Implement structural practices to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Implement structural practices in a timely manner, during the construction process, to minimize erosion and sediment runoff. Include the following devices; Location and details of installation and construction are shown on the drawings.

1.3.4.1 Silt Fences

Provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Properly install silt fences to effectively retain

sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing, excavation, and grading). Install silt fences in the locations indicated on the drawings. Obtain approval from the Contracting Officer prior to final removal of silt fence barriers.

1.3.5 Vegetation and Mulch

a. Provide temporary protection on sides and back slopes as soon as rough grading is completed or sufficient soil is exposed to require erosion protection. Protect slopes by accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydroseeding, anchoring mulch in place, covering with anchored netting, sodding, or such combination of these and other methods necessary for effective erosion control.

b. Seeding: Provide new seeding where ground is disturbed. Include topsoil or nutriment during the seeding operation necessary to establish a suitable stand of grass.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Storm Water Pollution Prevention Plan
Storm Water Notice of Intent

Pollution prevention plan and Notice of intent for NPDES coverage under the general permit for construction activities

1.5 DELIVERY, STORAGE, AND HANDLING

Identify, store and handle filter fabric in accordance with ASTM D 4873.

PART 2 PRODUCTS

2.1 COMPONENTS FOR SILT FENCES

2.1.1 Filter Fabric

Provide geotextile that complies with the requirements of ASTM D 4439, and consists of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and contains stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure. Provide synthetic filter fabric that contains ultraviolet ray inhibitors and stabilizers to assure a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. The filter fabric shall meet the following requirements:

FILTER FABRIC FOR SILT SCREEN FENCE

PHYSICAL PROPERTY	TEST PROCEDURE	STRENGTH REQUIREMENT

Grab Tensile Elongation (percent)	ASTM D 4632	100 lbs. min. 30 percent max.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

2.1.2 Silt Fence Stakes and Posts

Use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction, shall have a minimum cross section of 2 by 2 inches when oak is used and 4 by 4 inches when pine is used, and have a minimum length of 5 feet. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds/linear foot and a minimum length of 5 feet.

PART 3 EXECUTION

3.1 INSTALLATION OF SILT FENCES

Extend silt fences a minimum of 16 inches above the ground surface without exceeding 34 inches above the ground surface. Provide filter fabric from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, splice together filter fabric at a support post, with a minimum 6 inch overlap, and securely sealed. Excavate trench approximately 4 inches wide and 4 inches deep on the upslope side of the location of the silt fence. The 4 by 4 inch trench shall be backfilled and the soil compacted over the filter fabric. Remove silt fences upon approval by the Contracting Officer.

3.2 FIELD QUALITY CONTROL

Maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. Use the following procedures to maintain the protective measures.

3.2.1 Silt Fence Maintenance

Inspect the silt fences in accordance with paragraph, titled "Inspections," of this section. Any required repairs shall be made promptly. Pay close attention to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, replace the fabric promptly. Remove sediment deposits when deposits reach one-third of the height of the barrier. Remove a silt fence when it is no longer required. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall receive erosion control.

3.3 INSPECTIONS

3.3.1 General

Inspect disturbed areas of the construction site, areas that have not been finally stabilized used for storage of materials exposed to precipitation, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Conduct inspections at least once every month where sites have been finally stabilized.

3.3.2 Inspections Details

Inspect disturbed areas and areas used for material storage that are exposed to precipitation for evidence of, or the potential for, pollutants entering the drainage system. Observe erosion and sediment control measures identified in the Storm Water Pollution Prevention Plan to ensure that they are operating correctly. Inspect discharge locations or points to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Inspect locations where vehicles exit the site for evidence of offsite sediment tracking.

3.3.3 Erosion and Sediment Control Inspection Reports

Prepare "Storm Water Pollution Prevention Plan (SWPPP) Inspection Reports" (form provided at the pre-construction conference) to the Contracting Officer once every 7 calendar days and within 24 hours of a storm event that produced 0.5 inch or more of rain, and submit reports monthly. A copy of the inspection report shall be maintained on the job site.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 PROJECT RECORD DOCUMENTS
1.3.1 Record Drawings
1.3.1.1 Working Record and Final Record Drawings
1.3.1.2 Drawing Preparation
1.3.2 As-Built Record of Equipment and Materials
1.3.3 Final Approved Shop Drawings
1.3.4 Construction Contract Specifications
1.3.5 Real Property Equipment
1.4 RECORD DRAWINGS GEODATABASE
1.4.1 Data Migration
1.4.1.1 Water Distribution Network
1.4.1.2 Wastewater Network (Sewer)
1.4.2 Develop Geometric Network
1.4.3 Quality Assurance
1.4.4 Feature and Attribute Details - Wastewater
1.4.5 Feature and Attribute Details - Water and Reclaimed Water
1.5 SPARE PARTS DATA
1.6 PREVENTATIVE MAINTENANCE
1.7 WARRANTY MANAGEMENT
1.7.1 Warranty Management Plan
1.7.2 Performance Bond
1.7.3 Pre-Warranty Conference
1.7.4 Contractor's Response to Construction Warranty Service Requirements
1.7.5 Warranty Tags
1.8 OPERATION AND MAINTENANCE MANUALS
1.9 CLEANUP

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section Table of Contents --

SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 1971	(2005) Stewardship for the Cleaning of Commercial and Institutional Buildings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

As-Built Record of Equipment and Materials

Two copies of the record listing the as-built materials and equipment incorporated into the construction of the project.

Warranty Management Plan

One set of the warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. Furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

Spare Parts Data

Two copies of list that indicates manufacturer's name, part number, nomenclature, and stock level recommended for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

SD-08 Manufacturer's Instructions

Preventative Maintenance and Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

Define within the schedule the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation

capability requirements. On each test feature; e.g., gpm, rpm, psi, provide a signoff blank for the Contractor and Contracting Officer. Within a remarks column of the testing validation procedure include references to operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventative maintenance, condition monitoring (predictive testing) and inspection, adjustment, lubrication and cleaning necessary to prevent failure.

Posted Instructions

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with paragraph entitled, "Operation and Maintenance," of this section.

SD-11 Closeout Submittals

Record Drawings

Drawings showing final as-built conditions of the project. The final CADD record drawings must consist of one set of electronic CADD drawing files in the specified format, , and one set of the approved working Record drawings.

Record Drawings Geodatabase

At the conclusion of the project, the Contractor will deliver a geodatabase containing the CADD W/WW infrastructure data to KSC.

1.3 PROJECT RECORD DOCUMENTS

1.3.1 Record Drawings

This paragraph covers record drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working record drawings" and "final record drawings" refer to contract drawings which are revised to be used for final record drawings showing as-built conditions.

1.3.1.1 Working Record and Final Record Drawings

Revise 2 sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. Keep these working as-built marked drawings current on a weekly basis and at least one set available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction must be accurately and neatly recorded as they occur by means of details and notes. Prepare final record (as-built) drawings after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final record (as-built) drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final record drawings as specified herein, the Contracting Officer will deduct from the monthly

progress payment an amount representing the estimated cost of maintaining the record drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated drawings. Show on the working and final record drawings, but not limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, show by northing and easting coordinates on the record drawings. Locate all fittings, valves, splice boxes and similar appurtenances by northing and easting coordinates. Also record the average depth below the surface of each run.

b. The location and dimensions of any changes within the building structure.

c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

d. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where contract drawings or specifications present options, show only the option selected for construction on the final as-built prints.

h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, furnish a contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

j. Modifications (include within change order price the cost to change working and final record drawings to reflect modifications) and compliance with the following procedures.

(1) Follow directions in the modification for posting descriptive changes.

(2) Place a Modification Circle at the location of each deletion.

(3) For new details or sections which are added to a drawing, place a Modification Circle by the detail or section title.

(4) For minor changes, place a Modification Circle by the area changed on the drawing (each location).

(5) For major changes to a drawing, place a Modification Circle

by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, place a Modification Circle either by the schedule heading or by the change in the schedule.

(7) The Modification Circle size shall be 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.3.1.2 Drawing Preparation

Modify the record drawings as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints must be neat, legible and accurate. These drawings are part of the permanent records of this project and must be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor must be satisfactorily replaced by the Contractor at no expense to the Government.

Record drawings shall also be submitted in CADD format. When submitting record drawings in CADD format, the original Contract Documents shall be used as an XREF file and not modified. The record drawings shall be developed as CADD layers drawn using the XREF as a base. The Contractor is to follow CADD standards developed by the Government.

1.3.2 As-Built Record of Equipment and Materials

Furnish one copy of preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Submit two sets of final record of equipment and materials 10 days after final inspection. Key the designations to the related area depicted on the contract drawings. List the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1.3.3 Final Approved Shop Drawings

Furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.3.4 Construction Contract Specifications

Furnish final record (as-built) construction contract specifications, including modifications thereto, 30 days after transfer of the completed facility.

1.3.5 Real Property Equipment

Furnish a list of installed equipment furnished under this contract.

Include all information usually listed on manufacturer's name plate. In the "EQUIPMENT-IN-PLACE LIST" include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. Furnish a draft list at time of transfer. Furnish the final list 30 days after transfer of the completed facility.

1.4 RECORD DRAWINGS GEODATABASE

Using the CADD format Record Drawings developed Subpart entitled "PROJECT RECORD DRAWINGS" of this section, the Contractor is to provide a geodatabase of the Record Drawings based on the following.

1.4.1 Data Migration

The Contractor is to use the Record Drawings CADD layers which should be readable and georeferenced with real world coordinates.

Facility infrastructure data will be extracted from the provided CADD layers. Facility infrastructure data will be placed in the exact location as indicated by the CADD layers.

Infrastructure to be extracted will conform to a standard water/wastewater (W/WW) geodatabase schema. Features will be extracted into a standard W/WW geodatabase created by the Contractor. The Contractor is to notify the Contracting Officer if any infrastructure types that are encountered within the CADD layers do not conform to the schema. The provided list of infrastructure types and attributes identified in this document will be extracted wherever possible.

The Contractor will establish topology rules which will identify physical errors within the data such as gaps, overlaps, over/under shoots, and multipart features. These types of errors cause certain types of applications such as modeling and tracing to return unexpected and false results. Once errors are identified, the Contractor will correct them to the extent allowable by the supplied data.

Contained within Paragraphs entitled "Feature and Attribute Details - Wastewater" and "Feature and Attribute Details - Water & Reclaimed Water" are details on the creation and attribution of the Government owned and maintained features within a standard W/WW schema.

As with any network of features, points are dependent upon their relationships with lines. Therefore, as a matter of practice the line should be created first. In W/WW networks there are specific rules to follow while creating the linework:

a. All pipe lines split when intersecting another pipe line of another value. However, some lines appear to intersect but actually pass at different depths beneath the surface. These lines do not split.

b. A change in attribution requires a new section to be created. Even if the material, diameter and type are the same but the record set number or date of installation is different.

c. All connecting sections of pipe do so through a fitting or structure.

d. Valves do split pipe sections.

e. All terminating pipe lines are covered by some point feature.

f. Pipe lines do not end (nor should be split) just because they run off the as-built sheet.

The information available on each document pertaining to a type of W/WW infrastructure will be captured and stored with the feature in the correct W/WW geodatabase. The Contractor is to interpolate, extrapolate or analyze existing information to determine appropriate attribution for an infrastructure feature that is not clearly labeled in the provided CADD layers.

The following list contains common infrastructure types that may be extracted. Actual sub-types will be dependent upon existing facilities.

1.4.1.1 Water Distribution Network

a. Water (points)

1. Control Valves
   - Backflow Control
   - Blow Off
   - Air Release (ARV)
   - Reduced Pressure Backflow
   - Reduced Pressure Zone Assembly (RPZ)

2. System Valves
   - Butterfly
   - Gate
   - Hydrant Valve
   - Plug

3. Fittings
   - Bend
   - Cap
   - Coupling
   - Cross
   - Leak Detector
   - Mechanical Joint Tee (MJT)
   - Reducer
   - Saddle
   - Sleeve
   - Tap
   - Tee
   - Transition Gasket
   - Wye

4. Hydrants

5. Meters

6. Network Structures
   - Enclosed Storage Facility
   - Production Well
   - Pump Station
   - Treatment Plant

7. Sampling Stations

b. Water (lines)

1. Lateral Lines
   - Potable
   - Fire
   - Hydrant
   - Firex

2. Pressurized Mains
   - Bypass
   - Distribution Main
   - Transmission Main

1.4.1.2 Wastewater Network (Sewer)

a. Sewer (points)

1. Cleanouts

2. Control Valves
   - ARV
   - Backflow Control
   - Simple Check
   - Double Check
   - Pressure Vacuum
   - Vacuum Valve

3. System Valves
   - Gate
   - Plug

4. Fittings
   - Bend
   - Cap
   - Coupling
   - Cross
   - Leak Detector
   - MJT
   - Reducer
   - Saddle
   - Sleeve
   - Tap
   - Tee
   - Transition Coupling
   - Wye

5. Manholes

6. Network Structures
   - Enclosed Storage Facility
   - Production Well
   - Pump Station
   - Treatment Plant

7. Pumps
   - Axial flow

Rotary

b. Sewer (lines)

1. Lateral Lines

2. Pressurized Mains
Force
Pressure
Vacuum

3. Gravity Mains

1.4.2 Develop Geometric Network

The Contractor will establish geometric networks on the W/WW data. The geometric networks established will allow the Government to perform network trace operations such as upstream or downstream traces.

The Contractor will validate the geometric networks within the geodatabase for spatial and attribute inconsistencies. This will include establishing a method for reporting and correcting identifiable errors.

1.4.3 Quality Assurance

A visual survey will be conducted by the Contractor upon completion of the feature extraction to verify that the facility infrastructure is represented correctly in the geodatabase before delivery. Each infrastructure feature will be clearly labeled, symbolized and displayed during the visual survey. Network tracing will be used to check for gaps in connectivity. To the extent possible, with the provided source data, the Contractor will validate the existence of the required attributes for W/WW facility infrastructure. Automated routines will check for missing attribution and/or null values. The Contactor will then evaluate all null and blank column values in records to check for missing attribute data. Spatial and attribution errors identified during this process will be corrected.

Interim submittals will be delivered to the Government in a personal geodatabase format along with a list of CADD layers to be reviewed for Quality Assurance by the Contracting Officer. Comments from the Contracting Officer will be returned to the Contractor within a two-week period in the form of a point feature class. The Contactor will work with the Contracting Officer to define an appropriate comments attribute domain to facilitate the review process on both ends.

Project Deliverables

At the conclusion of the project, the Contractor will deliver a geodatabase containing the CADD W/WW infrastructure data to KSC.

1.4.4 Feature and Attribute Details - Wastewater

LssGravityMain - Gravity Mains are independent lines that begin and end at a manhole, cleanout, cap, or lift station. All gravity mains should be created with only two nodes, a beginning and an end (no additional vertices) where the beginning and end are normally manholes. In the rare case of terminating at a lift station site, the final gravity main section node will be a lift station (wet well is reserved for GPS points only). The

direction that the gravity main will be digitized is the direction of flow (down stream). The location of these pipe segments is generally in the center of roadways. Gravity mains will be split where pipe material changes or a direct tie-in of a force main occurs between access points (nodes; manholes). Gravity mains never have valves attached to them.

Subtypes:

Collector - Receive wastewater discharged from service laterals; this will be the only subtype used during digitizing unless specifically stated on the drawing.

Interceptor - Gravity mains larger than 8 inches in diameter that carry the wastewater discharged from one or more collector sewers.

Interconnect - This type of gravity main is identified as the primary trunk line that passes collections from one subsystem to the next. The interconnect can be described as the shortest distance from a lift station upstream to the next pressurized pipe.

Required Attribution:

Franchise_Code - Not applicable

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Collector, Interceptor, Interconnect.

InstallDate - Date of installation

Lifecycle Status - Feature is active, abandoned or removed.

Watertype - Sewage for all features.

Material - Mostly PVC or HDPE is used in new developments. There may be cases at road crossings to use DIP or CIP.

Slope - Do not calculate. If available on the record drawing.

Recordnumber - Not applicable

Comments - Any other pertinent notes.

Diameter - Available on the drawing. Almost all residential gravity mains are 8 inches. Do not assume.

UpstreamInvert - Highest elevation of the gravity main where it connects to a point feature.

DownstreamInvert - Lowest elevation of the gravity main where it connects to a feature.

Source - Populated as record drawing for all features.

Usetype - Populated as force main, gravity, low pressure or vacuum.

Hyperlink-Scanned image used to digitize features from. This is

the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LssLateralLine - Lateral lines are services. They are the only other feature type that interacts directly with the gravity system for the Government. Snap the lateral line directly to the edge of the main (do not split main). Again, the direction of digitization here is important and should follow the direction of flow.

There are some lateral lines that branch upstream from the connection to the main. These types of laterals are servicing multiple sites such as you will find at industrial sites.

By request of the Government, LssLateralPoints will be the upstream node at the terminating end of lateral lines. For gravity systems, where lateral lines intersect other lateral lines, the connecting node will be a service tap. Where the lateral line connects to the collector (gravity main, interceptor, interconnect) the connecting node will be a service tap For vacuum systems a service tap will be the connecting node where lateral lines intersect other lateral lines.. Where the lateral line connects to the main (vacuum, low pressure force main, force main)the connecting node will be a tee, wye or a cross. A service tap will not be required where a lateral line connects directly into a manhole.

Lateral line subtypes are generally based on the facility it is serving.

Subtypes:

Not Applicable

Required Attribution:

Franchise_code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government -owned and maintained infrastructures.

Subtype - Must be identified by creator (see above).

Install Date - Date of installation

Lifecycle Status - Feature is active, abandoned or removed.

Watertype - Sewage for all features.

Material - Pipe material.

Diameter - Diameter of pipe.

Recordnumber - Not applicable

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as force main, gravity, low pressure, or vacuum.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LssPressurizedMain - Pressurized Mains are like any other pressure system in a utility network. They change direction, size, material, and may curve (contains additional vertices). Logically, the source of a pressurized network of lines is a pump (at a lift station site). It transports waste into either another gravity system (into a manhole or gravity main) or directly to a treatment facility. Logically, as with other pressurized pipe networks, the location of these pipes is generally within an available right-of-way or easement but usually not located beneath a road.

Where a section of pressurized main intersects another section of pressurized main, all sections will be split. The connection points (terminating end) of a section of pipe will be covered by the appropriately selected fitting (i.e. a single pipe section connecting to another single pipe section will result in a split creating three pipes. The appropriate fittings will be a tee, wye or a cross.).

Subtypes:

Force - This type of pipe has sewage forced into it by pumps at a lift station site.

LowPressure - A low-pressure system

Vacuum - Pressurized mains that are part of vacuum systems.

AirRelease - This is a small diameter section of pipe that connects to the top main and provides a method of releasing air above ground via an air release control valve. . All air release diameters will be attributed as 2-inch.

Required Attribution:

Franchise_code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above).

Install Date - Date of installation.

LifecycleStatus - Feature is active, abandoned or removed.

Watertype - Sewage for all features.

Material - Pipe material.

Diameter - Diameter of pipe. All air release diameters will be attributed as 2-inch.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as force main, gravity, low pressure or vacuum.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LssControlValve - A control valve is used to control the quality of pressure in pressurized pipe systems. A control valve will split a force main.

Subtypes:

AirIntake - Are used in vacuum sewer systems. Usually 4-inch, this valve is installed on the facility's sewer, downstream of any traps. It is necessary to provide the air resulting in a natural pressure differential that becomes the driving force of the system. These valves are rarely found on as-builts, however, they can be found near government and industrial facilities.

AirRelease - Used to automatically vent trapped air in any pipeline conveying fluid. Therefore, these valves are found in all water, sewer, and reclaimed water system types. All air release diameters will be attributed as 2-inch.

Required Attribution:

Franchise_Code - Not Applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - See list of subtypes above.

Installdate - Date of installation.

Lifecyclestatus - Feature is active, abandoned or removed.

Watertype - Sewage for all features.

Diameter - Available on the drawing for air intakes, air release diameter will be 2 inches.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as force main, gravity, low pressure or vacuum.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in

the naming.

LssFitting - In sewer networks, fittings are used to connect pipe sections. Both ends of all pipe sections are covered by a fitting. On pressurized mains, fittings are frequent. The logic is the same, fittings connect pipe sections. Taps and saddles will be attributed as a tee and will split a pipe.

Subtypes:

Blowoff - Occurs at the end of a pressurized main; used for pressure relief of the system.

Wye - Used as the point of connection of two or three pipes where one pipe is non-perpendicular; lines connections usually occur at 45 and 22.5 degree connections. This fitting is the cousin of the tee; it does split pipes where used.

Tee - A point of connection for pressurized pipes. Tapping sleeves and saddles will be attributed as a tee. All tees split the connecting pipe section.

Sleeve - A point of connection for two pressurized pipes of the same diameter but may have different attribution somewhere else. A sleeve is used on pipe runs to show breaks in project phases where there is a change in record set numbers.

Reducer - A point of connection for two pressurized pipes of different diameters. The attribution (diameter) of the pipe section changes, therefore the reducer connects two individual line sections.

Cleanout - Found at the end of gravity mains and service lateral lines or sometimes at the connection point of multiple service lateral lines.

Bend - Bends will not be mapped.

Cap - These fittings are used as temporary termination points (at the ends) on a pressurized or gravity main. They are generally used when construction eliminates or re-routes service (cut and cap or stub-out and plug). They are sometimes used if expansion is unknown.

Cross - A cross occurs at the intersection of two pressurized system lines. Since these fittings require actually cutting the lines, the two system lines do split and become individual assets.

Coupling - Used as a point of connection when there is a change in material types along a pipe run.

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above)

InstallDate - Date of installation.

LifecycleStatus - Feature is active, abandoned or removed.

Watertype - Sewage for all features.

Diameter1 - Diameter of pipe 1 (run or usually largest pipe size) intersecting at the fitting.

Diameter2 - Diameter of pipe 2 (run or usually largest pipe size) intersecting at the fitting.

Diameter3 - Diameter of pipe 3 (branch or usually smaller or same pipe size) intersecting at the fitting.

Diameter4 - Diameter of pipe 4 (branch or usually smaller or same size pipe) intersecting at the fitting.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as force main, gravity, low pressure or vacuum.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LssLateralPoint - As defined by the Government, the lateral point will represent the service connection to the lateral line.

Subtypes:

Double Service - The lateral point serves two facilities.

Single Service - The lateral point serves one facility.

Service Tap - As defined by the Government, service taps will be used as the connection point of service lateral lines connecting to gravity mains. A service tap will be used to connect lateral lines to other lateral lines.

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above).

InstallDate - Date of installation.

Lifecyclestatus - Feature is active, abandoned or removed.

Watertype - Sewage for all features.

Diameter - Diameter of the lateral line.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as force main, gravity, low pressure or vacuum.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LssLiftStation - This class is named for just one type of feature contained within it. Vacuum Pump stations, valve pits, and, grinders are also included. This feature class represents network features that details information that is not to be represented outside the point created. The point is captured at the site and the incoming and outgoing pipe sections are connected to it using a virtual "flow line." In the case of "control panels" (see below) this point will not be part of the network. Wet wells, valve pad/vaults and control panels are collected by RTK GPS only. Do NOT map.

Subtype:

LiftStation - A lift station is a structure in the sewer network that takes sewage deposited by gravity mains, lifts it, and transfers it to an elevated pipe where gravity creates a natural downward pressure. Many contractors call pump stations lift stations on the as-built sheets, though the pressure is created by a pump. Classify the feature by its nomenclature on the as-built and represent it using a single point. The point will be connected to the incoming and outgoing pipe line section using a virtual "flow line."

MasterVacuumPumpStation - A pump station uses pumps to transfer sewage from a gravity pipe section into a pressurized main. Pump stations are clearly identified within as-builts. Though sometimes incorrectly identified pump stations end up classified as lift stations, classification will be done according to the nomenclature used on the as-builts. The PumpStation subtype is reserved for master vacuum pump stations only.

WetWell

ValveVault

Grinder - This is a small type of lift / pump station belonging to the low pressure system at a service site. Its function is similar to the pump station but also has a grinding component to prepare the sewage for passage into a small (1-inch to 2-inch) pressurized pipe.

VacuumValvePit - Used in vacuum system at service sites where contained within are the air intake valve for the vacuum service. A 3-inch vacuum main will be mapped to connect valve pits to the primary vacuum main.

ControlPanel

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above)

InstallDate - Date of installation.

Lifecyclestatus - Feature is active, abandoned or removed.

Watertype - Sewage for all features.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Bottomelevation - Bottom elevation only populated for lift stations can usually be found on the detail sheet.

Usetype - Populated as force main, gravity, low pressure or vacuum.

Topelevation - Attribution required for lift stations only. Usually found on lift station detail sheet.

Diameter - Attribution required for lift stations only. Diameter of lift station wet well and grinder stations can usually be found on the detail sheet.

Source - Populated as record drawing for all features.

InInvert - Populated for lift stations only.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LssManhole - A manhole is used for access to network gravity systems and control of flow through those systems. A manhole will always be found either initiating or connecting pipe lines used in the gravity network. Manholes are a critical component to all gravity systems; therefore, they are actively maintained and required for robust management programs.

Subtype:

Splitter - Is a component of the vacuum system. A 6-inch gravity main will be mapped to connect the splitter manhole to the valve pits. A 3-inch vacuum main will connect the valve pits to the

primary vacuum main These are rare and are clearly marked on the vacuum system record sets.

BufferTank - This is a component of the vacuum system.

InsideDrop - This is a standard manhole with an internal drop pipe and bowl used to control the rate of effluent inside the manhole. This will be clearly identifiable on the as-built drawing.

Terminal - This manhole is the farthest upstream manhole in a gravity branch. It is the highest point; it is not where the flow terminates but rather where the flow begins.

UnkManhole - Should not be used without complementing comments.

Discharge - Is a manhole that has a force main connecting to it.

OutsideDrop - This is a special manhole with an external drop pipe. This will be clearly identifiable on the as-built drawing.

Standard - The standard, or "typical" manhole.

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above).

InstallDate - Date of installation.

Lifecyclestatus - Feature is active, abandoned or removed.

Watertype - Sewage for all features.

Recordnumber - Not applicable.

Buffertype - This should be attributed for vacuum system features only. It will be labeled in the record set as a buffer tank.

Comments - Any other pertinent notes.

Rimelevation - Usually found on gravity system profile sheet.

Bottomelevation - Lowest invert elevation into the manhole.

Interconnect - This will this be captured for modeling purposes.

Source - Populated as record drawing for all features.

Usetype - Populated as force main, gravity, low pressure or vacuum.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LssMeter - Is a force main master meter assembly used to meter flows when there is a force main interconnect with another utility Franchise.

Subtype:

FlowMeter - Force main master meter assembly.

Franchise Meter-Used when two different Franchises establish an interconnection.

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above).

InstallDate - Date of installation.

Lifecyclestatus - Feature is active, abandoned or removed.

Watertype - Sewage for all features.

Diameter - Diameter of pipe.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as force main, gravity, low pressure or vacuum.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LssNetworkStructure - Network are large, clusters of features that exist at a site location. The details of the structure do not get captured in this database. For the purpose of delineating a sewer network, a structure point is captured at the site and the incoming and outgoing pipe sections are connected to it using a virtual "flow line."

Subtype:

TreatmentPlant - Wastewater treatment facility; final downstream destination of wastewater.

WRF - Wastewater treatment and reclamation facility, final downstream destination of wastewater and source of reclaimed water.

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above).

InstallDate - Date of installation.

Lifecyclestatus - Feature is active, abandoned or removed.

Watertype - Sewage for all features.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as force main, gravity, low pressure or vacuum.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LssSystemValve - System valves are used to control the flow of fluid through a piping system. In general, system valves are not used on pipe sections less than 4 inches in diameter.

Subtype:

UnkSystemValve - Only use this subtype if the drawing does not clearly identify the valve type. Many times, the sheet may only indicate "valve" and may have to have the type identified using another sheet or logical deduction. This type should rarely be used if ever.

ButterflyValve - These valve types are isolation valves similar to the function of a gate valve (see below) but are generally reserved for larger diameter (12 inches and greater) pipe sections.

GateValve - Gate valves are used to isolate the flow of a fluid through a piping system. They are generally located at sites where more than two pipes connect and usually conform to a minimum distance requirement. In general, it is rare to see a gate valve more than 1000 feet from the site of a connecting pipe line. The larger (diameter) pipe, the greater the distance from the connection.

PlugValve - Plug valves are used for a variety of occasions. There are below-grade plug valves at lift stations and others used in combination with check valves for backflow prevention. Most often they are used on small pipes (4 inches and less). But they do produce plug valves for large pipes too.

BallValve - A ball valve is also an isolation valve that uses an internally set ball with a hole bored through it that is turned by a handle to regulate flow. These valve types are small (typically

1 to 2 inches), thus being part of a low-pressure service.

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above).

InstallDate - Date of installation.

Lifecyclestatus - Feature is active, abandoned or removed.

Watertype - Sewage for all features.

Diameter - Diameter of the main passing through the valve.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as force main, gravity, low pressure or vacuum.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

1.4.5 Feature and Attribute Details - Water and Reclaimed Water

LwControlValve - A control valve is used to control the quality of pressure in pressurized pipe systems. A control valve will split a main line.

Subtypes:

AirRelease - Used to automatically vent trapped air in any pipeline conveying fluid. Therefore, these valves are found in all water, sewer, and reclaimed water system types. All air release diameters will be attributed as 2-inch.

BackflowPreventer

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - See list of subtypes above.

InstallDate - Date of installation.

Lifecyclestatus - Feature is active, abandoned or removed.

Watertype - Water or Reclaimed Water for all features.

Diameter - Available on the drawing for air intakes, air release diameter will be 2 inches.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as fire line, potable or reuse.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LwFitting - In pressurized distribution systems, fittings are used to connect pipe sections. Both ends of most pipe sections are covered by a fitting. However distribution networks will initiate and eventually terminate at points other than fittings. Fittings are frequent throughout a pressurized piping system but not all fittings should split a pipe in a GIS. Bends are used as connectors to redirect a pipe's bearing, but do not split pipes, therefore, bends will not to be mapped. Taps and saddles will be attributed as a tee and will split a pipe.

Subtypes:

Bend

Cap - These fittings are used as temporary termination points (at the ends) on a pressurized main. They are generally used when construction eliminates or re-routes service (cut and cap or stub-out and plug). They are sometimes used if expansion is unknown.

Cleanout - Found at the end of gravity mains and service lateral lines or sometimes at the connection point of multiple service lateral lines.

Cross - A cross occurs at the intersection of two pressurized system lines. Since these fittings require actually cutting the lines, the two system lines do split and become individual assets.

Coupling - Used as a point of connection when there is a change in material types along a pipe run.

Reducer - A point of connection for two pressurized pipes of different diameters. The attribution (diameter) of the pipe section changes, therefore the reducer connects two individual line sections.

Sleeve - A point of connection for two pressurized pipes of the same diameter but may have different attribution somewhere else. A sleeve is used on pipe runs to show breaks in project phases where there is a change in record set numbers.

Tee - A point of connection for pressurized pipes. Tapping sleeves and saddles will be attributed as a tee. All tees split the connecting pipe section which results in the intersection of three pipes.

Wye - if present, are used as the point of connection of two or three pipes where one pipe is non-perpendicular; lines connections usually occur at 45 and 22.5 degree connections. This fitting is the cousin of the tee; it does split pipes where used.

Blowoff - Occurs at the end of a pressurized main; used for pressure relief of the system.

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above)

InstallDate - Date of installation.

LifecycleStatus - Feature is active, abandoned or removed.

Watertype - Water or Reclaimed Water for all features.

Diameter1 - Diameter of pipe 1 (run or usually largest pipe size) intersecting at the fitting.

Diameter2 - Diameter of pipe 2 (run or usually largest pipe size) intersecting at the fitting.

Diameter3 - Diameter of pipe 3 (branch or usually smaller or same pipe size) intersecting at the fitting.

Diameter4 - Diameter of pipe 4 (branch or usually smaller or same size pipe) intersecting at the fitting.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as fire line, hydrant, irrigation, potable or reuse.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LwHydrant - Hydrants are terminal points within a hydrant assembly. The hydrant assembly is a collection of system features required to provide water to the hydrant from the connection with a pressurized main.

Generally the assembly consists of a tee or saddle (connection point at the main), a section of main, a gate valve and the hydrant.

Subtypes:

Hydrant - A hydrant subtype may be established but it is not necessary unless there exists a desire to track flushing hydrants from the rest.

FireDepartmentConnection - A type of hydrant found on Fire Lines and generally noted as a FDC in the record sets.

Require Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above)

InstallDate - Date of installation.

Lifecycle Status - Feature is active, abandoned or removed.

Watertype - Water for all features.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as Hydrant

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LwLateralLine - Lateral lines are basically lines connected to main distribution lines for the purpose of providing service(s). The distinction of these services vary and have been captured as subtypes that meet the needs of the Government (see below). Lateral lines can range from a single service line to a complex sub-network of distribution that stems off of the main distribution system. Lateral lines connect to main lines via a fitting, usually of the type tee, saddle or tap. The connection points for two or more lateral lines are also fittings but are sometimes not represented in the record set. in this case a service tap will be used.

Subtypes:

Potable

Fire

Firex

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above).

InstallDate - Date of installation.

Lifecycle Status - Feature is active, abandoned or removed.

Watertype - Water or Reclaimed Water for all features.

Material - Pipe material.

Diameter - Diameter of pipe.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as reuse, fire line, potable or irrigation

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LwMeter - Meters are generally the terminating end of a lateral line. However, there are in-line meters on the main distribution system at the KSC boundaries known as Master Meters, in which case the Government's maintenance responsibility terminates but the main distribution system does not.

Subtypes:

Double Service - The terminating point of a lateral line servicing exactly two independent account services.

Single Service - The termination point of a lateral line servicing one account service.

Master Meter - The in-line main distribution point at which the Government maintenance responsibility ends but the distribution network does not.
Franchise Meter-Used when two different Franchises establish an interconnection.

Multiple - The termination point of a lateral line servicing multiple services (i.e. an apartment complex)
Service Meter- The termination point of a lateral line servicing a reuse service.

Service Tap - As defined by the Government, service taps will be

used as the connection point of service lateral lines connecting to water or reuse mains. A service tap will be used to connect lateral lines to other lateral lines when fittings are not clearly called out on the record set.

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above).

InstallDate - Date of installation.

Lifecycle Status - Feature is active, abandoned or removed.

Watertype - Water or Reclaimed Water for all features.

Diameter - The diameter of the meter will be recorded if available. If the diameter of the meter has not been recorded, the meter will inherit the diameter of the attached pipe section.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as reuse, fire line, potable or irrigation.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LwNetworkStructure -Network are large, clusters of features that exist at a site location. The details of the structure do not get captured in this database. For the purpose of delineating a water network, a structure point is captured at the site and the incoming and outgoing pipe sections are connected to it using a virtual "flow line."

Subtype:

TreatmentPlant - Water treatment facility; this is the initial point of the main distribution system where the water type is "potable".

EnclosedStorageFacility-This is for future underground storage structures.

PumpStation- Potable water booster station.

PotableWell- A domestic potable well.

ElevatedTank- this feature connects the potable system coming from the plant and the rest of an areas distribution system. The tank

is used to store water and provide pressure to a system continuously. Many of these tanks have been replaced with in-line booster stations.

Water Reclamation Facility - Wastewater treatment and reclamation facility, final downstream destination of wastewater and source of reclaimed water.

Pumping Station-Reuse pump station

Control Structure-Reuse pond control structure

Pump-Reuse irrigation pump located at reuse ponds.

Irrigation Well- Well used to supply a reuse system

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above).

InstallDate - Date of installation.

Lifecyclestatus - Feature is active, abandoned or removed.

Watertype - Water or Reclaimed Water for all features.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Populated as hydrant, fire line, potable or irrigation.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LwPressurizedMain - Pressurized Mains are like any other pressure system in a utility network. They change direction, size, material, and may curve (contains additional vertices). Logically, the source of a pressurized network of lines is a pump. Logically, as with other pressurized pipe networks, the location of these pipes is generally within an available right-of-way or easement but usually not located beneath a road.

Where a section of pressurized main intersects another section of pressurized main, all sections will be split. The connection points (terminating end) of a section of pipe will be covered by the appropriately selected fitting (i.e. a single pipe section connecting to another single pipe section will result in a split creating three pipes. The appropriate fittings will be a tee, wye or a cross.).

Subtypes:

FireLine- this pipe type is used to supply fire suppression and sprinkler systems to facilities, etc… This type could be addressed as a subtype of a lateral or service but is frequently identified within the main distribution system because of its size (diameter).

AirRelease- this is a small diameter section of pipe that connects to the top main and provides a method of releasing air above ground via an air release control valve. All air release diameters will be attributed as 2-inch.

DistributionMain- this is the primary type of main used within distribution systems. This will be the default main type during data creation. Pipe diameters of less than 12-inches.

HydrantLine- this is the main section used within a hydrant assembly (see hydrant above).

TransmissionMain- Pressurized pipes with diameter of 12-inches or greater.

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above).

InstallDate - Date of installation.

LifecycleStatus - Feature is active, abandoned or removed.

Watertype - Water or Reclaimed Water for all features.

Material - Pipe material.

Diameter - Diameter of pipe. All air release diameters will be attributed as 2-inch.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Reuse, hydrant, fire line, potable or irrigation.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

LwSamplingStation - Sampling stations are sites used to collect water samples. Will not be mapped.

Subtypes:

SamplingStation - these are "sites" not features used to collect water samples for testing of chemicals and other characteristics of the water. The sampling usually happens at an existing feature.

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above).

InstallDate - Date of installation.

LifecycleStatus - Feature is active, abandoned or removed.

Watertype - Water or Reclaimed Water for all features.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

LwSystemValve - System valves are used to control the flow of fluid through a piping system. In general, system valves are not used on pipe sections less than 4-inches in diameter.

Subtype:

UnkSystemValve - Only use this subtype if the drawing does not clearly identify the valve type. Many times, the sheet may only indicate "valve" and may have to have the type identified using another sheet or logical deduction. This type should rarely be used if ever.

ButterflyValve - These valve types are isolation valves similar to the function of a gate valve (see below) but are generally reserved for larger diameter (12 inches and greater) pipe sections.

GateValve - Gate valves are used to isolate the flow of a fluid through a piping system. They are generally located at sites where more than two pipes connect and usually conform to a minimum distance requirement. In general, it is rare to see a gate valve more than 1000 feet from the site of a connecting pipe line. The larger (diameter) pipe, the greater the distance from the connection.

PlugValve - Plug valves are used for a variety of occasions. There are below-grade plug valves at lift stations and others used in combination with check valves for backflow prevention. Most often they are used on small pipes (4 inches and less). But they do produce plug valves for large pipes too.

BallValve - A ball valve is also an isolation valve that uses an internally set ball with a hole bored through it that is turned by a handle to regulate flow. These valve types are small (typically 1 to 2 inches), thus being part of a low-pressure service.

HydrantValve- this valve is a gate valve only this one is part of the hydrant assembly and only isolates flow to the hydrant and has no other impact on the system.

Required Attribution:

Franchise_Code - Not applicable.

Private - Identifies privately owned and maintained infrastructures versus Government-owned and maintained infrastructures.

Subtype - Must be identified by creator (see above).

InstallDate - Date of installation.

Lifecyclestatus - Feature is active, abandoned or removed.

Watertype - Water or Reclaimed Water for all features.

Diameter - Diameter of the main passing through the valve.

Recordnumber - Not applicable.

Comments - Any other pertinent notes.

Source - Populated as record drawing for all features.

Usetype - Reuse, hydrant, fire line, potable or irrigation.

Hyperlink-Scanned image used to digitize features from. This is the image number along with dot tif or dot jpg depending on the image type. Do not include drive letters, file paths, or words in the naming.

1.5 SPARE PARTS DATA

Indicate manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

Supply two items of each part for spare parts inventory. Provision of spare parts does not relieve the Contractor of responsibilities listed under the contract guarantee provisions.

1.6 PREVENTATIVE MAINTENANCE

Submit Preventative Maintenance and Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

Define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the

schedule. Provide a signoff blank for the Contractor and Contracting Officer for each test feature; e.g., gpm, rpm, psi. Include a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventative maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.7 WARRANTY MANAGEMENT

1.7.1 Warranty Management Plan

Develop a warranty management plan which contains information relevant to the clause Warranty of Construction. At least 30 days before the planned pre-warranty conference, submit the warranty management plan for Government approval. Include within the warranty management plan all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan must be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below must include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase must be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Assemble approved information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period will begin on the date of project acceptance and continue for the full product warranty period. A joint 4 month and 9 month warranty inspection will be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Include within the warranty management plan , but not limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subContractors, manufacturers or suppliers involved.

b. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include valves, meters, pumps, motors, transformers, and for all commissioned systems such as alarm systems, lightning protection systems, etc.

c. A list for each warranted equipment, item, feature of construction or system indicating:

1. Name of item.
2. Model and serial numbers.
3. Location where installed.
4. Name and phone numbers of manufacturers or suppliers.
5. Names, addresses and telephone numbers of sources of spare parts.
6. Warranties and terms of warranty. Include one-year overall warranty of construction. Items which have extended warranties

must be indicated with separate warranty expiration dates.
7. Cross-reference to warranty certificates as applicable.
8. Starting point and duration of warranty period.
9. Summary of maintenance procedures required to continue the warranty in force.
10. Cross-reference to specific pertinent Operation and Maintenance manuals.
11. Organization, names and phone numbers of persons to call for warranty service.
12. Typical response time and repair time expected for various warranted equipment.

d. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

e. Procedure and status of tagging of all equipment covered by extended warranties.

f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.7.2 Performance Bond

The Contractor's Performance Bond must remain effective throughout the construction period.

1.7.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty will be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, be continuously available, and be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.7.4 Contractor's Response to Construction Warranty Service Requirements

Following oral or written notification by the Contracting Officer, respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the three categories of priorities listed below. Submit a report on any warranty item that has been repaired during the warranty period. Include within the report the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframes specified, the Government will perform the work and backcharge the construction warranty payment item established.

a. First Priority Code 1. Perform onsite inspection to evaluate

situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.

b. Second Priority Code 2. Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.

c. Third Priority Code 3. All other work to be initiated within 3 work days and work continuously to completion or relief.

d. The "Construction Warranty Service Priority List" is as follows:

Code 1-Air Conditioning Systems
(1) Recreational support.
(2) Air conditioning leak in part of building, if causing damage.
(3) Air conditioning system not cooling properly.

Code 1-Doors
(1) Overhead doors not operational, causing a security, fire, or safety problem.
(2) Interior, exterior personnel doors or hardware, not functioning properly, causing a security, fire, or safety problem.

Code 3-Doors
(1) Overhead doors not operational.
(2) Interior/exterior personnel doors or hardware not functioning properly.

Code 1-Electrical
(1) Power failure (entire area or any building operational after 1600 hours).
(2) Security lights
(3) Smoke detectors

Code 2-Electrical
(1) Power failure (no power to a room or part of building).
(2) Receptacle and lights (in a room or part of building).

Code 3-Electrical
Street lights.

Code 1-Gas
(1) Leaks and breaks.
(2) No gas to family housing unit or cantonment area.

Code 1-Heat
(1). Area power failure affecting heat.
(2). Heater in unit not working.

Code 2-Kitchen Equipment
(1) Dishwasher not operating properly.
(2) All other equipment hampering preparation of a meal.

Code 1-Plumbing
(1) Hot water heater failure.
(2) Leaking water supply pipes.

Code 2-Plumbing
(1) Flush valves not operating properly.

(2) Fixture drain, supply line to commode, or any water pipe leaking.
(3) Commode leaking at base.

Code 3 -Plumbing
Leaky faucets.

Code 3-Interior
(1) Floors damaged.
(2) Paint chipping or peeling.
(3) Casework.

Code 1-Roof Leaks
Temporary repairs will be made where major damage to property is occurring.

Code 2-Roof Leaks
Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.

Code 2-Water (Exterior)
No water to facility.

Code 2-Water (Hot)
No hot water in portion of building listed.

Code 3-All other work not listed above.

1.7.5 Warranty Tags

At the time of installation, tag each warranted item with a durable, oil and water resistant tag approved by the Contracting Officer. Attached each tag with a copper wire and spray with a silicone waterproof coating. The date of acceptance and the QC signature must remain blank until the project is accepted for beneficial occupancy. Show the following information on the tag.

a. Type of product/material_____.

b. Model number_____.

c. Serial number_____.

d. Contract number_____.

e. Warranty period_____from_____to_____.

f. Inspector's signature_____.

g. Construction Contractor_____.

Address_____.

Telephone number_____.

h. Warranty contact_____.

Address_____.

Telephone number_____.

i. Warranty response time priority code_____.

j. WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.

1.8 OPERATION AND MAINTENANCE MANUALS

Operation and Maintenance Manuals must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Bind information in manual format and grouped by technical sections. Test data must be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals must have 0.3937-inch holes and be bound in 3-ring, loose-leaf binders. Organize data by separate index and tabbed sheets, in a loose-leaf binder. Binder must lie flat with printed sheets that are easy to read. Caution and warning indications must be clearly labeled.

Submit classroom and field instructions in the operation and maintenance of systems equipment where required by the technical provisions. These services must be directed by the Contractor, using the manufacturer's factory-trained personnel or qualified representatives. Contracting Officer will be given 7 calendar days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor, such as lists, static exhibits, and visual aids, must be made available to the Contracting Officer.

Submit 6 copies of the project operation and maintenance manuals 30 calendar days prior to testing the system involved. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

1.9 CLEANUP

Provide final cleaning in accordance with ASTM E 1971. Leave premises "broom clean." Use only nonhazardous cleaning materials, including natural cleaning materials, in the final cleanup. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces. Clean equipment and fixtures to a sanitary condition. Clean filters of operating equipment and comply with the Indoor Air Quality (IAQ) Management Plan. Clean debris from roofs, gutters, downspouts and drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site. Recycle, salvage, and return construction and demolition waste from project in accordance with the Waste Management Plan. Promptly and legally transport and dispose of any trash. Do not burn, bury, or otherwise dispose of trash on the project site.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMISSION OF OPERATION AND MAINTENANCE DATA
1.2.1 Package Quality
1.2.2 Package Content
1.2.3 Changes to Submittals
1.2.4 Review and Approval
1.2.5 O&M Database
1.3 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES
1.3.1 Operating Instructions
1.3.1.1 Safety Precautions
1.3.1.2 Operator Prestart
1.3.1.3 Startup, Shutdown, and Post-Shutdown Procedures
1.3.1.4 Normal Operations
1.3.1.5 Emergency Operations
1.3.1.6 Operator Service Requirements
1.3.1.7 Environmental Conditions
1.3.2 Preventive Maintenance
1.3.2.1 Lubrication Data
1.3.2.2 Preventive Maintenance Plan and Schedule
1.3.2.3 Cleaning Recommendations
1.3.3 Corrective Maintenance (Repair)
1.3.3.1 Troubleshooting Guides and Diagnostic Techniques
1.3.3.2 Wiring Diagrams and Control Diagrams
1.3.3.3 Maintenance and Repair Procedures
1.3.3.4 Removal and Replacement Instructions
1.3.3.5 Spare Parts and Supply Lists
1.3.4 Corrective Maintenance Work-Hours
1.3.5 Appendices
1.3.5.1 Product Submittal Data
1.3.5.2 Manufacturer's Instructions
1.3.5.3 O&M Submittal Data
1.3.5.4 Parts Identification
1.3.5.5 Warranty Information
1.3.5.6 Personnel Training Requirements
1.3.5.7 Testing Equipment and Special Tool Information
1.3.5.8 Testing and Performance Data
1.3.5.9 Contractor Information
1.4 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES
1.5 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES
1.5.1 Data Package 1

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section Table of Contents --

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 1971	(2005) Stewardship for the Cleaning of Commercial and Institutional Buildings

1.2 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors shall compile and prepare data and deliver to the Contractor prior to the training of Government personnel. The Contractor shall compile and prepare aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.2.1 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.2.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Commissioned items without a specified data package requirement in the individual technical sections shall use Data Package 3. Commissioned items with a Data Package 1 or 2 requirement shall use instead Data Package 3.

1.2.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.2.4 Review and Approval

The Government's Commissioning Authority (CA) shall review the commissioned systems and equipment submittals for completeness and applicability. The Government shall verify that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. This work shall be in addition to the normal review procedures for O&M data.

1.2.5 O&M Database

Develop a database from the O&M manuals that contains the information required to start a preventative maintenance program.

1.3 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.3.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.3.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.3.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.3.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.3.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.3.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.3.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as

lubrication, adjustment, inspection, and recording gage readings.

1.3.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.3.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.3.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.3.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.3.2.3 Cleaning Recommendations

Provide environmentally preferable cleaning recommendations in accordance with ASTM E 1971.

1.3.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.3.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.3.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.3.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.3.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.3.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.3.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.3.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.3.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.3.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

1.3.5.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.3.5.4 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

1.3.5.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.3.5.6 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.3.5.7 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.3.5.8 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

1.3.5.9 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.4 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES

Include Data Package 1 and the following for control systems:

a. Narrative description on how to perform and apply all functions,

features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

b. Full as-built sequence of operations.

c. Copies of all checkout tests and calibrations performed by the Contractor (not Cx tests).

d. Full points list. A listing of rooms shall be provided with the following information for each room:

(1) Floor

(2) Room number

(3) Room name

(4) Air handler unit ID

(5) Reference drawing number

(6) Air terminal unit tag ID

(7) Heating and/or cooling valve tag ID

(8) Minimum cfm

(9) Maximum cfm

e. Full print out of all schedules and set points after testing and acceptance of the system.

f. Full as-built print out of software program.

g. Electronic copy on disk or CD of the entire program for this facility.

h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.5 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.5.1 Data Package 1

a. Safety precautions

b. Operator prestart

c. Start-up, shutdown, and post-shutdown procedures

d. Normal operations

e. Environmental conditions

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Product submittal data

m. Manufacturer's instructions

n. O&M submittal data

o. Parts identification

p. Testing equipment and special tool information

q. Warranty information

r. Testing and performance data

s. Contractor information

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - EXISTING CONDITIONS

SECTION 02 41 00

DEMOLITION AND DECONSTRUCTION

PART 1 GENERAL

1.1 REFERENCES
1.2 PROJECT DESCRIPTION
1.2.1 Demolition/Deconstruction Plan
1.2.2 General Requirements
1.3 ITEMS TO REMAIN IN PLACE
1.3.1 Existing Construction Limits and Protection
1.3.2 Weather Protection
1.3.3 Trees
1.3.4 Utility Service
1.3.5 Facilities
1.4 BURNING
1.5 SUBMITTALS
1.6 QUALITY ASSURANCE
1.6.1 Dust and Debris Control
1.7 PROTECTION
1.7.1 Traffic Control Signs
1.7.2 Protection of Personnel
1.8 RELOCATIONS
1.9 EXISTING CONDITIONS

PART 2 PRODUCTS

2.1 FILL MATERIAL

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED
3.1.1 Structures
3.1.2 Utilities and Related Equipment
3.1.2.1 General Requirements
3.1.2.2 Disconnecting Existing Utilities
3.1.3 Paving and Slabs
3.1.4 Concrete
3.1.5 Miscellaneous Metal
3.1.6 Mechanical Equipment and Fixtures
3.1.6.1 Preparation for Storage
3.1.6.2 Piping
3.1.7 Electrical Equipment and Fixtures
3.1.7.1 Fixtures
3.1.7.2 Electrical Devices
3.1.7.3 Wiring Ducts or Troughs
3.1.7.4 Conduit and Miscellaneous Items
3.1.8 Items With Unique/Regulated Disposal Requirements
3.2 CONCURRENT EARTH-MOVING OPERATIONS

3.3 DISPOSITION OF MATERIAL
3.3.1 Title to Materials
3.3.2 Export Control
3.3.3 Reuse of Materials and Equipment
3.3.4 Salvaged Materials and Equipment
3.3.5 Recycling
3.3.6 Disposal of Ozone Depleting Substance (ODS)
3.3.6.1 Special Instructions
3.3.7 Unsalvageable and Non-Recyclable Material
3.4 CLEANUP
3.5 DISPOSAL OF REMOVED MATERIALS
3.5.1 Regulation of Removed Materials
3.5.2 Burning on Government Property
3.5.3 Removal to Spoil Areas on Government Property
3.5.4 Removal from Government Property
3.6 REUSE OF SALVAGED ITEMS

-- End of Section Table of Contents --

SECTION 02 41 00

DEMOLITION AND DECONSTRUCTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI Guideline K	(2009) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6	(2006) Safety Requirements for Demolition Operations

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(2007; Rev K) Obstruction Marking and Lighting

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 82	Protection of Stratospheric Ozone

1.2 PROJECT DESCRIPTION

1.2.1 Demolition/Deconstruction Plan

Prepare a Demolition Plan and submit proposed salvage, demolition, deconstruction, and removal procedures for approval no later than 14 days before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, and a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. Coordinate with Waste Management Plan. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. Submit certification of DBPR certified pollutant storage contractor for removal of underground storage

tank. Provide procedures for safe conduct of the work in accordance with Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS. Plan shall be approved by Contracting Officer prior to work beginning.

1.2.2 General Requirements

Do not begin demolition or deconstruction until authorization is received from the Contracting Officer. The work of this section is to be performed in a manner that maximizes salvage and recycling of materials. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the buildings. The work includes demolition, deconstruction, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with OSHA, NASA/KSC Health and Safety Policies, and other applicable Sections.

1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

1.3.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

1.3.3 Trees

Protect trees within the project site which might be damaged during demolition or deconstruction, and which are indicated to be left in place, by a 6 foot high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

1.3.4 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off by the Government and disconnected and sealed by the Contractor.

1.3.5 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions; G
Demolition Plan; G
Notification; G

Proposed salvage, demolition, deconstruction, and removal procedures for approval before work is started.

SD-07 Certificates

Certification of DBPR Certified Pollutant Storage Contractor; G

1.6 QUALITY ASSURANCE

Furnish timely notification of demolition and deconstruction projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the State's environmental protection agency and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of NASA KSC policy, conform to the safety requirements contained in ASSE/SAFE A10.6. Comply with the Environmental Protection Agency and NASA/KSC requirements specified. Use of explosives will not be

permitted.

Use best management practices (BMPs) to prevent releases of metal and/or PCB contaminated paint chips to the environment. The following are offered as suggested BMPs:

a. Where possible, demolish structures by collapsing walls inward onto facility foundation.

b. Where possible, limit heavy equipment use to paved surfaces.

c. Control stormwater runoff from paved areas by installing silt fencing and/or sediment barriers across stormwater flumes.

d. Drum or containerize, using appropriate PWQ/TRP listed containers, all paint chip contaminated sediments and submit debris for testing. Dispose of characterized sediment waste in accordance with KSC Waste Management Requirements following the PWQ/TRP process.

e. Maintain regular housekeeping on the construction site thus preventing significant stormwater runoff before it occurs.

1.6.1 Dust and Debris Control

Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

Use best management control measures to prevent the release of paint chips to the environment.

BMPs include, but are not limited to, the following:

a. Contain demolition debris where possible to impermeable surface.

b. Control stormwater runoff from the site with silt fencing.

c. Conduct daily housekeeping to limit potential paint chip migration.

d. Collect and remove all demolition debris from the project area.

e. Containerize and dispose of appropriate sediment collected adjacent to silt fence.

f. Upon completion of demolition, remove the first 6 inches of top soil from within and 6 feet beyond the project area and dispose of in the KSC landfill.

1.7 PROTECTION

1.7.1 Traffic Control Signs

a. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement by wind. Notify the Contracting Officer prior to beginning such work.

Provide a minimum of 2 aviation red or high intensity white obstruction

lights on temporary structures (including cranes) over 100 feet above ground level. Light construction and installation shall comply with FAA AC 70/7460-1. Lights shall be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer. Maintain the temporary services during the period of construction and remove only after permanent services have been installed and tested and are in operation.

1.7.2 Protection of Personnel

Before, during and after the demolition and deconstruction work continuously evaluate the condition of the structure being demolished and deconstructed and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Items to be relocated which are damaged by the Contractor shall be repaired or replaced with new undamaged items as approved by the Contracting Officer.

1.9 EXISTING CONDITIONS

Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Digital photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document.

PART 2 PRODUCTS

2.1 FILL MATERIAL

a. Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill voids, depressions or excavations resulting from demolition or deconstruction of structures. Fill material shall be waste products from demolition or deconstruction until all waste appropriate for this purpose is consumed.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and

prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse onsite whenever possible.

3.1.1 Structures

Remove existing structures indicated to bottom of foundation walls.

Demolish structures in a systematic manner from the top of the structure to the ground.

3.1.2 Utilities and Related Equipment

3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or deconstruction work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities, as indicated and uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer.

3.1.3 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs including aggregate base as indicated. Provide neat sawcuts at limits of pavement removal as indicated. Pavement and slabs designated to be recycled and utilized in this project shall be moved, ground and stored as directed by the Contracting Officer. Unpainted concrete shall be transported to Diverted Aggregate Reclamation and Collection Yard (DARCY) in accordance with NASA KSC policy.

3.1.4 Concrete

Salvage removed concrete.

3.1.5 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Scrap metal shall become the Contractor's property. Recycle scrap metal as part of demolition and deconstruction operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

3.1.6 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Disconnect mechanical equipment and fixtures at fittings. Remove service valves attached to the unit. Where indicated, salvage each item of equipment and fixtures as a whole unit; listed, indexed, tagged, and stored. Salvage each unit with its normal operating auxiliary equipment. Transport salvaged equipment and fixtures, including motors and machines, to a designated storage area as directed by the Contracting Officer. Do not remove equipment until approved. Do not offer low-efficiency equipment for reuse; provide to recycling service for disassembly and recycling of parts.

3.1.6.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; tanks, piping and fixtures shall be drained; interiors, if previously used to store flammable, explosive, or other dangerous liquids, shall be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit.

3.1.6.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Store salvaged piping according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Box prefabricated supports, hangers, plates, valves, and specialty items according to size and type. Wrap sprinkler heads individually in plastic bags before boxing. Classify piping not designated for salvage, or not reusable, as scrap metal.

3.1.7 Electrical Equipment and Fixtures

Where indicated, salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

3.1.7.1 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage. Note: Manage ballasts that cannot be identified as being PCB-free as if they are PCB-contaminated.

3.1.7.2 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators,

meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

3.1.7.3 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway and store separately.

3.1.7.4 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.1.8 Items With Unique/Regulated Disposal Requirements

Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition or deconstruction work in areas occupied by structures to be demolished or deconstructed until all demolition and deconstruction in the area has been completed and debris removed. Fill holes, open basements and other hazardous openings.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.3.2 Export Control

Comply with U.S. Export Control Laws. Deconstruct all facilities and associated equipment so that they can neither be reassembled nor recognized. Render unrecognizable all NASA and Contractor tags.

3.3.3 Reuse of Materials and Equipment

Remove and store materials and equipment listed in the Demolition Plan or indicated by the Contracting Officer to be reused or relocated to prevent

damage, and reinstall as the work progresses.

3.3.4 Salvaged Materials and Equipment

Remove materials and equipment that are listed in the Demolition Plan and specified to be removed by the Contractor and that are to remain the property of the Government, and deliver to the Reutilization, Recycling and Marketing Facility (RRMF).

a. Salvage items and material to the maximum extent possible.

b. Store all materials salvaged for the Contractor as approved by the Contracting Officer and remove from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

c. Remove salvaged items to remain the property of the Government in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage must be repaired or replaced to match existing items. Properly identify the contents of containers.

d. Remove historical items in a manner to prevent damage.

e. Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990.

3.3.5 Recycling

Make every practical effort to reclaim and segregate materials that have the ability to be recycled. Segregate all reclaimed concrete from other wastes and transport to the KSC Landfill (L7-0071) on Schwartz Road. Transport all unpainted concrete to DARCY. Transport all reclaimed scrap metal, not being recycled by the Contractor outside KSC, to the RRMF with a KSC Form 7-49. Turn these items and the KSC Form 7-29 into RRMF personnel to ensure the proper disposition of the materials before leaving the recycling area. For any other information regarding what materials can be recycled or other general information regarding recycling policies at KSC, contact NASA Environmental.

3.3.6 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be turned over to the Contracting Officer. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

3.3.6.1 Special Instructions

No more than one type of ODS is permitted in each container. A warning/hazardous label shall be applied to the containers in accordance with NASA KSC policy. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

a. Activity name and unit identification code

b. Activity point of contact and phone number

c. Type of ODS and pounds of ODS contained

d. Date of shipment

3.3.7 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material in the KSC Class III Landfill located on Schwartz Road in accordance with Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION and the special conditions.

3.4 CLEANUP

Remove debris and rubbish from excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified in the Waste Management Plan and Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION. Storage of removed materials on the project site is prohibited, unless otherwise specified on the drawings.

3.5.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property.

3.5.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition and deconstruction structures to designated spoil areas on Government property.

3.5.4 Removal from Government Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

3.6 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - EXISTING CONDITIONS

SECTION 02 82 13.00 98

ASBESTOS ABATEMENT

PART 1 GENERAL

1.1 SUMMARY
1.2 DEFINITIONS
1.3 REFERENCES
1.4 DESCRIPTION OF WORK
1.5 SUBMITTALS
1.6 LICENSES PERMITS, AND NOTICES
1.6.1 Notification
1.7 IMPLEMENTATION PLAN
1.8 AIR MONITORING REPORTS
1.8.1 Air Sample Analytical Method
1.8.2 Air Sampling Rate, Volumes and Frequency
1.9 WORKER PROTECTION

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 TEMPORARY UTILITIES AND SERVICES
3.2 WORK AREA PREPARATION
3.2.1 Work Area(s)
3.3 WASTE LOAD-OUT UNIT
3.4 SIGNS AND MARKINGS
3.5 RESPIRATORY PROTECTION
3.5.1 Air Quality for Supplied Air Respiratory Systems
3.6 REMOVAL OF ASBESTOS
3.7 DAILY HOUSEKEEPING
3.8 CLEANING PROCEDURES
3.9 INSPECTION
3.9.1 Initial Inspection
3.9.2 Daily Inspection
3.9.3 Final Inspection
3.10 ASBESTOS WASTE AND CONTAMINATED MATERIALS
3.10.1 Removal of Asbestos Waste Materials
3.10.1.1 Waste Inventory
3.10.2 Work Area Disposal
3.10.3 Decontamination Area And Support Area Disposal
3.11 WASTE TRANSPORTATION AND DISPOSAL
3.12 ASBESTOS ABATEMENT NOTICE AND CHECKLIST
3.13 FINAL ACCEPTANCE

-- End of Section Table of Contents --

SECTION 02 82 13.00 98

ASBESTOS ABATEMENT

PART 1 GENERAL

1.1 SUMMARY

This section specifies the asbestos abatement requirements and the Contractor's applicable asbestos procedures, which include demolition or salvage of structures where asbestos is present, removal or encapsulation of materials containing asbestos, construction, alteration, repair, maintenance, or renovation of structures, substrates, or portions thereof, that contain asbestos, installation of products containing asbestos, asbestos spill/emergency cleanup, transportation, disposal, storage, containment of and housekeeping activities involving asbestos or products containing asbestos, on the site or location at which construction activities are performed.

Under OSHA, Asbestos Abatement work is categorized into four classes:

Class I Work: Activities involving the removal of Thermal System Insulation (TSI) and surfacing Asbestos Containing Materials (ACM) and Presumed Asbestos Containing Material (PACM).

Class II Work: Activities involving the removal of ACM that is not TSI or surfacing material. This includes wallboard, floor tile and sheeting, roofing, siding, shingles, and construction mastics.

Class III Work: Repair and Maintenance operations, where ACM, including TSI and surfacing ACM and PACM, is likely to be disturbed.

Class IV Work: Maintenance and custodial activities during which employees contact but do not disturb ACM or PACM and activities to clean up dust, waste, and debris from Class I,II, and III activities.

Conduct abatement work in accordance with the Class I, II, III, or IV Methods of Compliance as required by 29 CFR 1910,29 CFR 1926, 40 CFR 61-SUBPART M, 49 CFR 171, 49 CFR 172, FAC CHAPTER 62-257, and FL-STAT 469. Submit all required training certifications prior to commencement of work.

1.2 DEFINITIONS

FLAC - Florida Licensed Asbestos Consultant as defined within the FL-STAT 469 ASBESTOS ABATEMENT.

IH - Kennedy Space Center Industrial Hygienist. This person can be either a Government Civil Servant or an authorized Government Contractor. This person is responsible for the oversight, approval of the abatement procedures and the health, safety, and welfare of those who it effects.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-7.1	(2004) Commodity Specification for Air

FLORIDA ADMINISTRATIVE CODE (FAC)

FAC CHAPTER 62-257	Florida Administrative Code, Asbestos Program

FLORIDA STATUTES (FL-STAT)

FL-STAT 469	Asbestos Abatement

JOHN F. KENNEDY SPACE CENTER (KSC)

KNPR 8500.1	KSC Environmental Requirements
KNPR 1840.19	KSC Industrial Hygiene Programs
KNPR 8715.3	KSC Safety Practices Procedural Requirements

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 7400	(1994) Standard Test Method for Asbestos and Other Fibers by PCM
NIOSH 94-113	(1994; 4th Ed) NIOSH Manual of Analytical Methods

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
40 CFR 61-SUBPART M	National Emission Standard for Asbestos
40 CFR 763	Asbestos
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

1.4 DESCRIPTION OF WORK

Abate materials containing asbestos as indicated on the drawings in accordance with NASA KSC policy.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Work Schedule; G in accordance with the paragraph entitled, "Worker Protection," of this section.

Notification of Demolition/Renovation; G

SD-02 Shop Drawings

Submit items in accordance with the paragraph entitled, "Implementation Plan," of this section.

Coordination Drawings; G

Detailed Drawings; G

SD-06 Test Reports

Submit the following:

Initial Exposure Assessments in accordance with 29 CFR 1926

Submit Air Monitoring Reports in accordance with paragraph entitled, "Air Monitoring Report," of this section.

Maintain Work Site entry logs of all personnel entering and leaving the regulated work area by the on-site competent person indicating the date and time of entry and egress.

Maintain Daily Site Inspection Logs by the on-site competent person indicating the date, time and results of the work area daily site inspections.

Maintain Waste Inventory of all generated waste drums or containers indicating the location and approximate quantity of material in each container.

SD-07 Certificates

Submit the following certificates:

Asbestos Consultant's License from the State of Florida, Department of Business and Professional Regulation (DBPR)

Asbestos Contractor's License; G or other Contractor license approval from the State of Florida, Department of Business and Professional Regulation (DBPR).

Training Certifications; G, and experience of Contractor's "Competent Person", Supervisor, and workers.

Proficiency Analytical Test Certification

SD-08 Manufacturer's Instructions

Submit Material Safety Data Sheets in accordance with the paragraph entitled, "Licenses Permits, and Notices," of this section.

Submit Implementation Plan; G as identified in paragraph entitled, "Implementation Plan," prior to initial site set-ups or start of work.

SD-11 Closeout Submittals

Within 10 days after the completion of work, submit to the Contracting Officer a written summary and copies of the following items:

Notification of Demolition/Renovation.

Waste Disposal Permit and all Disposal Shipping Manifests and Tickets.

Daily site inspection logs and other OSHA compliance inspection records.

Air Monitoring Reports conducted during the abatement.

Calibration Records; G for sampling equipment taken before and after each air sample.

Entry logs and Waste Stream Inventory maintained during the abatement task.

1.6 LICENSES PERMITS, AND NOTICES

Ensure that the FLAC possesses a current license and comply with all Federal, State and Local Regulations. Only those consultants who are certified and licensed by DBPR are permitted to perform Asbestos Surveys or abatement specifications and plans as per Florida Statute 469.

Contractor's possession of a current Asbestos Contractor's License is mandatory, as well as securing all necessary licenses and permits associated with asbestos removal, transportation, and disposal as may be required by Federal, State, and local regulations. Only those Contractors who are certified and licensed by the State of Florida DBPR will be permitted to perform asbestos abatement activities at Kennedy Space Center.

A Waste Disposal Permit and all Disposal Shipping Manifests and Tickets are to be obtained.

Submit the following certificates:

Certification of participation in a Proficiency Analytical Test (PAT) program such as or equivalent to the American Industrial Hygiene Association PAT or Asbestos Analytical Registry (AAR) accreditation certificate and Interlab QA/QC Program participation for the independent air monitoring agency selected by the Contractor before starting work.

Training Certifications and accreditation certificates for the independent air monitoring agency's on-site personnel and a copy of independent air monitoring agency's Quality Control Program.

Certification documents by the Contractor verifying that employees have been provided current respirator fit test, training, and medical examinations in compliance with 29 CFR 1926.

Material safety data sheets as required for materials to be used on the specified project.

1.6.1 Notification

When applicable, submit Florida Department of Environmental Protection (DEP) "Notice of Demolition or Asbestos Renovation" (DEP Form 62-257.900(1)) to DEP District Office. A copy of the notification is to be provided to the Government as part of the Implementation Plan.

1.7 IMPLEMENTATION PLAN

Prepare and submit a detailed, written Implementation Plan created, signed and sealed by a FLAC to the Government for approval, prior to the start of work, that includes the following:

Coordination drawings including site specific drawings of proposed work areas, clean room/change areas, mini-enclosures, shower, equipment room, waste loading/staging areas, work areas, emergency egress, and areas to be modified.

Detailed drawings for asbestos abatement systems consisting of fabrication and assembly drawings for all parts of the work in sufficient detail to enable the Government to check conformity with the requirements of the contract documents.

A copy of the applicable DEP Notification of Demolition/Renovation (DEP Form 62-257.900(1)).

Plan of Action, including proposed procedures to be used in complying with the requirements of this specification, 29 CFR 1926,and other applicable regulatory requirements, sequence of asbestos abatement work, the interfaces of trades involved in the performance of work, posting of licenses, permits, etc., methods to be used to assure the safety of visitors to the site, disposal plan including location of approved disposal site, a detailed description of the methods employed to control pollution, and a detailed work schedule. Expand upon the method for removal of ACM, method of removal to prohibit visible emissions in the work area, and packaging of removed debris.

Details of the decontamination areas and procedures, locations of staging areas, and posting of warning signs to be used in the work area.

Sketch(s) or drawing(s) of complete contract area(s) showing the shower room, clean room, drum staging area, and decontamination and containment areas. Indicate designation of the "Competent Person" (CP), and Site Supervisor.

Provide a written Air Monitoring Plan to be prepared under the direction of and signed/stamped by a Certified Industrial Hygienist (C.I.H.)or FLAC

specifying the air monitoring criteria and an action plan for implementation by the Competent Person. Identify in the plan the Competent Person to be on site at all times (unless otherwise authorized by the Contracting Officer) during asbestos abatement operations. The FLAC or his/her representative/competent person is responsible for ensuring applicable regulatory compliance during all phases of the asbestos abatement activities. The competent person has the authority to stop work for unsafe conditions and for not adhering to applicable regulations. Provide a qualified back-up person in the event that the Competent Person is absent from job site.

Provide certification that the Contractor, his staff, and abatement workers (including Supervisors) have attended and successfully completed (an) asbestos abatement course(s) including refresher courses as set forth in FL-STAT 469 and in accordance with 29 CFR 1926 and 40 CFR 763.

Provide a Respiratory Protection Program in accordance with 29 CFR 1910 including training in the care, use, and maintenance of respirators and fit test certification.

Provide a written description of respiratory equipment (name, type, model number) and protective clothing provided to the abatement workers.

Provide documentation that all personnel assigned to the abatement project have been examined annually by a physician. Submit the physician's written opinion containing the results of the employee's medical examination in compliance with 29 CFR 1926. Establish, maintain, and make readily available for review all Work site entry logs.

Provide Procedures for enforcement of Personal Hygiene Practices.

Prepare and submit a Contingency Plan for emergencies including fire, accident, respirator supplied air system failure, or any other event that may require modification of the work area procedures. Include in the plan specific procedures for decontamination and the need for medical attention in the event of an emergency.

Submit any additional procedures (fall protection, confined space, etc.) and policies that are in effect to ensure worker safety and environmental, KNPR 8500.1 and KNPR 8715.3 requirements are met.

Submit the Implementation Plan to the Government for review and approval. Commencement of work will not be permitted until the Implementation Plan is given final approval.

1.8 AIR MONITORING REPORTS

Obtain the services of an independent Air Monitoring Agency accredited by the American Industrial Hygiene Association (AIHA), for analysis of airborne asbestos concentration levels. Provide a copy of the monitoring agency's Quality Control Program to Contracting Officer prior to commencement of the abatement activities. Ensure the individual performing the on-site air monitoring meets the requirements as set forth in FL-STAT 469 and 40 CFR 763, and performs sample collections in accordance with the approved Air Monitoring Plan.

Perform all Air Monitoring under the direction of the FLAC using an independent Air Monitoring Contractor, in compliance with Florida Statute 469 requirements.

Calibrate pumps before and after each air sample and submit calibration records to the Government.

Submit daily Air Monitoring Reports. Include in the Air Monitoring Report the following information for each sample:

Sample identification, Sample location,

Employee Name, Social Security Number,

Description of task being monitored,

Exposure level results in (f/cc),

Monitoring instrument identification number,

Pre-calibration, post calibration, and average flow rate of each sample,

Sample date, start and stop times,

Type of protective devices worn (if any),

Project identification number, Facility number and name,

Sampling and Analytical Methods used,

Contact name and company, and name of individual performing the sampling.

1.8.1 Air Sample Analytical Method

Airborne fiber sampling and analytical procedures are to be analyzed by Phase Contrast Microscopy (PCM) in accordance with 29 CFR 1926 and NIOSH 94-113 7400 method.

1.8.2 Air Sampling Rate, Volumes and Frequency

Conduct daily monitoring utilizing sample rates, volumes and frequency in accordance with 29 CFR 1926 and retain for final submittal at closeout. The minimum number of samples or sample volumes may not be less than those specified below:

Type of Sample	Volume	Minimum No. Samples	Location
Prior to set-up (within 24 hrs)	1200L	2	Regulated Area
Personal, During work	400L	2	Personal B.Z.
Area samples, Adjacent to work area.	1200L	2	Regulated Area
Area samples at Negative Air Unit Exhaust.	1200L	1	In area of outlets

NOTE: The Contractor shall perform air sampling outside the regulated work area.

1.9 WORKER PROTECTION

Perform Initial Exposure Assessments and Employee Exposure Monitoring in accordance with 29 CFR 1926, part 1926.1101, with input and approval of the FLAC.

Select and provide respiratory protection to employees and ensure they are utilized in accordance with 29 CFR 1926.

Submit the Work schedule indicating the work days, hours, and the number of workers per shift. Include a bar chart to identify the individual milestones through to the completion of the project (i.e., number of days to complete work site preparation, number of days to complete ACM removal, etc.).

Submit the OSHA compliance inspection records as part of the closeout documents.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TEMPORARY UTILITIES AND SERVICES

The Government will make available at the work site, water at hose bibs and 120 Volt AC at receptacles for the Contractor's use. Provide water proof safety lighting where necessary for safe, adequate illumination.

Ensure all electrical equipment to be used inside the work areas is powered from an Underwriters Laboratory (UL) approved Ground Fault Circuit Interrupter (GFCI). Do not exceed the manufacturers limits per GFCI. Make all necessary connections and restore the site connections to their original condition or better, prior to project completion.

Ensure all energized or pressurized systems inside the work area have been locked out, tagged out or otherwise rendered safe.

Provide temporary water to control the generation of airborne dust, to allow for area, personnel, and equipment decontamination, and to supply decontamination unit needs. Also provide a backflow preventer at the source.

Provide temporary sanitary drainage piping to the decontamination unit sump and to the shower unit at a minimum slope of 2.0 percent, and temporary drainage piping to waste water pump and existing drain in accordance with local standards and as approved by the Contracting Officer. Collect used shower water and filter with approved water filtration equipment to remove asbestos contamination. Discharge only clean water to the sanitary system.

3.2 WORK AREA PREPARATION

During ACM removal, confine equipment and employees to the designated work area(s).

Unless otherwise directed by the Contracting Officer, the Contractor is to establish and maintain a 25-foot access control barrier zone(s) around the designated work area(s).

3.2.1 Work Area(s)

Inform all other Contractors and personnel on the site of the abatement work of the nature of the Contractor's work with ACM and/or PACM, of the existence of and requirements pertaining to regulated areas, and the measures taken to ensure that employees of such other Contractor employers are not exposed to asbestos in accordance with 29 CFR 1926.

Use industry controls and work practice methods in accordance with 29 CFR 1926. Ensure daily site inspection logs are posted at the jobsite by the on-site competent person.

3.3 WASTE LOAD-OUT UNIT

Establish a waste load-out unit to provide for interim secure storage of asbestos-contaminated items (drums, tools, equipment). Decontaminate all equipment and waste containers prior to being taken out of the work area(s).

All asbestos-containing waste material is to be sealed in leak-tight disposal containers or bags, or wrapped in polyethylene sheeting. Thoroughly wet all waste within the disposal containers. Maintain proper labeling protocols for all running and final inventory of filled disposable containers.

3.4 SIGNS AND MARKINGS

Post signs prior to commencing asbestos work as required in 29 CFR 1926. Post signs at the perimeter of the asbestos work areas, along the route of the temporary waste material holding (Drum Staging) area, and at all entrances to asbestos work areas. Ensure signs are conspicuous and legible.

Post telephone numbers and locations of emergency services including, but not limited to, fire, ambulance, doctor, and hospital, at the regulated area.

Post one copy of all permits at the work site perimeter in a accessible location outside the regulated area.

Post one copy of the Abatement Contractors current license at the work site perimeter in a accessible location outside the regulated area.

Post hazard communication notification signs in accordance with KNPR 1840.19 requirements.

3.5 RESPIRATORY PROTECTION

Instruct and train each worker involved in asbestos abatement in proper respirator use and care. Fit all respirators by approved qualitative or quantitative test. Use respiratory protection appropriate for the fiber level encountered in the Work Area and as specified herein, or as required for other situations encountered.

3.5.1 Air Quality for Supplied Air Respiratory Systems

The Contractor is to provide air used for breathing in Type "C" supplied air respiratory systems that meets or exceeds CGA G-7.1, standards for Grade D air.

3.6 REMOVAL OF ASBESTOS

Use industry controls and work practices for all operations in accordance with 29 CFR 1926 Methods of Compliance for Class I, II, III, or IV asbestos work. The FLAC or his/her representative are responsible for these practices.

Ensure all Class I, II, III and IV work is supervised by an on site Competent Person at all times that work is in progress.

Following removal of contaminated items and asbestos material, seal the edges of adjacent surfaces, which were exposed when asbestos was removed, with an asbestos bridging sealant/encapsulant.

3.7 DAILY HOUSEKEEPING

Maintain a clean work area in accordance with 29 CFR 1926. At the end of each shift or prior to leaving the work site unattended prepare contaminated waste for disposal by packaging the waste and removing it from the work area.

3.8 CLEANING PROCEDURES

Clean the work area at the end of each day's abatement activities. Designate a separate, secured area within the work area for storage of debris until it can be properly disposed. Secure the work area after termination of the work day. Clean all equipment by HEPA vacuuming and wet wiping.

3.9 INSPECTION

Do not commence removal of asbestos materials prior to satisfactory concurrence to proceed on the Asbestos Abatement Pre-Work Inspection (checklist KSC Form 28-1230NS).

3.9.1 Initial Inspection

The Contractor will conduct a walk-through of the work area prior to beginning the abatement work to review existing conditions and ensure safe and practical conditions for the work to be implemented. Any damage to structures, surfaces, and equipment, which could be misconstrued as damage resulting from work, is to be documented by the Contractor and immediately submitted to the Contracting Officer.

Perform background sampling for work areas in accordance with 29 CFR 1926 prior to beginning the abatement work.

3.9.2 Daily Inspection

Maintain a work site entry log of all personnel who enter the regulated work area. Through continuous surveillance and inspections of the worksite, ensure the integrity of containment, proper function of the negative pressure system, and posting of signs and labels. Also ensure, through frequent inspections during each work shift, that appropriate work practices are followed, appropriate protective clothing and equipment are used, and worker decontamination procedures are being followed.

Provide updated copies of the Air Monitoring Reports, Daily Site Inspection

Logs and Waste Stream Inventory to the Contracting Officer at the end of each week of the abatement work.

NASA/Kennedy Space Center reserves the right to conduct periodic inspections and air monitoring in the work area(s). If the work area is unsafe as determined by the Government, the Contracting Officer will require the Contractor to stop work until the unsafe conditions are corrected.

3.9.3 Final Inspection

The thoroughness of asbestos removal is to be evaluated by visually inspecting for residual asbestos material and accumulated dust followed by air sampling. Evidence of residual asbestos or asbestos debris upon completion of the work is not acceptable.

Upon completion of the work, conduct a thorough visual inspection of the work area by the Abatement Contractor to ensure no residual asbestos material, dust or debris remains. Document final inspections on the Asbestos Abatement Clearance Inspection Checklist (KSC Form 28-1231NS).

If applicable, final aggressive air sampling is to be performed for each NPE work area after completion of a satisfactory visual inspection. The clearance criteria is 0.01 fibers per cubic centimeter (f/cc) of air as determined by PCM. Satisfactory fiber counts from all final samples are to be less than 0.01 f/cc. If any of the final air samples contain greater than 0.01 f/cc, repeat the final cleaning operation and re-test the area until satisfactory clearance levels are obtained.

In no case may fewer than two (2) final samples be collected for any area.

Ensure clearance air sample volumes meet the minimum volumes as indicated for analysis by NIOSH 7400 method.

3.10 ASBESTOS WASTE AND CONTAMINATED MATERIALS

3.10.1 Removal of Asbestos Waste Materials

For purposes of this paragraph, asbestos waste materials are defined as those materials which contain or have been contaminated by asbestos and are not planned to be encapsulated and remain at the job site. They are primarily removed asbestos, disposable clothing and safety equipment, polyethylene sheeting, contaminated amended water, vacuum cleaner contents, and filtration media.

Contain all asbestos waste material in two (2) 6 mil polyethylene disposal bags, or two (2) 6 mil disposal bags and a sealed leak-tight container such as, but not limited to, a steel or fiberboard drum. Pack the asbestos waste material while still wet. Clean the external surface of the waste containers by HEPA vacuuming and wet wiping before moving from the work area. Protect the interior of truck or dumpster with two layers of polyethylene sheeting.

3.10.1.1 Waste Inventory

Label and clearly mark all disposal containers, dumpsters, and trucks, in accordance with 40 CFR 61-SUBPART M, 29 CFR 1910 of OSHA's Hazard Communications Standard, and 49 CFR 171 and 49 CFR 172, Hazardous Substances.

Provide conspicuous, legible labels, affixed to plastic bags and drums indicating the name of the waste generator and the location (facility name and number) where the waste was generated.

For non-friable asbestos that will be disposed at the KSC/Schwartz Road Landfill, provide a completed landfill disposal verification form (KSC Form 28-1064NS) send to Contracts Administration. NOTE: Regulated ACM is not permitted for disposal at KSC/Schwartz Road Landfill.

Provide a Waste Shipment Record (WSR) to the Contracting Officer in accordance with the instructions in 40 CFR 61-SUBPART M.

3.10.2 Work Area Disposal

After final inspection has been completed and the work area is released for occupancy. Dispose of all plastic sheeting, tape, and any other trash and debris, except for critical barriers, in sealable plastic bags, or in drums and moved to the staging area. After final wet wipe of the work area and satisfactory clearance air sampling, dismantle critical barriers and the decontamination unit.

3.10.3 Decontamination Area And Support Area Disposal

Dismantle the decontamination area after the work area is released for re-occupancy. Vacuum all surfaces of the decontamination unit before it is disassembled.

3.11 WASTE TRANSPORTATION AND DISPOSAL

Transport and dispose of asbestos waste in full compliance with 40 CFR 61-SUBPART M, SUBPART A, 49 CFR 171 and 49 CFR 172.

3.12 ASBESTOS ABATEMENT NOTICE AND CHECKLIST

An Asbestos Abatement Pre-Work Inspection form (KSC Form 28-1230NS) and an Asbestos Abatement Clearance Checklist (KSC Form 28-1231NS). Send copies to the Contracting Officer upon satisfactory completion of the work. Notify the Contracting Officer at least three days prior to the planned commencement of work. Coordinate and schedule all Pre-Work and Clearance Site inspections with the Contracting Officer. The completed forms are to be used to establish approval of the containment, work practices and final acceptance/re-occupancy of the work area(s).

3.13 FINAL ACCEPTANCE

The work will not be considered complete until the asbestos materials identified herein have been abated, the areas cleaned, satisfactory clearance air monitoring completed, all asbestos contaminated waste has been properly disposed of, and all project close out documents have been received and approved by the Contracting Officer.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 02 - EXISTING CONDITIONS

SECTION 02 82 33.13 20

REMOVAL/CONTROL AND DISPOSAL OF PAINT WITH LEAD

PART 1 GENERAL

1.1 REFERENCES
1.2 DEFINITIONS
1.2.1 Abatement
1.2.2 Action Level
1.2.3 Area Sampling
1.2.4 Competent Person (CP)
1.2.5 Contaminated Room
1.2.6 Decontamination Shower Facility
1.2.7 Deleading
1.2.8 Eight-Hour Time Weighted Average (TWA)
1.2.9 High Efficiency Particulate Air (HEPA) Filter Equipment
1.2.10 Lead
1.2.11 Lead-Based Paint (LBP)
1.2.12 Lead-Based Paint Activities
1.2.13 Lead-Based Paint Hazard (LBP Hazard)
1.2.14 Paint with Lead (PWL)
1.2.15 Lead Control Area
1.2.16 Lead Permissible Exposure Limit (PEL)
1.2.17 Personal Sampling
1.2.18 Physical Boundary
1.3 DESCRIPTION
1.3.1 Description of Work
1.3.2 Coordination with Other Work
1.4 SUBMITTALS
1.5 QUALITY ASSURANCE
1.5.1 Qualifications
1.5.1.1 Qualifications of CP
1.5.1.2 Training Certification
1.5.1.3 Testing Laboratory
1.5.1.4 Third Party Consultant Qualifications
1.5.2 Requirements
1.5.2.1 Competent Person (CP) Responsibilities
1.5.2.2 Lead-Based Paint/Paint with Lead Removal/Control Plan (LBP/PWL R/CP)
1.5.2.3 Occupational and Environmental Assessment Data Report
1.5.2.4 Medical Examinations
1.5.2.5 Training
1.5.2.6 Respiratory Protection Program
1.5.2.7 Hazard Communication Program
1.5.2.8 Waste Management
1.5.2.9 Environmental, Safety and Health Compliance
1.5.3 Pre-Construction Conference
1.6 EQUIPMENT
1.6.1 Respirators

1.6.2 Special Protective Clothing
1.6.3 Rental Equipment Notification
1.6.4 Vacuum Filters
1.6.5 Equipment for Government Personnel
1.7 PROJECT/SITE CONDITIONS
1.7.1 Protection of Existing Work to Remain

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 PREPARATION
3.1.1 Protection
3.1.1.1 Notification
3.1.1.2 Boundary Requirements
3.1.1.3 Heating, Ventilating and Air Conditioning (HVAC) Systems
3.1.1.4 Decontamination Facility
3.1.1.5 Eye Wash Station
3.1.1.6 Mechanical Ventilation System
3.1.1.7 Personnel Protection
3.2 ERECTION
3.2.1 Lead Control Area Requirements
3.3 APPLICATION
3.3.1 Work Procedures
3.3.2 Lead-Based Paint Removal/Control/Deleading
3.3.2.1 Outdoor Paint Removal
3.3.3 Personnel Exiting Procedures
3.4 FIELD QUALITY CONTROL
3.4.1 Tests
3.4.1.1 Air and Wipe Sampling
3.4.1.2 Air Sampling During Paint Removal Work
3.4.1.3 Sampling After Paint Removal/Control
3.4.1.4 Testing of Removed Paint and Used Abrasive
3.5 CLEANING AND DISPOSAL
3.5.1 Cleanup
3.5.1.1 Clearance Certification
3.5.2 Disposal
3.5.2.1 Disposal Documentation

-- End of Section Table of Contents --

SECTION 02 82 33.13 20

REMOVAL/CONTROL AND DISPOSAL OF PAINT WITH LEAD

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z88.2	(1992) Respiratory Protection

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

HUD 6780	(1995; Errata Aug 1996;Rev Ch. 7 - 1997) Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing

JOHN F. KENNEDY SPACE CENTER (KSC)

KNPR 8500.1	KSC Environmental Requirements

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.103	Respiratory Protection
29 CFR 1926.21	Safety Training and Education
29 CFR 1926.33	Access to Employee Exposure and Medical Records
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 745	Lead-Based Paint Poisoning Prevention in Certain Residential Structures

UNDERWRITERS LABORATORIES (UL)

UL 586	(2009) Standard for High-Efficiency Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 Abatement

As applied to target housing and child occupied facilities, "abatement" means any set of measures designed to permanently eliminate lead-based paint hazards in accordance with standards established by appropriate Federal agencies. Such term includes:

a. The removal of lead-based paint and lead-contaminated dust, the permanent containment or encapsulation of lead-based paint, the replacement of lead-painted surfaces or fixtures, and the removal or covering of lead contaminated soil; and

b. All preparation, cleanup, disposal, and post-abatement clearance testing activities associated with such measures.

1.2.2 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period in a work environment.

1.2.3 Area Sampling

Sampling of lead concentrations within the lead control area and inside the physical boundaries, which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel.

1.2.4 Competent Person (CP)

As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations. A Certified Industrial Hygienist (CIH) certified for comprehensive practice by the American Board of Industrial Hygiene or a Certified Safety Professional (CSP) certified by the Board of Certified Safety Professionals is the best choice.

1.2.5 Contaminated Room

Refers to a room for removal of contaminated personal protective equipment (PPE).

1.2.6 Decontamination Shower Facility

That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.

1.2.7 Deleading

Activities conducted by a person who offers to eliminate lead-based paint or lead-based paint hazards or to plan such activities in commercial buildings, bridges or other structures.

1.2.8 Eight-Hour Time Weighted Average (TWA)

Airborne concentration of lead to which an employee is exposed, averaged over an 8 hour workday as indicated in 29 CFR 1926.62.

1.2.9 High Efficiency Particulate Air (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron or larger size particles.

1.2.10 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps.

1.2.11 Lead-Based Paint (LBP)

Paint or other surface coating that contains lead.

1.2.12 Lead-Based Paint Activities

In the case of target housing or child occupied facilities, lead-based paint activities include; a lead-based paint inspection, a risk assessment, or abatement of lead-based paint hazards.

1.2.13 Lead-Based Paint Hazard (LBP Hazard)

Any condition that causes exposure to lead from lead-contaminated dust, lead-contaminated soil, lead-based paint that is deteriorated or present in accessible surfaces, friction surfaces, or impact surfaces that would result in adverse human health effects.

1.2.14 Paint with Lead (PWL)

Any paint that contains lead as determined by the testing laboratory using a valid test method. The requirements of this section does not apply if no detectable levels of lead are found using a quantitative method for analyzing paint using laboratory instruments with specified limits of detection (usually 0.01%). An X-Ray Fluorescence (XRF) instrument is not considered a valid test method.

1.2.15 Lead Control Area

A system of control methods to prevent the spread of lead dust, paint chips or debris to adjacent areas that may include temporary containment, floor or ground cover protection, physical boundaries, and warning signs to prevent unauthorized entry of personnel. HEPA filtered local exhaust equipment may be used as engineering controls to further reduce personnel exposures or building/outdoor environmental contamination.

1.2.16 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a workday, the PEL shall be determined by the following formula:

PEL (micrograms/cubic meter of air) = 400/No. hrs worked per day

1.2.17 Personal Sampling

Sampling of airborne lead concentrations within the breathing zone of an

employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and centered at the nose or mouth of an employee.

1.2.18 Physical Boundary

Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead control area but inside the physical boundary."

1.3 DESCRIPTION

1.3.1 Description of Work

Remove/control lead-based/paint with lead as indicated on the drawings. Remove paint in accordance with this Section and recycle, handle, and/or dispose of materials with lead paint in accordance with Federal and State regulations, this Section, and Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION. If a painted surface has not been tested for lead paint, assume lead is present. Sample and analyze the paint to determine if lead is present.

1.3.2 Coordination with Other Work

The contractor shall coordinate with work being performed in adjacent areas. Coordination procedures shall be explained in the Removal/Control Plan and shall describe how the Contractor will prevent lead exposure to other contractors and/or Government personnel performing work unrelated to lead activities.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Vacuum Filters; G

Respirators; G

SD-06 Test Reports

sampling results; G

Occupational and Environmental Assessment Data Report; G

SD-07 Certificates

Qualifications of CP; G

Testing Laboratory qualifications; G

Training Certification of workers and supervisors; G

Third Party Consultant Qualifications; G

lead-based paint/paint with lead removal/control plan including CP approval (signature, date, and certification number); G

SD-11 Closeout Submittals

KSC Waste Management Contractor is responsible for disposal of all hazardous, controlled, and universal wastes.

KSC Waste Management Internal Manifest; G

Certification of Medical Examinations

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

1.5.1.1 Qualifications of CP

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide previous experience of the CP. Submit proper documentation that the CP is trained, licensed, and certified in accordance with Federal, State, and local laws.

1.5.1.2 Training Certification

Submit a certificate for each employee and supervisor, signed and dated by the training provider meeting 40 CFR 745 (Subpart L) requirements, stating that the employee or supervisor has received the required lead training and is certified to perform or supervise deleading or lead removal. Submit proof the work will be performed by a certified firm.

1.5.1.3 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the air and wipe sampling, testing, and reporting of airborne concentrations of lead. Use a laboratory accredited under the EPA National Lead Laboratory Accreditation Program (NLLAP) by either the American Association for Laboratory Accreditation (A2LA) or the American Industrial Hygiene Association (AIHA) and that is successfully participating in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis. Laboratories selected to perform blood lead analysis shall be OSHA approved.

1.5.1.4 Third Party Consultant Qualifications

Submit the name, address, and telephone number of the third party consultant selected to perform the wipe sampling for determining concentrations of lead in dust or soil sampling. Submit proper documentation that the consultant is trained and certified as an inspector technician or inspector/risk assessor by the USEPA authorized State (or local) certification and accreditation program.

1.5.2 Requirements

1.5.2.1 Competent Person (CP) Responsibilities

a. Verify training meets all federal, State, and local requirements.

b. Review and approve lead-based paint/paint with lead removal/control plan for conformance to the applicable standards. Ensure work is performed in strict accordance with specifications at all times.

c. Continuously inspect lead-based paint removal/control work for conformance with the approved plan.

d. Perform air and wipe sampling.

e. Control work to prevent hazardous exposure to human beings and to the environment at all times.

f. Certify the conditions of the work as called for elsewhere in this specification.

1.5.2.2 Lead-Based Paint/Paint with Lead Removal/Control Plan (LBP/PWL R/CP)

Submit a detailed job-specific plan of the work procedures to be used in the removal/control of LBP/PWL. The plan shall include a sketch showing the location, size, and details of lead control areas, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include a description of equipment and materials, controls and job responsibilities for each activity from which lead is emitted. Include in the plan, eating, drinking, smoking and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and paint debris disposal plan, air sampling plan, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that lead is not released outside the lead control area. Include site preparation, cleanup and clearance procedures. Include occupational and environmental sampling, training, sampling methodology, frequency, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan. Include a description of arrangements made among contractors on multi-contractor worksites to inform affected employees and to clarify responsibilities to control exposures.

The Removal/Control Plan shall be developed by a certified planner/project designer.

In occupied buildings, the Removal/Control Plan shall also include an occupant protection program that describes the measures that will be taken during the work to protect the building occupants.

1.5.2.3 Occupational and Environmental Assessment Data Report

If initial monitoring is necessary, submit occupational and environmental sampling results to the Contracting Officer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

In order to reduce the full implementation of 29 CFR 1926.62, the Contractor shall provide documentation. Submit a report that supports the determination to reduce full implementation of the requirements of 29 CFR 1926.62 and supporting the Lead Removal/Control Plan.

a. The initial monitoring shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead for stated work.

b. Submit worker exposure data gathered during the task based trigger operations of 29 CFR 1926.62 with a complete process description. This includes manual demolition, manual scraping, manual sanding, heat gun, power tool cleaning, rivet busting, cleanup of dry expendable abrasives, abrasive blast enclosure removal, abrasive blasting, welding, cutting and torch burning where lead containing coatings are present.

c. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the lead compliance plan per 29 CFR 1926.62.

1.5.2.4 Medical Examinations

Initial medical surveillance as required by 29 CFR 1926.62 shall be made available to all employees exposed to lead at any time (1 day) above the action level. Full medical surveillance shall be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records shall show that employees meet the medical surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62, and 29 CFR 1926.103. Maintain complete and accurate medical records of employees for a period of at least 30 years or for the duration of employment plus 30 years, whichever is longer.

1.5.2.5 Training

Train each employee performing paint removal, disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62, and State and local regulations where appropriate.

1.5.2.6 Respiratory Protection Program

a. Provide each employee required to wear a respirator a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

1.5.2.7 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

1.5.2.8 Waste Management

The Waste Management Plan shall be in accordance with Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION.

1.5.2.9 Environmental, Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of Federal, State, local authorities, and KNPR 8500.1 regarding removing, handling, storing, transporting, and disposing of lead waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply. The following Federal and State laws, ordinances, criteria, rules and regulations regarding removing, handling, storing, transporting, and disposing of lead-contaminated materials apply:

a. 40 CFR 745 (Subpart L)

b. 29 CFR 1926.62

Licensing and certification in the State of Florida is required.

1.5.3 Pre-Construction Conference

Along with the CP, meet with the Contracting Officer to discuss in detail the waste management plan and the lead-based paint/paint with lead removal/control plan, including work procedures and precautions for the removal plan.

1.6 EQUIPMENT

1.6.1 Respirators

Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust. Respirators shall comply with the requirements of 29 CFR 1926.62.

1.6.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with proper disposable protective whole body clothing, head covering, gloves, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

1.6.3 Rental Equipment Notification

If rental equipment is to be used during lead-based paint handling and disposal, notify the rental agency in writing concerning the intended use of the equipment. Furnish a copy of the written notification to the Contracting Officer.

1.6.4 Vacuum Filters

UL 586 labeled HEPA filters.

1.6.5 Equipment for Government Personnel

Furnish the Contracting Officer with two complete sets of personal

protective equipment (PPE) daily, as required herein, for entry into and inspection of the paint removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, and hand protection. PPE shall remain the property of the Contractor. The Government will provide respiratory protection for the Contracting Officer.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Protection of Existing Work to Remain

Perform paint removal work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better.

PART 2 PRODUCTS

Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

3.1.1.1 Notification

a. Notify the Contracting Officer 20 days prior to the start of any paint removal work.

3.1.1.2 Boundary Requirements

a. Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that lead will not escape outside the lead control area.

b. Warning Signs - Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

3.1.1.3 Heating, Ventilating and Air Conditioning (HVAC) Systems

Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6 mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area.

3.1.1.4 Decontamination Facility

Provide clean and contaminated change rooms in accordance with this specification and 29 CFR 1926.62.

3.1.1.5 Eye Wash Station

Where eyes may be exposed to injurious corrosive materials, suitable

facilities for quick drenching or flushing of the eyes shall be provided within the work area.

3.1.1.6 Mechanical Ventilation System

a. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.62.

b. To the extent feasible, use local exhaust ventilation connected to HEPA filters or other collection systems, approved by the CP. Local exhaust ventilation systems shall be evaluated and maintained in accordance with 29 CFR 1926.62.

c. Vent local exhaust outside the building only and away from building ventilation intakes.

d. Use locally exhausted, power actuated, paint removal tools.

3.1.1.7 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

3.2 ERECTION

3.2.1 Lead Control Area Requirements

Establish a lead control area by situating critical barriers and physical boundaries around the area or structure where LBP/PWL removal/control operations will be performed.

3.3 APPLICATION

3.3.1 Work Procedures

Perform removal of lead-based paint in accordance with approved lead-based paint/paint with lead removal/control plan. Use procedures and equipment required to limit occupational and environmental exposure to lead when lead-based paint is removed in accordance with 29 CFR 1926.62. Dispose of removed paint chips and associated waste in compliance with Environmental Protection Agency (EPA), State, and local requirements.

3.3.2 Lead-Based Paint Removal/Control/Deleading

Manual or power sanding of interior and exterior surfaces is not permitted unless tools are equipped with HEPA attachments or wet methods. The dry sanding or grinding of surfaces that contain lead is prohibited. Provide methodology for LBP removal/control in work plan. Remove paint within the areas designated on the drawings in order to completely expose the substrate. Take whatever precautions necessary to minimize damage to the underlying substrate.

Provide methodology for LBP/PWL removal and abatement/control and processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris/waste and to ensure that unprotected personnel are not exposed to hazardous

concentrations of lead. Describe this LBP/PWL removal/control process in the LBP/PWL R/CP.

3.3.2.1 Outdoor Paint Removal

Perform outdoor removal as indicated in federal, State, and local regulations and in the LBP/CPR/CP. The worksite preparation (barriers or containments) shall be job dependent and presented in the LBP/PWL R/CP.

3.3.3 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn during the work day:

a. Vacuum themselves off.

b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.

c. Change to clean clothes prior to leaving the physical boundary designated around the lead control area.

3.4 FIELD QUALITY CONTROL

3.4.1 Tests

3.4.1.1 Air and Wipe Sampling

Air sample for lead in accordance with 29 CFR 1926.62 and as specified herein. Air and wipe sampling shall be directed or performed by the CP.

a. The CP shall be on the job site directing the air and non-clearance wipe sampling and inspecting the lead-based paint removal/control work to ensure that the requirements of the contract have been satisfied during the entire lead-based paint removal operation.

b. Collect personal air samples on employees who are expected to have the greatest risk of exposure as determined by the CP. In addition, collect air samples on at least 25 percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.

c. Submit results of air samples, within 72 hours after the air samples are taken.

d. Before any work begins, a third party consultant shall collect and analyze baseline wipe samples in accordance with methods defined in federal, State, and local standards inside and outside of the physical boundary to assess the degree of dust contamination in the facility prior to lead-based paint removal/control.

e. Collect surface wipe samples at a location no greater than 10 feet outside the lead control area at a frequency of once per day while lead removal work is conducted. Surface wipe results shall meet criteria in paragraph "Clearance Certification."

3.4.1.2 Air Sampling During Paint Removal Work

Conduct area air sampling daily, on each shift in which lead-based paint

removal operations are performed, in areas immediately adjacent to the lead control area. Sufficient area monitoring shall be conducted to ensure unprotected personnel are not exposed at or above 30 micrograms per cubic meter of air. If 30 micrograms per cubic meter of air is reached or exceeded, stop work, correct the conditions(s) causing the increased levels. Notify the Contracting Officer immediately. Determine if condition(s) require any further change in work methods. Removal work shall resume only after the CP and the Contracting Officer give approval. For outdoor operations, at least one sample on each shift shall be taken on the downwind side of the lead control area.

3.4.1.3 Sampling After Paint Removal/Control

After the visual inspection, collect wipe samples according to the HUD protocol contained in HUD 6780 to determine the lead content of settled dust and dirt in micrograms per square meter foot of surface area.

3.4.1.4 Testing of Removed Paint and Used Abrasive

Test removed paint and used abrasive in accordance with 40 CFR 261 for hazardous waste.

3.5 CLEANING AND DISPOSAL

3.5.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. At the end of each shift and when the paint removal operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the CP. Reclean areas showing dust or residual paint chips or debris. After visible dust, chips and debris is removed, wet wipe and HEPA vacuum all surfaces in the work area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The CP shall then certify in writing that the area has been cleaned of lead contamination before restarting work.

3.5.1.1 Clearance Certification

The CP shall certify in writing that air samples collected outside the lead control area during paint removal operations are less than 30 micrograms per cubic meter of air; the respiratory protection used for the employees was adequate; the work procedures were performed in accordance with 29 CFR 1926.62 and 40 CFR 745; and that there were no visible accumulations of material and dust containing lead left in the work site. Do not remove the lead control area or roped off boundary and warning signs prior to the Contracting Officer's acknowledgement of receipt of the CP certification.

For lead-based paint hazard abatement work, surface wipe and soil sampling shall be conducted and clearance determinations made according to the work practice standards presented in 40 CFR 745.227.

3.5.2 Disposal

a. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing that may produce airborne

concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR 262. Dispose of lead-contaminated waste material in accordance with Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION paragraph "Materials Management and Waste Disposal", and NASA KSC policy.

b. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.

3.5.2.1 Disposal Documentation

In accordance with NASA KSC policy, provide all KSC Waste Management internal manifest copies upon completion of the project to the Contracting Officer.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 03 - CONCRETE

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 REFERENCES
1.2 DEFINITIONS
1.3 SUBMITTALS
1.4 MODIFICATION OF REFERENCES
1.5 DELIVERY, STORAGE, AND HANDLING
1.5.1 Reinforcement
1.6 QUALITY ASSURANCE
1.6.1 Drawings
1.6.1.1 Reinforcing Steel
1.6.2 Test Reports
1.6.2.1 Concrete Mix Design
1.7 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

PART 2 PRODUCTS

2.1 CONCRETE
2.1.1 Contractor-Furnished Mix Design
2.1.1.1 Mix Proportions for Normal Weight Concrete
2.1.1.2 Required Average Strength of Mix Design
2.1.2 Ready-Mix Concrete
2.1.3 Concrete Curing Materials
2.1.3.1 Moisture-Retaining Cover
2.1.3.2 Membrane-Forming Curing Compound
2.2 MATERIALS
2.2.1 Cement
2.2.1.1 Fly Ash and Pozzolan
2.2.1.2 Portland Cement
2.2.2 Water
2.2.3 Aggregates
2.2.4 Nonshrink Grout
2.2.5 Admixtures
2.2.5.1 High Range Water Reducer (HRWR) (Superplasticizers)
2.2.5.2 Pozzolan
2.2.6 Vapor Barrier
2.2.7 Materials for Curing Concrete
2.2.7.1 Liquid Membrane-Forming Compound
2.2.8 Expansion/Contraction Joint Filler
2.2.8.1 Preformed Joint Filler Strips
2.2.9 Joint Sealants
2.2.9.1 Horizontal Surfaces, 3 Percent Slope, Maximum
2.2.9.2 Vertical Surfaces Greater Than 3 Percent Slope
2.2.9.3 Waterstops
2.2.9.4 Joint Sealant Compound
2.2.10 Epoxy Bonding Compound

2.2.11 Biodegradable Form Release Agent
2.3 REINFORCEMENT
2.3.1 Reinforcing Bars
2.3.2 Wire
2.3.2.1 Welded Wire Fabric
2.3.3 Reinforcing Bar Supports
2.3.4 Supports for Reinforcement
2.4 BONDING MATERIALS
2.4.1 Concrete Bonding Agent
2.4.2 Epoxy-Resin Adhesive Binder
2.5 CLASSIFICATION AND QUALITY OF CONCRETE
2.5.1 Concrete Classes and Usage
2.5.2 Limits for Concrete Proportions
2.5.3 Maximum Size of Aggregate
2.5.4 Slump
2.5.5 Total Air Content

PART 3 EXECUTION

3.1 EXAMINATION
3.2 PREPARATION
3.2.1 General
3.2.2 Subgrade Under Foundations and Footings
3.2.3 Subgrade Under Slabs on Ground
3.2.4 Formwork
3.2.5 Edge Forms and Screed Strips for Slabs
3.2.6 Reinforcement and Other Embedded Items
3.3 FORMS
3.3.1 General
3.3.2 Design and Construction of Formwork
3.3.3 Coating
3.3.4 Reshoring
3.3.5 Reuse
3.3.6 Forms for Standard Rough Form Finish
3.3.7 Forms for Standard Smooth Form Finish
3.3.8 Form Ties
3.3.9 Tolerances for Form Construction
3.3.10 Removal of Forms and Supports
3.3.10.1 Special Requirements for Reduced Time Period
3.4 WATERSTOP SPLICES
3.5 FORMED SURFACES
3.5.1 Preparation of Form Surfaces
3.5.2 Tolerances
3.5.3 As-Cast Form
3.6 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS
3.6.1 General
3.6.2 Vapor Barrier
3.6.3 Reinforcement Supports
3.6.4 Splicing
3.6.5 Cover
3.6.6 Setting Miscellaneous Material
3.6.7 Construction Joints
3.6.8 Expansion Joints and Contraction Joints
3.6.9 Fabrication
3.6.10 Placing Reinforcement
3.6.11 Spacing of Reinforcing Bars
3.6.12 Concrete Protection for Reinforcement
3.7 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE
3.7.1 Measuring

3.7.2 Mixing
3.7.3 Transporting
3.8 PLACING CONCRETE
3.8.1 General Placing Requirements
3.8.2 Footing Placement
3.8.3 Vibration
3.8.4 Pumping
3.8.5 Cold Weather
3.8.6 Hot Weather
3.8.7 Follow-up
3.8.8 Placing Concrete in Forms
3.8.9 Placing Concrete Slabs
3.8.10 Bonding
3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES
3.9.1 Defects
3.9.2 Not Against Forms (Top of Walls)
3.9.3 Formed Surfaces
3.9.3.1 Tolerances
3.9.3.2 As-Cast Rough Form
3.9.3.3 Standard Smooth Finish
3.9.4 Grout Finish
3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION
3.10.1 Finish
3.10.1.1 Scratched
3.10.1.2 Steel Troweled
3.10.1.3 Nonslip Finish
3.10.1.4 Broomed
3.10.1.5 Pavement
3.10.2 Flat Floor Finishes
3.10.3 Concrete Walks
3.10.4 Pits and Trenches
3.11 CURING AND PROTECTION
3.11.1 General
3.11.2 Moist Curing
3.11.2.1 Ponding or Immersion
3.11.2.2 Fog Spraying or Sprinkling
3.11.2.3 Impervious Sheeting
3.11.3 Liquid Membrane-Forming Curing Compound
3.11.3.1 Application
3.11.3.2 Protection of Treated Surfaces
3.11.4 Requirements for Type III, High-Early-Strength Portland Cement
3.11.5 Curing Periods
3.11.6 Curing Methods
3.11.7 Curing Formed Surfaces
3.11.8 Curing Unformed Surfaces
3.11.9 Temperature of Concrete During Curing
3.11.10 Protection from Mechanical Injury
3.11.11 Protection After Curing
3.12 FIELD QUALITY CONTROL
3.12.1 Sampling
3.12.2 Testing
3.12.2.1 Slump Tests
3.12.2.2 Temperature Tests
3.12.2.3 Compressive Strength Tests
3.12.2.4 Air Content
3.12.2.5 Strength of Concrete Structure
3.12.2.6 Testing Concrete Structure for Strength
3.13 WASTE MANAGEMENT
3.13.1 Mixing Equipment

3.13.2 Reinforcing Steel
3.14 JOINTS
3.14.1 Construction Joints
3.14.2 Waterstops
3.14.3 Isolation Joints in Slabs on Ground
3.14.4 Contraction Joints in Slabs on Ground
3.14.5 Sealing Joints in Slabs on Ground
3.15 INSTALLATION OF ANCHORAGE DEVICES
3.15.1 General
3.15.2 Placing Anchorage Devices
3.16 CONCRETE CONVEYING
3.16.1 Transfer of Concrete At Project Site
3.16.2 Mechanical Equipment for Conveying Concrete

-- End of Section Table of Contents --

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI/MCP-1	(2010) Manual of Concrete Practice Part 1
ACI/MCP-2	(2010) Manual of Concrete Practice Part 2
ACI/MCP-3	(2010) Manual of Concrete Practice Part 3
ACI/MCP-4	(2010) Manual of Concrete Practice Part 4

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 322M/M 322	(2007) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

ASTM INTERNATIONAL (ASTM)

ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 496/A 496M	(2007) Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497/A 497M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A 615/A 615M	(2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 996/A 996M	(2009b) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM C 1107/C 1107M	(2008) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

ASTM C 143/C 143M	(2009) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 156	(2009a) Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	(2008) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 173/C 173M	(2009) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(2007) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2009a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2009) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 311	(2007) Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	(2009a) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(2004) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(2008a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM C 932	(2006) Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering
ASTM C 94/C 94M	(2010a) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2009a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C 990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D 1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1751	(2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 4397	(2009) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 5759	(1995; R 2005) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D 6690	(2007) Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM E 1155	(1996; R 2008) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E 329	(2009) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP (2001; 27Ed) Manual of Standard Practice

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS MMM-A-001993 (1978) Adhesive, Epoxy, Flexible, Filled (For Binding, Sealing, and Grouting)

1.2 DEFINITIONS

a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, ground granulated blast-furnace slag, and silica fume.

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

d. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcing Steel; G

Reproductions of contract drawings are unacceptable.

SD-03 Product Data

Joint sealants
Epoxy Bonding Compound

Submit manufacturer's product data, indicating VOC content. Manufacturer's catalog data for the following items must include printed instructions for admixtures, bonding agents, epoxy-resin adhesive binders.

Waterstops

Submit documentation indicating type of biobased material in product and biobased content.

SD-05 Design Data

Concrete mix design; G

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, ground slag, and admixtures; and applicable reference specifications.

SD-06 Test Reports

Compressive strength tests

Air Content

Slump

Air Entrainment

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces.

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.6 QUALITY ASSURANCE

1.6.1 Drawings

1.6.1.1 Reinforcing Steel

ACI/MCP-4. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.6.2 Test Reports

1.6.2.1 Concrete Mix Design

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix must be suitable for the job conditions. Include mill test and all other test for cement, aggregates, and admixtures in the laboratory test reports.

1.7 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

Perform concrete testing by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency must meet the requirements of ASTM E 329.

PART 2 PRODUCTS

2.1 CONCRETE

2.1.1 Contractor-Furnished Mix Design

ACI/MCP-1, ACI/MCP-2, and ACI/MCP-3 except as otherwise specified. Indicate the compressive strength (f'c) of the concrete for each portion of the structure(s) and as specified below.

Location	f'c (Min. 28-Day Comp. Strength) (psi)	ASTM C 33/C 33M Maximum Nominal Aggregate (Size No.)	Range of Slump (inches)	Maximum Water-Cement Ratio (by weight)	Air Entr. (percent)
Concrete exposed to weather	4000	57	1 to 4	0.45	6

2.1.1.1 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified are the responsibility of the Contractor. Base mixture proportions on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M. Samples of all materials used in mixture proportioning studies must be representative of those proposed for use in the project and must be accompanied by the manufacturer's or producer's test report indicating compliance with these specifications. Base trial mixtures having proportions, consistencies, and air content suitable for the work on methodology described in ACI/MCP-1. In the trial mixture, use at least three different water-cement ratios for each type of mixture, which must produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratio required must be based on equivalent water-cement ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast-furnace slag by weight equivalency method. Design laboratory trial mixture for maximum permitted slump and air content. Each combination of material proposed for use must have separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. Report the temperature of

concrete in each trial batch. For each water-cement ratio, at least three test cylinders for each test age must be made and cured in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M for 7 and 28 days. From these results, plot a curve showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, plot a curve showing the relationship between 7 and 28 day strengths.

2.1.1.2 Required Average Strength of Mix Design

The selected mixture must produce an average compressive strength exceeding the specified strength by the amount indicated in ACI/MCP-2. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation must be calculated and the required average compressive strength must be determined in accordance with ACI/MCP-2. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength must follow ACI/MCP-2 requirements.

2.1.2 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C 94/C 94M.

2.1.3 Concrete Curing Materials

2.1.3.1 Moisture-Retaining Cover

Provide waterproof paper cover for curing concrete conforming to ASTM C 171, regular or white, or polyethylene sheeting conforming to ASTM C 171, or polyethylene-coated burlap consisting of a laminate of burlap and a white opaque polyethylene film permanently bonded to the burlap; burlap must conform to ASTM C 171, Class 3, and polyethylene film must conform to ASTM C 171. When tested for water retention in accordance with ASTM C 156, weight of water lost 72 hours after application of moisture retaining covering material must not exceed 0.039 gram per square centimeter of the mortar specimen surface.

2.1.3.2 Membrane-Forming Curing Compound

Provide liquid type compound conforming to ASTM C 309, Type 1, clear, Type 1D with fugitive dye for interior work and Type 2, white, pigmented for exterior work.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150/C 150M, Type I or II blended cement except as modified herein. Provide blended cement that consists of a mixture of ASTM C 150/C 150M, Type II, cement and one of the following materials: ASTM C 618 pozzolan or fly ash, ASTM C 989 ground granulated blast-furnace slag. For portland cement manufactured in a kiln fueled by hazardous waste, maintain a record of source for each batch. Supplier must certify that no hazardous waste is used in the fuel mix or raw materials. Supplier must certify that the hazardous waste is neutralized by the manufacturing process and that no additional pollutants are discharged. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.2.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition must be 6 percent for Types N and F. Add with cement. Fly ash content must be a minimum of 15 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly ash permittable that meets the code requirements for cement content. Report the chemical analysis of the fly ash in accordance with ASTM C 311. Evaluate and classify fly ash in accordance with ASTM D 5759.

High contents of supplementary cementitious materials can have some detrimental effects on the concrete properties, such as slowing excessively the strength gain rate, and delaying and increasing the difficulty of finishing. The recommended maximum content (by weight of the total cementitious material) for these materials are:

1. For ground granulated blast-furnace (GGBF) slag: 50 percent

2. For fly ash or natural pozzolan: 40 percent (25 percent in cold climates)

3. For silica fume: 10 percent

2.2.1.2 Portland Cement

Provide cement that conforms to ASTM C 150/C 150M, Type I, IA, II, or IIA. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

2.2.2 Water

Minimize the amount of water in the mix. The amount of water must not exceed 45 percent by weight of cementitious materials (cement plus pozzolans), and in general, improve workability by adjusting the grading rather than by adding water. Water must be fresh, clean, and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.2.3 Aggregates

ASTM C 33/C 33M, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Provide aggregates that do not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.2.4 Nonshrink Grout

ASTM C 1107/C 1107M.

2.2.5 Admixtures

ASTM C 494/C 494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures.

2.2.5.1 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C 494/C 494M, Type F.

2.2.5.2 Pozzolan

Provide fly ash or other pozzolans used as admixtures that conform to ASTM C 618.

2.2.6 Vapor Barrier

ASTM D 4397 polyethylene sheeting, minimum thickness indicated in drawings.

2.2.7 Materials for Curing Concrete

Consider agents that are not toxic and emit low or no Volatile Organic Compounds (VOC).

2.2.7.1 Liquid Membrane-Forming Compound

ASTM C 309, white-pigmented, Type 2, Class B.

2.2.8 Expansion/Contraction Joint Filler

ASTM D 1751. Material must be 1/2 inch thick, unless otherwise indicated.

2.2.8.1 Preformed Joint Filler Strips

Provide nonextruding and resilient bituminous type filler strips conforming to ASTM D 1751.

2.2.9 Joint Sealants

Use concrete penetrating sealers with a low VOC content.

2.2.9.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D 6690 or ASTM C 920, Type M, Class 25, Use T.

2.2.9.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C 920, Type M, Grade NS, Class 25, Use T.

2.2.9.3 Waterstops

Provide waterstops made of rubber and that conform to ASTM D 1752 or provide waterstops made of polyvinylchloride (PVC) and that conform to ASTM C 990.

2.2.9.4 Joint Sealant Compound

Provide hot-poured, elastic type compound conforming to ASTM D 6690.

2.2.10 Epoxy Bonding Compound

ASTM C 881/C 881M. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Grade 1

or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 40 degrees F; Class B if placement temperature is between 40 and 60 degrees F; or Class C if placement temperature is above 60 degrees F.

2.2.11 Biodegradable Form Release Agent

Provide form release agent that is colorless, biodegradable, and with a low VOC content. A minimum of 85 percent of the total product must be biobased material. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

2.3 REINFORCEMENT

2.3.1 Reinforcing Bars

ACI/MCP-2 unless otherwise specified. Use deformed steel.
ASTM A 615/A 615M and AASHTO M 322M/M 322 with the bars marked A, S, W, Grade 60; or ASTM A 996/A 996M with the bars marked R, Grade 60, or marked A, Grade 60.

2.3.2 Wire

ASTM A 82/A 82M or ASTM A 496/A 496M.

2.3.2.1 Welded Wire Fabric

ASTM A 185/A 185M or ASTM A 497/A 497M. Provide flat sheets of welded wire fabric for slabs and toppings.

2.3.3 Reinforcing Bar Supports

Provide bar ties and supports of coated or non corrodible material.

2.3.4 Supports for Reinforcement

Supports include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcing bars and wire fabric in place.

Provide wire bar type supports conforming to ACI/MCP-3, ACI/MCP-4 and CRSI 10MSP.

Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

2.4 BONDING MATERIALS

2.4.1 Concrete Bonding Agent

Provide aqueous-phase, film-forming, nonoxidizing, freeze and thaw-resistant compound agent suitable for brush or spray application conforming to ASTM C 932.

2.4.2 Epoxy-Resin Adhesive Binder

Provide two-component, epoxy-polysulfide polymer type binder with an

amine-type curing-agent conforming to FS MMM-A-001993, Type I or ASTM C 881/C 881M.

2.5 CLASSIFICATION AND QUALITY OF CONCRETE

2.5.1 Concrete Classes and Usage

Provide concrete classes, compressive strength, requirements for air entrainment, and usage as follows:

CONCRETE CLASS	MIN. 28-DAY COMPRESSIVE STRENGTH POUNDS PER SQ. IN.	REQUIREMENT FOR AIR ENTRAINMENT	USAGE
3A	3,000	Air-entrained	For foundation
4A	4,000	Air-entrained	For structural concrete work exposed to freezing and thawing, unless otherwise indicated or specified, such as exterior columns and spandrels

2.5.2 Limits for Concrete Proportions

Provide limits for maximum water/cement ratio and minimum cement content for each concrete class as follows:

CONCRETE CLASS	MAX. WATER/CEMENT RATIO BY WEIGHT	MIN. CEMENT FOR 3- TO 4-INCH SLUMP, (NO. OF 94-POUND SACKS) PER CU. YD.
3A	0.45	6.0
4A	0.46	6.0

* Weight of water to weight of cement in pounds in one cubic yard of concrete

2.5.3 Maximum Size of Aggregate

Size of aggregate, designated by the sieve size on which maximum amount of retained coarse aggregate is 5 to 10 percent by weight, must be as follows:

MAXIMUM SIZE OF AGGREGATE	ASTM C 33/C 33M SIZE NUMBER	TYPE OF CONSTRUCTION
3/4 inch	67	Reinforced walls, columns, girders, beams, and other formed sections having a dimension between forms of not less than 6 inches and clear distance between reinforcing bars or reinforcing bar and

MAXIMUM SIZE OF AGGREGATE	ASTM C 33/C 33M SIZE NUMBER	TYPE OF CONSTRUCTION
		face of form of not less than 1 inch
3/4 inch	67	Monolithic concrete slabs and other flatwork having a depth of not less than 2-1/2 inches and a clear distance between reinforcing bars of not less than 1 inch
1/2 inch	7	Concrete joist construction, beams, reinforced walls, and other formed work having a clear distance between reinforcing bars and face of form of less than 1 inch

Maximum size of aggregate may be that required for most critical type of construction using that concrete class.

2.5.4 Slump

Provide slump for concrete at time and in location of placement as follows:

TYPE OF CONSTRUCTION	SLUMP
Columns, beams, reinforced walls, monolithic slabs	Not less than 1 inch nor more than 4 inches

2.5.5 Total Air Content

Air content of exposed concrete and interior concrete must be in accordance with ASTM C 260 and/or as follows:

LIMITS CONCRETE EXPOSURE	REQUIREMENT FOR AIR ENTRAINMENT	MAXIMUM SIZE OF AGGREGATE	TOTAL AIR CONTENT BY VOLUME
Exposed to freezing and thawing or subjected to hydraulic pressure	Air-entrained	1-1/2 or 2 inches	4 to 6 percent
		3/4 inch	5 to 7 percent
		1/2 or 3/8 inch	6 to 8.5 percent

Provide concrete exposed to freezing and thawing or subjected to hydraulic pressure that is air-entrained by addition of approved air-entraining admixture to concrete mix.

PART 3 EXECUTION

3.1 EXAMINATION

Do not begin installation until substrates have been properly constructed; verify that substrates are plumb and true.

If substrate preparation is the responsibility of another installer, notify AContracting Officer of unsatisfactory preparation before processing.

Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Contracting Officer and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

3.2.1 General

Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, ice, and other deleterious substances before start of concrete placing.

Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

When subgrade material is semiporous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited. When subgrade material is porous, seal subgrade surface by covering surface with specified water barrier subgrade cover; this may also be used over semiporous, dry subgrade material instead of water sprinkling.

3.2.3 Subgrade Under Slabs on Ground

Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.

Previously constructed subgrade or fill must be cleaned of foreign materials and inspected by the Contractor for adequate compaction and surface tolerances as specified.

Actual density of top 12 inches of subgrade soil material-in-place must not be less than the following percentages of maximum density of same soil material compacted at optimum moisture content in accordance with ASTM D 1557.

SOIL MATERIAL	PERCENT MAXIMUM DENSITY
Drainage fill	100
Cohesionless soil material	100
Cohesive soil material	95

Finish surface of drainage fill under interior slabs on ground must not show deviation in excess of 1/4 inch when tested with a 10-foot straightedge parallel with and at right angles to building lines.

Finished surface of subgrade or fill under exterior slabs on ground must not be more than 0.02-foot above or 0.10-foot below elevation indicated.

Prepare subgrade or fill surface under exterior slabs on ground as specified for subgrade under foundations and footings.

3.2.4 Formwork

Complete and approve formwork. Remove debris and foreign material from interior of forms before start of concrete placing.

3.2.5 Edge Forms and Screed Strips for Slabs

Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.6 Reinforcement and Other Embedded Items

Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.

3.3 FORMS

ACI/MCP-2. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water must be watertight.

3.3.1 General

Construct forms to conform, within the tolerances specified, to shapes dimensions, lines, elevations, and positions of cast-in-place concrete members as indicated. Forms must be supported, braced, and maintained sufficiently rigid to prevent deformation under load.

3.3.2 Design and Construction of Formwork

Provide formwork design and construction that conforms to ACI/MCP-2, Chapter 4.

Provide forms that are tight to prevent leakage of cement paste during concrete placing.

Support form facing materials by structural members spaced close to prevent deflection of form facing material. Fit forms placed in successive units for continuous surfaces to accurate alignment to ensure a smooth completed surface within the tolerances specified. Where necessary to maintain the tolerances specified, such as long spans where immediate supports are not possible, camber formwork for anticipated deflections in formwork due to weight and pressure of fresh concrete and to construction loads.

Chamfer exposed joints, edges, and external corners a minimum of 3/4 inch by moldings placed in corners of column, beam, and wall forms.

Provide shores and struts with a positive means of adjustment capable of

taking up formwork settlement during concrete placing operations. Obtain adjustment with wedges or jacks or a combination thereof. When adequate foundations for shores and struts cannot be secured, provide trussed supports.

Provide temporary openings in wall forms, column forms, and at other points where necessary to permit inspection and to facilitate cleaning.

Provide forms that are readily removable without impact, shock, or damage to concrete.

3.3.3 Coating

Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.3.4 Reshoring

Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Forms on columns, walls, or other load-bearing members may be stripped after 2 days if loads are not applied to the members. After forms are removed, reshore slabs and beams over 10 feet in span and cantilevers over 4 feet for the remainder of the specified time period in accordance with paragraph entitled "Removal of Forms." Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Provide reshoring elements with the same load-carrying capabilities as original shoring and spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.3.5 Reuse

Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.

3.3.6 Forms for Standard Rough Form Finish

Give rough form finish concrete formed surfaces that are to be concealed by other construction, unless otherwise specified.

Form facing material for standard rough form finish must be the specified concrete form plywood or other approved form facing material that produces concrete surfaces equivalent in smoothness and appearance to that produced by new concrete form plywood panels.

For concrete surfaces exposed only to the ground, undressed, square-edge, 1-inch nominal thickness lumber may be used. Provide horizontal joints that are level and vertical joints that are plumb.

3.3.7 Forms for Standard Smooth Form Finish

Give smooth form finish concrete formed surfaces that are to be exposed to view or that are to be covered with coating material applied directly to concrete or with covering material bonded to concrete, such as waterproofing, dampproofing, painting, or other similar coating system.

Form facing material for standard smooth finish must be the specified overlaid concrete form plywood or other approved form facing material that is nonreactive with concrete and that produce concrete surfaces equivalent in smoothness and appearance to that produced by new overlaid concrete form plywood panels.

Maximum deflection of form facing material between supports and maximum deflection of form supports such as studs and wales must not exceed 0.0025 times the span.

Provide arrangement of form facing sheets that are orderly and symmetrical, and sheets that are in sizes as large as practical.

Arrange panels to make a symmetrical pattern of joints. Horizontal and vertical joints must be solidly backed and butted tight to prevent leakage and fins.

3.3.8 Form Ties

Provide ties that are factory fabricated metal, adjustable in length, removable or snap-off type that do allow form deflection or do not spall concrete upon removal. Portion of form ties remaining within concrete after removal of exterior parts must be at least 1-1/2 inches back from concrete surface. Provide form ties that are free of devices that leave a hole larger than 7/8 inch or less than 1/2 inch in diameter in concrete surface. Form ties fabricated at the project site or wire ties of any type are not acceptable.

3.3.9 Tolerances for Form Construction

Construct formwork to ensure that after removal of forms and prior to patching and finishing of formed surfaces, provide concrete surfaces in accordance with tolerances specified in ACI/MCP-1 and ACI/MCP-2.

3.3.10 Removal of Forms and Supports

After placing concrete, forms must remain in place for the time periods specified in ACI/MCP-4. Do not remove forms and shores (except those used for slabs on grade and slip forms) until the Contracting Officer determines that the concrete has gained sufficient strength to support its weight and superimposed loads. Base such determination on compliance with one of the following:

a. The plans and specifications stipulate conditions for removal of forms and shores, and such conditions have been followed, or

b. The concrete has been properly tested with an appropriate ASTM standard test method designed to indicate the concrete compressive strength, and the test results indicate that the concrete has gained sufficient strength to support its weight and superimposed loads.

Prevent concrete damage during form removal. Clean all forms immediately after removal.

3.3.10.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C 39/C 39M test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the

design strength.

3.4 WATERSTOP SPLICES

Fusion weld in the field.

3.5 FORMED SURFACES

3.5.1 Preparation of Form Surfaces

Coat contact surfaces of forms with form-coating compound before reinforcement is placed. Provide a commercial formulation form-coating compound that does not bond with, stain, nor adversely affect concrete surfaces and impair subsequent treatment of concrete surfaces that entails bonding or adhesion nor impede wetting of surfaces to be cured with water or curing compounds. Do not allow excess form-coating compound to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete is placed. Make thinning of form-coating compound with thinning agent of the type, in the amount, and under the conditions recommended by form-coating compound manufacturer's printed or written directions.

3.5.2 Tolerances

ACI/MCP-4 and as indicated.

3.5.3 As-Cast Form

Provide form facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary to meet required tolerances. Do not use material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which can impair the texture of the concrete surface.

3.6 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI/MCP-2. Provide bars, wire fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

3.6.1 General

Provide details of reinforcement that are in accordance with ACI/MCP-3 and ACI/MCP-4 and as specified.

3.6.2 Vapor Barrier

Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12 inches and tape or cement joints. Remove torn, punctured, or damaged vapor barrier material and provide with new vapor barrier prior to placing concrete. Concrete placement must not damage vapor barrier material.

3.6.3 Reinforcement Supports

Place reinforcement and secure with galvanized or non corrodible chairs, spacers, or metal hangers. For supporting reinforcement on the ground, use concrete or other non corrodible material, having a compressive strength equal to or greater than the concrete being placed.

3.6.4 Splicing

As indicated. For splices not indicated ACI/MCP-2. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches.

3.6.5 Cover

ACI/MCP-2 for minimum coverage, unless otherwise indicated.

3.6.6 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.6.7 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.

3.6.8 Expansion Joints and Contraction Joints

Provide expansion joint at edges of interior floor slabs on grade abutting vertical surfaces, and as indicated. Make expansion joints 1/2 inch wide unless indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used. Provide contraction joints, either formed or saw cut or cut with a jointing tool, to the indicated depth after the surface has been finished. Complete saw joints within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

3.6.9 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

Provide fabrication tolerances that are in accordance with ACI/MCP-1, ACI/MCP-2 and ACI/MCP-3.

Provide hooks and bends that are in accordance with ACI/MCP-3 and ACI/MCP-4.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not be permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Tolerance on nominally square-cut, reinforcing bar ends must be in accordance with ACI/MCP-3.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

a. Bar lengths, depths, and bends beyond specified fabrication tolerances

b. Bends or kinks not indicated on drawings or approved shop drawings

c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

3.6.10 Placing Reinforcement

Place reinforcement in accordance with ACI/MCP-3 and ACI/MCP-4.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire fabric on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

Contractor must cooperate with other trades in setting of anchor bolts, inserts, and other embedded items. Where conflicts occur between locating reinforcing and embedded items, the Contractor must notify the Contracting Officer so that conflicts may be reconciled before placing concrete. Anchors and embedded items must be positioned and supported with appropriate accessories.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

Provide supports for reinforcing bars that are sufficient in number and sufficiently heavy to carry the reinforcement they support, and in accordance with ACI/MCP-3, ACI/MCP-4 and CRSI 10MSP. Do not use supports to support runways for concrete conveying equipment and similar construction loads.

Equip supports on ground and similar surfaces with sand-plates.

Support welded wire fabric as required for reinforcing bars.

Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than 16 gage.

With the exception of temperature reinforcement, tied to main steel approximately 24 inches on center, reinforcement must be accurately placed, securely tied at intersections with 18-gage annealed wire, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must

conform to ACI/MCP-3.

Bending of reinforcing bars partially embedded in concrete is permitted only as specified in ACI/MCP-3 and ACI/MCP-4.

3.6.11 Spacing of Reinforcing Bars

Spacing must be as indicated. If not indicated, spacing must be in accordance with ACI/MCP-3 and ACI/MCP-4.

Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to approval.

3.6.12 Concrete Protection for Reinforcement

Concrete protection must be in accordance with the ACI/MCP-3 and ACI/MCP-4.

3.7 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C 94/C 94M, and ACI/MCP-2, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.7.1 Measuring

Make measurements at intervals as specified in paragraphs entitled "Sampling" and "Testing."

3.7.2 Mixing

ASTM C 94/C 94M and ACI/MCP-2. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 84 degrees F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 84 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

3.7.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.8 PLACING CONCRETE

Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement, consolidation, and finishing; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other. Position grade stakes on 10 foot centers maximum in each direction when pouring interior slabs and on 20 foot centers maximum for exterior slabs.

3.8.1 General Placing Requirements

Deposit concrete continuously or in layers of such thickness that no concrete is placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation.

Concrete to receive other construction must be screeded to proper level to avoid excessive skimming or grouting.

Do not use concrete which becomes nonplastic and unworkable or does not meet quality control limits as specified or has been contaminated by foreign materials. Use of retempered concrete is permitted. Remove rejected concrete from the site.

3.8.2 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width must be a minimum of 4 inches greater than indicated.

3.8.3 Vibration

ACI/MCP-2. Furnish a spare, working, vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches in depth with high frequency mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate internal vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 9,000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 20 inches apart. Penetrate the previously placed lift with the vibrator when more than one lift is required. Place concrete in 24 inch maximum vertical lifts. Use external vibrators on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.8.4 Pumping

ACI/MCP-2. Pumping must not result in separation or loss of materials nor

cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 2 inches. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of course aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

3.8.5 Cold Weather

ACI/MCP-2. Do not allow concrete temperature to decrease below 50 degrees F Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 37 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

3.8.6 Hot Weather

Maintain required concrete temperature using Figure 2.1.5 in ACI/MCP-2 to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.8.7 Follow-up

Check concrete within 24 hours of placement for flatness, levelness, and other specified tolerances. Adjust formwork and placement techniques on subsequent pours to achieve specified tolerances.

3.8.8 Placing Concrete in Forms

Deposit concrete placed in forms in horizontal layers not exceeding 24 inches.

Remove temporary spreaders in forms when concrete placing has reached elevation of spreaders.

Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Design vibrators to operate with vibratory element submerged in concrete and maintain a speed of not less than 9,000 impulses per minute when submerged in concrete. Provide vibrating equipment adequate in number of units and power of each unit to properly consolidate concrete. Vibration of forms and reinforcement is not be permitted. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced points not farther apart than visible effectiveness of

machine. Do not insert vibrator into lower courses of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of concrete mix.

Do not start placing of concrete in supporting elements until concrete previously placed in columns and walls is no longer plastic and has been in place a minimum of 2 hours.

3.8.9 Placing Concrete Slabs

Place and consolidate concrete for slabs in a continuous operation, within the limits of approved construction joints until placing of panel or section is completed.

During concrete placing operations, consolidate concrete by mechanical vibrating equipment so that concrete is worked around reinforcement and other embedded items and into corners. Consolidate concrete placed in beams and girders of supported slabs and against bulkheads of slabs on ground by mechanical vibrators as specified. Consolidate concrete in remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other approved method. Limit consolidation operations to time necessary to obtain consolidation of concrete without bringing an excess of fine aggregate to the surface. Concrete to be consolidated must be as dry as practical and surfaces thereof must not be manipulated prior to finishing operations. Bring concrete correct level with a straightedge and struck-off. Use bull floats or darbies to smooth surface, leaving it free of humps or hollows. Sprinkling of water on plastic surface is not permitted.

Provide finish of slabs as specified.

3.8.10 Bonding

Surfaces of set concrete at joints, except where bonding is obtained by use of concrete bonding agent, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.

At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.

Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

Bonding of fresh concrete to concrete that has set may be obtained by use of a concrete bonding agent. Apply such bonding material to cleaned concrete surface in accordance with approved printed instructions of bonding material manufacturer.

3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.9.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete must not vary more than the allowable tolerances of ACI/MCP-4. Exposed surfaces must be uniform in appearance and finished to a smooth form finish unless otherwise specified.

3.9.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

3.9.3 Formed Surfaces

3.9.3.1 Tolerances

ACI/MCP-1 and as indicated.

3.9.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view. Patch these holes and defects and level abrupt irregularities. Remove or rub off fins and other projections exceeding 0.25 inch in height.

3.9.3.3 Standard Smooth Finish

Finish must be as-cast concrete surface as obtained with form facing material for standard smooth finish. Repair and patch defective areas as specified; and all fins and remove other projections on surface.

3.9.4 Grout Finish

Provide finish that is standard, smooth coated with grout as specified.

Give finish to interior and exterior concrete vertical surfaces that are to be exposed to view.

Grout is required consisting of one part portland cement to 1-1/2 parts fine aggregate by volume, mixed with water to produce a consistency of thick paint. Portland cement portion must be a blend of standard portland cement and white portland cement, proportioned as determined by trial mixes so that final color of grout when dry approximates color of surrounding concrete. Fine aggregate must pass No. 30 mesh sieve.

Surface of concrete is required to be wetted, and grout must be applied immediately to wetted surfaces. Spread grout over surface with clean burlap pads or sponge-rubber floats to fill pits, air bubbles, and surface holes. Remove excess grout by scraping, then rubbing surface with clean burlap to remove visible grout film. Keep grout damp by means of fog spray during setting period. Complete finish the day it is started, and make limits of a finished area at natural breaks in finished surface.

3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI/MCP-2, unless otherwise specified. Slope floors uniformly to drains where drains are provided.

3.10.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.10.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance as defined below,roughen the surface with stiff brushes of rakes before final set.

3.10.1.2 Steel Troweled

Use for floors intended as walking surfaces, and for reception of floor coverings. First, provide a floated finish. Next, the finish must be power troweled two times, and finally hand troweled. The first troweling after floating needs to produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Perform additional trowelings done by hand after the surface has hardened sufficiently. The final troweling is done when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate the surface by the hand troweling operations. The finished surface must be essentially free of trowel marks and uniform in texture and appearance. The finished surface must produce a surface level to within 1/4 inch in 10 feet. On surfaces intended to support floor coverings, remove any defects of sufficient magnitude to show through the floor covering by grinding.

3.10.1.3 Nonslip Finish

Use on surfaces of exterior platforms, steps, and landings; and on exterior and interior pedestrian ramps. Apply dry shake aggregate of ceramically bonded aluminum oxide to the surface at a minimum rate of 25 pounds per 100 square feet. Blend approximately two-thirds of the aggregate with portland cement as recommended by the manufacturer and apply to the surface evenly and without segregation. After blended material has been embedded by floating, apply the remainder of the blended material to the surface at right angles to the previous application. Apply blended material heavier in any areas not sufficiently covered by the first application. Perform a second floating immediately following the first. After the selected material has been embedded by the two floatings, complete the operation with a broomed finish.

3.10.1.4 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.10.1.5 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained. Round edges and joints with an edger having a radius of 1/8 inch.

3.10.2 Flat Floor Finishes

ACI/MCP-2. Construct in accordance with one of the methods recommended in Table 7.15.3, "Typical Composite Ff/FL Values for Various Construction Methods." ACI/MCP-1 for tolerance tested by ASTM E 1155.

a. Specified Conventional Value:

Floor Flatness (Ff)	20	13 minimum
Floor Levelness (FL)	15	10 minimum

b. Specified Industrial:

Floor Flatness (Ff)	30	15 minimum
Floor Levelness (FL)	20	10 minimum

3.10.3 Concrete Walks

Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet unless otherwise indicated. Cut contraction joints one inch deep with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet maximum. Give walks a broomed finish. Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 1/4 inch in 5 feet.

3.10.4 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.11 CURING AND PROTECTION

ACI/MCP-2 unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do

not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

3.11.1 General

Protect freshly placed concrete from premature drying and cold or hot temperature and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of cement and proper hardening of concrete.

Start initial curing as soon as free water has disappeared from surface of concrete after placing and finishing. Keep concrete moist for minimum 72 hours.

Final curing must immediately follow initial curing and before concrete has dried. Continue final curing until cumulative number of hours or fraction thereof (not necessarily consecutive) during which temperature of air in contact with the concrete is above 50 degrees F has totaled 168 hours. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, final curing may be terminated when the average compressive strength has reached 70 percent of the 28-day design compressive strength. Prevent rapid drying at end of final curing period.

3.11.2 Moist Curing

Remove water without erosion or damage to the structure. Prevent water run-off.

3.11.2.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water must not be more than 50 degrees F less than the temperature of the concrete. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.11.2.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.11.2.3 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top

down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.11.3 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5 in ACI/MCP-2 indicates that hot weather conditions cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

3.11.3.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats must be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound must form a uniform, continuous, coherent film that does not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Re-spray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.11.3.2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.11.4 Requirements for Type III, High-Early-Strength Portland Cement

The curing periods are required to be not less than one-fourth of those specified for portland cement, but in no case less than 72 hours.

3.11.5 Curing Periods

ACI/MCP-2 except 10 days for retaining walls, pavement or chimneys, 21 days for concrete that is in full-time or intermittent contact with seawater, salt spray, alkali soil or waters. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

3.11.6 Curing Methods

Accomplish curing by moist curing, by moisture-retaining cover curing, by membrane curing, and by combinations thereof, as specified.

Moist curing:

Accomplish moisture curing by any of the following methods:

Keeping surface of concrete wet by covering with water

Continuous water spraying

Covering concrete surface with specified absorptive cover for curing concrete saturated with water and keeping absorptive cover wet by water spraying or intermittent hosing. Place absorptive cover to provide coverage of concrete surfaces and edges with a slight overlap over adjacent absorptive covers.

Moisture-cover curing:

Accomplish moisture-retaining cover curing by covering concrete surfaces with specified moisture-retaining cover for curing concrete. Place cover directly on concrete in widest practical width, with sides and ends lapped at least 3 inches. Weight cover to prevent displacement; immediately repair tears or holes appearing during curing period by patching with pressure-sensitive, waterproof tape or other approved method.

Membrane curing:

Accomplish membrane curing by applying specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has disappeared. Apply curing compound uniformly in a two-coat operation by power-spraying equipment using a spray nozzle equipped with a wind guard. Apply second coat in a direction at right angles to direction of first coat. Total coverage for two coats must be not more than 200 square feet per gallon of curing compound. Respray concrete surfaces which are subjected to heavy rainfall within 3 hours after curing compound has been applied by method and at rate specified. Maintain continuity of coating for entire curing period and immediately repair damage to coating during this period.

Membrane-curing compounds must not be used on surfaces that are to be covered with coating material applied directly to concrete or with a covering material bonded to concrete, such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, painting, and other coatings and finish materials.

3.11.7 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

3.11.8 Curing Unformed Surfaces

Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.

Unless otherwise specified, accomplish final curing of unformed surfaces by any of curing methods specified above, as applicable.

Accomplish final curing of concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

3.11.9 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 37 degrees F in any 1 hour nor 80 degrees F in any 24-hour period.

3.11.10 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.11.11 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.12 FIELD QUALITY CONTROL

3.12.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31/C 31M for making test specimens.

3.12.2 Testing

3.12.2.1 Slump Tests

ASTM C 143/C 143M. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

3.12.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.12.2.3 Compressive Strength Tests

ASTM C 39/C 39M. Make five test cylinders for each set of tests in accordance with ASTM C 31/C 31M. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Take samples for strength tests of each mix design of concrete placed each day not less than once a day, nor less than once for each 160 cubic yards of concrete, nor less than once for each 5400 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 450 psi, take a minimum of three ASTM C 42/C 42M core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test is considered structurally adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Retest locations represented by erratic core strengths. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.12.2.4 Air Content

ASTM C 173/C 173M or ASTM C 231 for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.12.2.5 Strength of Concrete Structure

Compliance with the following is considered deficient if it fails to meet the requirements which control strength of structure in place, including following conditions:

Failure to meet compressive strength tests as evaluated

Reinforcement not conforming to requirements specified

Concrete which differs from required dimensions or location in such a manner as to reduce strength

Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified

Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration

Poor workmanship likely to result in deficient strength

3.12.2.6 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements, make cores drilled from hardened concrete for compressive strength determination in accordance with ASTM C 42/C 42M, and as follows:

Take at least three representative cores from each member or area of

concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.

Test cores after moisture conditioning in accordance with ASTM C 42/C 42M if concrete they represent is more than superficially wet under service.

Air dry cores, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.

Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required must be borne by the Contractor.

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the Contracting Officer.

3.13 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows.

3.13.1 Mixing Equipment

Before concrete pours, designate Company-owned site meeting environmental standards for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.13.2 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.14 JOINTS

3.14.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Locate construction joints as follows:

In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

Joints must be perpendicular to main reinforcement. Reinforcement must be continued across construction joints.

3.14.2 Waterstops

Provide waterstops in construction joints as indicated.

Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Make field joints in waterstops in accordance with waterstop manufacturer's printed instructions, as approved. Protect waterstops protruding from joints from damage.

3.14.3 Isolation Joints in Slabs on Ground

Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Fill joints with premolded joint filler strips 1/2 inch thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 3/4 inch in depth where joint is sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

3.14.4 Contraction Joints in Slabs on Ground

Provide joints to form panels as indicated.

Under and on exact line of each contraction joint, cut 50 percent of welded wire fabric reinforcement before placing concrete.

Joints must be 1/8-inch wide by 1/5 to 1/4 of slab depth and formed by inserting hand-pressed fiberboard strip into fresh concrete until top surface of strip is flush with slab surface or by cutting the concrete with a saw after the concrete has set. After concrete has cured for at least 7 days, the Contractor must remove inserts and clean groove of foreign matter and loose particles.

3.14.5 Sealing Joints in Slabs on Ground

Isolation and contraction joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.

Sealing is not required for isolation and contraction joints to be covered with finish flooring material. Groove must be left ready to receive filling material that is provided as part of finish floor covering work.

3.15 INSTALLATION OF ANCHORAGE DEVICES

3.15.1 General

Anchorage devices and embedded items required for other work that is attached to, or supported by, set and build in cast-in-place concrete as part of the work of this section, using setting drawings, instructions, and directions for work to be attached thereto.

3.15.2 Placing Anchorage Devices

Anchorage devices and embedded items must be positioned accurately and supported against displacement. Fill openings in anchorage devices such as slots and threaded holes with an approved, removable material to prevent entry of concrete into openings.

3.16 CONCRETE CONVEYING

3.16.1 Transfer of Concrete At Project Site

Handle concrete from point of delivery and transfer to concrete conveying equipment and to locations of final deposit as rapidly as practical by methods which prevent segregation and loss of concrete mix materials.

3.16.2 Mechanical Equipment for Conveying Concrete

Equipment must ensure a continuous flow of concrete at delivery end, as approved. Provide runways for wheeled concrete-conveying equipment from concrete delivery point to locations of final deposit. Interior surfaces of concrete conveying equipment must be free of hardened concrete, debris, water, snow, ice, and other deleterious substances.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 03 - CONCRETE

SECTION 03 40 00.00 10

PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION

PART 1 GENERAL

1.1 REFERENCES
1.2 SYSTEM DESCRIPTION
1.2.1 Standard Precast Units
1.2.2 Proprietary Precast Units
1.2.3 Joints and Sealants
1.2.4 Concrete Mix Design
1.2.4.1 Concrete Mix Proportions
1.2.4.2 Concrete Strength
1.2.4.3 Water-to-Cement Ratio
1.2.4.4 Air Content
1.3 SUBMITTALS
1.4 QUALITY ASSURANCE
1.4.1 NPCA and ACPA Plant Certification
1.4.2 Qualifications, Quality Control and Inspection
1.4.2.1 Qualifications
1.4.2.2 Quality Control Procedures
1.4.2.3 Inspection
1.5 DELIVERY, STORAGE, AND HANDLING
1.5.1 Delivery
1.5.2 Storage
1.5.3 Handling

PART 2 PRODUCTS

2.1 MATERIALS
2.1.1 Cement
2.1.2 Silica Fume
2.1.3 Fly Ash and Pozzolans
2.1.4 Ground Granulated Blast-Furnace Slag
2.1.5 Water
2.1.6 Aggregates
2.1.6.1 Selection
2.1.6.2 Aggregates for Lightweight Concrete
2.1.7 Admixtures
2.1.7.1 Air-Entraining
2.1.7.2 Accelerating, Retarding, Water Reducing
2.1.8 Reinforcement
2.1.8.1 Reinforcing Bars
2.1.8.2 Reinforcing Wire
2.1.8.3 Welded Wire Fabric
2.1.8.4 Epoxy Coated Reinforcement
2.1.8.5 Galvanized Reinforcement
2.1.9 Synthetic Fiber Reinforcement
2.1.10 Inserts and Embedded Metal

2.1.11 Accessories
2.1.12 Pipe Entry Connectors
2.1.13 Grout
2.1.14 Precast Concrete Manholes
2.1.14.1 Manhole Bases
2.1.14.2 Manhole Wall and Top
2.1.14.3 Manhole Bench Walls
2.1.14.4 Manhole Frames and Covers
2.1.14.5 Manhole Steps
2.1.14.6 Jointing Precast Sections
2.1.14.7 Pipe Connections to Manholes
2.1.14.8 Drop Sections
2.1.14.9 Dampproofing
2.1.14.10 Lining and Coating

PART 3 EXECUTION

3.1 FABRICATION AND PLACEMENT
3.1.1 Forms
3.1.2 Reinforcement
3.1.3 Embedded Items
3.1.4 Synthetic Fiber Reinforced Concrete
3.2 CONCRETE
3.2.1 Concrete Mixing
3.2.2 Concrete Placing
3.2.2.1 Cold Weather Concreting
3.2.2.2 Hot Weather Concreting
3.2.3 Concrete Curing
3.2.3.1 Curing by Moisture Retention
3.2.4 Surface Finish
3.2.4.1 Formed Non-Architectural Surfaces
3.2.4.2 Unformed Surfaces
3.2.4.3 Special Finishes
3.2.5 Stripping Products from Forms
3.2.6 Patching and Repair
3.2.6.1 Repairing Minor Defects
3.2.6.2 Repairing Honeycombed Areas
3.2.6.3 Repairing Major Defects
3.2.7 Shipping Products
3.3 INSTALLATION
3.3.1 Site Access
3.3.2 Precast Structure Installation
3.3.2.1 Dampproofing
3.3.3 Manhole Installation
3.3.3.1 Manhole Pipe Connections
3.3.3.2 Mortar
3.3.3.3 Setting Manhole Frame and Cover
3.3.3.4 Dampproofing
3.3.4 Leakage Tests
3.3.4.1 Exfiltration Test
3.3.4.2 Vacuum Test
3.3.4.3 Leakage Tests for Drain Manholes
3.3.5 Cleaning

-- End of Section Table of Contents --

SECTION 03 40 00.00 10

PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 211.2	(1998; R 2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 305R	(1999; Errata 2006) Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 318	(2008; Errata 2008; Errata 2009; Errata 2009; Errata 2009; Errata 2009; Errata 2009) Building Code Requirements for Structural Concrete and Commentary

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA QPC	(2005; Ver 3.0) QCast Plant Certification Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010) Structural Welding Code - Steel
AWS D1.4/D1.4M	(2005; Errata 2005) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 36/A 36M	(2008) Standard Specification for Carbon

Structural Steel

ASTM A48/A48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A 615/A 615M	(2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 767/A 767M	(2009) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A 775/A 775M	(2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 884/A 884M	(2006) Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM C 1064/C 1064M	(2008) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C 1107/C 1107M	(2008) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1116/C 1116M	(2008a) Standard Specification for Fiber-Reinforced Concrete
ASTM C 1240	(2005) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C 1244	(2005e1) Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
ASTM C 138/C 138M	(2009) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete
ASTM C 143/C 143M	(2009) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 1478	(2008) Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes and Laterals
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 171	(2007) Standard Specification for Sheet

	Materials for Curing Concrete
ASTM C 173/C 173M	(2009) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(2007) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2009a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2009) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 330	(2005) Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C 39/C 39M	(2009a) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 443	(2005a) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 478	(2009) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 494/C 494M	(2008a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 595/C 595M	(2008a) Standard Specification for Blended Hydraulic Cements
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 877	(2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM C 923	(2008) Standard Specification for

	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 989	(2009a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C 990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS SS-S-210	(Rev A, Notice 3) Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA)

NPCA QC Manual	(2005; R 2006) Quality Control Manual for Precast Plants

1.2 SYSTEM DESCRIPTION

Furnish precast concrete units designed and fabricated by an experienced and acceptable precast concrete manufacturer who has been, for at least 3 years, regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings. Coordinate precast work with the work of other trades.

1.2.1 Standard Precast Units

Design standard precast concrete units to withstand indicated design load conditions in accordance with applicable industry design standards. Design shall also consider stresses induced during handling, shipping and installation as to avoid product cracking or other handling damage. Indicate design loads for precast concrete units on the shop drawings.

1.2.2 Proprietary Precast Units

Products manufactured under franchise arrangements shall conform to all the requirements specified by the franchiser. Items not included in the franchise specification, but included in this specification, shall conform to the requirements in this specification.

1.2.3 Joints and Sealants

Provide joints and sealants between adjacent units of the type and configuration indicated on shop drawings meeting specified design and performance requirements.

1.2.4 Concrete Mix Design

1.2.4.1 Concrete Mix Proportions

Base selection of proportions for concrete on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. Develop the concrete proportions using the same type and brand

of cement, the same type and brand of pozzolan, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project. Do not use calcium chloride in precast concrete containing reinforcing steel or other embedded metal items. The use of self-consolidating concrete is permitted, provided that mix design proportions and constituents meet the requirements of this specification.

1.2.4.2 Concrete Strength

Provide precast concrete units with a 28-day compressive strength (f'c) of 5000 psi.

1.2.4.3 Water-to-Cement Ratio

Furnish concrete, that will be exposed to freezing and thawing, containing entrained air and with water-cement ratios of 0.45 or less. Furnish concrete which will not be exposed to freezing, but which is required to be watertight, with a water-cement ratio of 0.48 or less if the concrete is exposed to fresh water, or 0.45 or less if exposed to brackish water or sea water. Furnish reinforced concrete exposed to deicer salts, brackish water or seawater with a water-cement ratio of 0.40 or less for corrosion protection.

1.2.4.4 Air Content

The air content of concrete that will be exposed to freezing conditions shall be within the limits given below.

NOMINAL MAXIMUM AGGREGATE SIZE	AIR CONTENT % SEVERE EXPOSURE	MODERATE EXPOSURE
10 mm (3/8 inch)	6.0 to 9.0	4.5 to 7.5
13 mm (1/2 inch)	5.5 to 8.5	4.0 to 7.0
19 mm (3/4 inch)	4.5 to 7.5	3.5 to 6.5
25 mm (1.0 inch)	4.5 to 7.5	3.0 to 6.0
38 mm (1.5 inch)	4.5 to 7.0	3.0 to 6.0

Note: For specified compressive strengths greater than 5000 psi, air content may be reduced 1 percent

1.3 SUBMITTALS

All submittals are the responsibility of the precast concrete producer. Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Procedures

Quality control procedures established by the precast manufacturer in accordance with NPCA QC Manual and/or ACPA QPC.

SD-03 Product Data

Standard Precast Units; G

Cut sheets, for standard precast concrete units, showing conformance to project drawings and requirements, and to applicable industry design standards listed in this specification.

Accessories

Proper installation instructions and relevant product data for items including, but not limited to, sealants, gaskets, connectors, steps, cable racks and other items installed before or after delivery.

SD-06 Test Reports

Test Reports

1.4 QUALITY ASSURANCE

Demonstrate adherence to the standards set forth in NPCA QC Manual and/or ACPA QPC. Meet requirements written in the subparagraphs below.

1.4.1 NPCA and ACPA Plant Certification

The precast concrete producer shall be certified by the National Precast Concrete Association's and/or the American Concrete Pipe Association's Plant Certification Program prior to and during production of the products for this project.

1.4.2 Qualifications, Quality Control and Inspection

1.4.2.1 Qualifications

Select a precast concrete producer that has been in the business of producing precast concrete units similar to those specified for a minimum of 3 years. The precast concrete producer shall maintain a permanent quality control department or retain an independent testing agency on a continuing basis.

1.4.2.2 Quality Control Procedures

Show that the following QC tests are performed as required and in accordance with the ASTM standards indicated.

a. Slump: Perform a slump test for each 150 cu yd of concrete produced, or once a day, whichever comes first. Perform slump tests in accordance with ASTM C 143/C 143M.

b. Temperature: Measure the temperature of fresh concrete when slump or air content tests are made and when compressive test specimens are made in accordance with ASTM C 1064/C 1064M.

c. Compressive Strength: Make at least four compressive strength specimens for each 150 cubic yards of concrete of each mix in accordance with the following Standards: ASTM C 31/C 31M, ASTM C 192/C 192M, ASTM C 39/C 39M.

d. Air Content: Perform tests for air content on air-entrained, wet-cast concrete for each 150 cu yd of concrete, but not less often than once each day when air-entrained concrete is used. Determine the

air content in accordance with either ASTM C 231 or ASTM C 173/C 173M for normal weight aggregates and ASTM C 173/C 173M for lightweight aggregates.

e. Unit Weight: Perform tests for unit weight a minimum of once per week to verify the yield of batch mixes. Perform unit weight tests for each 100 cu yd of lightweight concrete in accordance with ASTM C 138/C 138M.

Submit test reports as Follows:

a. Copies of material certifications and/or laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolans, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

b. Copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Such tests may include compressive strength, flexural strength, plastic or hardened air content, freeze thaw durability, abrasion and absorption. Clearly detail in the specifications special tests for precast concrete or cast-in items.

c. Sufficient documentation, when the use of self-consolidating concrete (SCC) is proposed, showing a minimum of 30-days production track records demonstrating that SCC is appropriate for casting of the product.

d. Copies of in-plant QA/QC inspection reports, upon the request of the Contracting Officer.

1.4.2.3 Inspection

The Contracting Officer may place an inspector in the plant when the units covered by this specification are being manufactured. The precast concrete producer shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver precast units to the site in accordance with the delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite, all precast concrete units will be inspected by the Contracting Officer for quality and final acceptance.

1.5.2 Storage

Store units off the ground or in a manner that will minimize potential damage.

1.5.3 Handling

Handle, transport, and store products in a manner to minimize damage.

Lifting devices or holes shall be consistent with industry standards. Perform lifting with methods or devices intended for this purpose as indicated on shop drawings.

PART 2 PRODUCTS

2.1 MATERIALS

Except as otherwise specified in the following paragraphs, conform materials to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.1.1 Cement

Furnish cement conforming to ASTM C 150/C 150M, Type I, II, III or V. Furnish blended cements that conform to ASTM C 595/C 595M.

2.1.2 Silica Fume

Provide silica fume conforming to ASTM C 1240. Provide available alkalies conforming to the optimal limit given in Table 2 of ASTM C 1240. Silica fume may be furnished as a dry, densified material or as a slurry. When necessary, coordinate the services of a technical representative experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume.

2.1.3 Fly Ash and Pozzolans

Fly ash is used as an admixture conforming to ASTM C 618, Class C or F with 4 percent maximum loss on ignition and 35 percent maximum cement replacement by weight.

2.1.4 Ground Granulated Blast-Furnace Slag

Ground granulated blast furnace slag is used as an admixture conforming to ASTM C 989, Grade 120 with between 25 to 50 percent maximum cement replacement by weight.

2.1.5 Water

Furnish water potable or free of deleterious substances in amounts harmful to concrete or embedded metals.

2.1.6 Aggregates

2.1.6.1 Selection

Furnish aggregates conforming to ASTM C 33/C 33M. Provide aggregates not containing any substance, which may be deleteriously reactive with the alkalies in the cement.

2.1.6.2 Aggregates for Lightweight Concrete

ASTM C 330

2.1.7 Admixtures

2.1.7.1 Air-Entraining

ASTM C 260

2.1.7.2 Accelerating, Retarding, Water Reducing

ASTM C 494/C 494M

2.1.8 Reinforcement

2.1.8.1 Reinforcing Bars

a. Deformed Billet-steel: ASTM A 615/A 615M

2.1.8.2 Reinforcing Wire

a. Plain Wire: ASTM A 82/A 82M

2.1.8.3 Welded Wire Fabric

a. Plain Wire: ASTM A 185/A 185M

2.1.8.4 Epoxy Coated Reinforcement

a. Reinforcing Bars: ASTM A 775/A 775M
b. Wires and Fabric: ASTM A 884/A 884M

2.1.8.5 Galvanized Reinforcement

Provide galvanized reinforcement conforming to ASTM A 767/A 767M.

2.1.9 Synthetic Fiber Reinforcement

Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 2 inch.

2.1.10 Inserts and Embedded Metal

All items embedded in concrete shall be of the type required for the intended task, and meet the following standards.

a. Structural Steel Plates, Angles, etc.: ASTM A 36/A 36M
b. Hot-dipped Galvanized: ASTM A 153/A 153M
c. Proprietary Items: In accordance with manufacturers published literature

2.1.11 Accessories

a. Rubber Gaskets for Circular Concrete Sewer Pipe and Culvert Pipe: ASTM C 443.

b. External Sealing Bands for Noncircular Sewer, Storm Drain and Culvert Pipe: ASTM C 877.

c. Preformed Flexible Joint Sealants for Concrete Pipe, Manholes, and Manufactured Box Sections: ASTM C 990.

d. Elastomeric Joint Sealants: ASTM C 920

e. Grade Rings: Precast concrete grade rings shall be used to support and adjust manhole frames. Grade rings shall conform to ASTM C 478 and shall be set in a full bed of mortar.

2.1.12 Pipe Entry Connectors

Pipe entry connectors shall conform to ASTM C 923 or ASTM C 1478.

2.1.13 Grout

Nonshrink grout shall conform to ASTM C 1107/C 1107M. Cementitious grout shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

2.1.14 Precast Concrete Manholes

Precast concrete manholes shall conform to ASTM C 478.

2.1.14.1 Manhole Bases

Manhole bases shall be precast concrete. Their design and fabrication shall conform to the general requirements of this Section and the provisions of ASTM C 478. The bases shall conform to the dimensions shown on the drawings. The horizontal joint at the top of the base shall be compatible with that of the precast wall sections.

The precast bases shall be manufactured to contain openings in the wall of minimum size to receive the ends of the pipe. All penetrations shall be cast in at the concrete precast plant. Drilled openings shall not be permitted. These openings shall be accurately set to conform to line and grade of pipe.

All precast concrete bases shall be free from cracks, damaged joints, exposed reinforcing, aggregate pockets, spalls, and dimensional distortions or other irregularities. Any units rejected by the Contracting Officer shall be tagged and removed from the job site immediately.

2.1.14.2 Manhole Wall and Top

Precast concrete walls shall be made up of straight, circular sections and eccentric tops if manhole steps are required. The total height of precast wall required for each manhole shall be determined in the field and shall be such that the vertical distance between the top of the assembled precast units and the bottom of the installed cast-iron manhole frame is a minimum of 4 inches and a maximum of 12 inches to allow for masonry work or precast concrete grade rings.

All precast units shall be laid up plumb and level. Minimum longitudinal and circumferential reinforcing steel shall be in conformance with ASTM C 478.

All precast concrete sections shall be free from cracks, damaged joints, exposed reinforcing, aggregate pockets, spalls, dimensional distortions, or other irregularities. Any units rejected by the Contracting Officer shall be tagged and removed from the job site immediately.

Precast reinforced concrete slab tops for manholes shall be 8 inches thick and manufactured in accordance with ASTM C 478. Openings shall be eccentric when manholes are furnished with steps and concentric if they have no steps and of the proper diameter to receive the frame specified.

Slab tops shall be set in a full bed of mortar.

2.1.14.3 Manhole Bench Walls

The flow channels in each manhole shall be carefully shaped following the details on the drawings. They shall match the inverts and size of pipes which connect to the manhole, creating a channel of gradual slope and curvature so that a smooth, uninterrupted flow through the manhole is ensured. The inverts of these channels shall be constructed of half pipe sections or concrete. For bends, sort sections of half pipe may be cut and used to form the channel. Refer to drawings for details. The bench surface itself shall extend laterally to the manhole walls, pitching slightly toward the flow channel.

Minimum concrete Class C mix shall be used for bench walls and all exposed surfaces shall receive a steel-troweled finish. Horizontal surfaces shall then be brush finished.

2.1.14.4 Manhole Frames and Covers

Frames and covers shall have 24-inch openings and shall be heavy duty, non-penetrating pickhole type of non-rocking design and shall have machined bearing surfaces to prevent rocking and rattling under traffic loads.

Material shall be gray cast iron conforming to ASTM A48/A48M, Class 30; or shall be ductile cast iron conforming to ASTM A536, Grade 60-40-18.

Castings shall be manufactured true to pattern and shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion, or other defects. Components shall fit together completely.

Covers shall have cast-in, 1-1/2-inch-wide, raised letters with lettering as shown in the drawings.

The finish shall be smooth and well cleaned by shot-blasting or by some other approved method.

Frames shall be firmly seated in a full bed of mortar and be positioned to conform to the adjacent finished grade or to the specific elevation shown on the drawings. Frames shall be set parallel to surface slopes. Covers shall seat uniformly in any position in the frame without rocking.

2.1.14.5 Manhole Steps

When shown on the drawings, manhole steps shall be copolymer polypropylene plastic with 1/2-inch Grade 60 steel reinforcement as manufactured by M.A. Industries, Inc., or equal.

Steps are to be cast in or grouted solid into the precast units at intervals of 12 inches. Steps shall be in conformance with OSHA requirements, having drop front or equivalent. Bolted-on types are not acceptable.

2.1.14.6 Jointing Precast Sections

Seal tongue-and-groove joints of precast manhole sections with either rubber O-ring gaskets or preformed flexible joint sealant. O-ring gaskets shall conform to ASTM C 443 and FS SS-S-210. Preformed flexible joint sealant shall be Kent Seal No. 2 by Hamilton-Kent, Ram-Nek by Henry, or

equal.

After the joints are assembled the gap between sections shall be packed on the inside and outside with Anti-Hydro "Axpandaretes," Masterflow 713 by Master Builders or Five Star Grout by U.S. Grout Corp. and shall be troweled smooth so that no projections remain on the inside.

The completed joint shall withstand 15-psi internal water pressure without leakage or displacement of gasket or sealant.

2.1.14.7 Pipe Connections to Manholes

Connect pipe to manholes in the following ways:

Flexible sleeve - integrally cast the sleeve in a precast manhole section or install the sleeve in a formed or cored opening. Fasten pipe in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous material to protect from corrosion. Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve, Kor-N-Seal connector, or equal.

Compression gasket - integrally cast the compression gasket in a precast manhole section. Insert pipe into compression gasket. The compression gasket shall be A-Lok or equal.

At the discretion of the Contracting Officer the following procedure may be allowed:

Grout-in-place - Precast manhole sections shall have a formed, tapered circular opening larger than the pipe outside diameter. Grout shall be non-shrink and waterproof equal to Hallemite, Waterplug, or Embeco. Plastic pipe shall have a waterstop gasket secured to the pipe with a stainless steel clamp before grouting.

2.1.14.8 Drop Sections

Whenever the invert of a pipe entering a manhole is 24 inches or more in height above the invert of the lowest pipe leaving the manhole, it shall be connected to the manhole with a drop section as shown on the drawings. The manhole shall be constructed in the normal manner,, except that the concrete base shall be extended for outside drop pipes and a straight clean-out pipe shall be connected through the wall as detailed on the drawings.

Fittings and special adapters required for the outside drop section shall be of the same material and class as the pipe entering the manhole. After installing the outside drop section and pipe connections into the manhole, encase the entire vertical, outside assembly in concrete, as shown, using Concrete Class "C" mix.

2.1.14.9 Dampproofing

Apply two coats of bituminous waterproofing material to the exterior surfaces of precast concrete structures by brush or spray and in accordance with the manufacturer's recommendations. Dampproofing shall be Hydrocide 648 by Sonneborn Building Products, Dehydratine 4 by A.C. Horn Inc., RIW Marine Liquid by Toch Brothers, or equal.

2.1.14.10 Lining and Coating

Refer to Section 09 97 24 CONCRETE REPAIR AND HYDROGEN SULFIDE PROTECTIVE COATING for the lining and coating specifications.

PART 3 EXECUTION

3.1 FABRICATION AND PLACEMENT

Perform fabrication in accordance with NPCA QC Manual and/or ACPA QPC unless specified otherwise.

3.1.1 Forms

Use forms, for manufacturing precast concrete products, of the type and design consistent with industry standards and practices. They should be capable of consistently providing uniform products and dimensions. Construct forms so that the forces and vibrations to which the forms will be subjected can cause no product damage. Clean forms of concrete build-up after each use. Apply form release agents according to the manufacturers recommendations and do not allow to build up on the form casting surfaces.

3.1.2 Reinforcement

Follow applicable ASTM Standard or ACI 318 for placement and splicing. Fabricate cages of reinforcement either by tying the bars, wires or welded wire fabric into rigid assemblies or by welding, where permissible, in accordance with AWS D1.4/D1.4M. Position reinforcing as specified by the design and so that the concrete cover conforms to requirements. The tolerance on concrete cover shall be one-third of that specified but not more than 1/2 inch. Provide concrete cover not less than 1/2 inch. Take positive means to assure that the reinforcement does not move significantly during the casting operations.

3.1.3 Embedded Items

Position embedded items at locations specified in the design documents. Perform welding in accordance with AWS D1.1/D1.1M when necessary. Hold rigidly in place inserts, plates, weldments, lifting devices and other items to be imbedded in precast concrete products so that they do not move significantly during casting operations.

3.1.4 Synthetic Fiber Reinforced Concrete

Add fiber reinforcement to the concrete mix in accordance with the applicable sections of ASTM C 1116/C 1116M and the recommendations of the manufacturer, and in an amount of 0.1 percent by volume.

3.2 CONCRETE

3.2.1 Concrete Mixing

Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

3.2.2 Concrete Placing

Deposit concrete into forms as near to its final location as practical. Keep the free fall of the concrete to a minimum. Consolidate concrete in

such a manner that segregation of the concrete is minimized and honeycombed areas are kept to a minimum. Use vibrators to consolidate concrete with frequencies and amplitudes sufficient to produce well consolidated concrete.

3.2.2.1 Cold Weather Concreting

Perform cold weather concreting in accordance with ACI 306.1.

a. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather.

b. Free from frost all concrete materials and all reinforcement, forms, fillers, and ground with which concrete is to come in contact.

c. Do not use frozen materials or materials containing ice.

d. In cold weather the temperature of concrete at the time of placing shall not be below 45 degrees F. Discard concrete that freezes before its compressive strength reaches 500 psi.

3.2.2.2 Hot Weather Concreting

Recommendations for hot weather concreting are given in detail in ACI 305R. During hot weather, give proper attention to constituents, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure. The temperature of concrete at the time of placing shall not exceed 90 degrees F.

3.2.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing.

3.2.3.1 Curing by Moisture Retention

Prevent moisture evaporation from exposed surfaces until adequate strength for stripping is reached by one of the following methods:

a. Cover with polyethylene sheets a minimum of 6 mils thick in accordance with ASTM C 171.

b. Cover with burlap or other absorptive material and keep continually moist.

c. Use of a membrane-curing compound applied at a rate not to exceed 200 square ft/gallon, or in accordance with manufacturers' recommendations according to ASTM C 309.

3.2.4 Surface Finish

Finish unformed surfaces of wet-cast precast concrete products as specified. If no finishing procedure is specified, finish such surfaces using a strike-off to level the concrete with the top of the form.

3.2.4.1 Formed Non-Architectural Surfaces

Cast surfaces against approved forms following industry practices in cleaning forms, designing concrete mixes, placing and curing concrete.

Normal color variations, form joint marks, small surface holes caused by air bubbles, and minor chips and spalls will be accepted but no major imperfections, honeycombs or other major defects will be permitted.

3.2.4.2 Unformed Surfaces

Finish unformed surfaces with a vibrating screed, or by hand with a float. Normal color variations, minor indentations, minor chips and spalls will be accepted but no major imperfections, honeycombs, or other major defects shall be permitted.

3.2.4.3 Special Finishes

Troweled, broom or other finishes shall be according to the requirements of project documents and performed in accordance with industry standards or supplier specifications. Submit finishes for approval when required by the project documents. The sample finishes shall be approved prior to the start of production.

3.2.5 Stripping Products from Forms

Do not remove products from the forms until the concrete reaches the compressive strength for stripping required by the design. If no such requirement exists, products may be removed from the forms after the final set of concrete provided that stripping damage is minimal.

3.2.6 Patching and Repair

No repair is required to formed surfaces that are relatively free of air voids and honeycombed areas, unless the surfaces are required by the design to be finished.

3.2.6.1 Repairing Minor Defects

Defects that will not impair the functional use or expected life of a precast concrete product may be repaired by any method that does not impair the product.

3.2.6.2 Repairing Honeycombed Areas

When honeycombed areas are to be repaired, remove all loose material and cut back the areas into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Use proprietary repair materials in accordance with the manufacturer's instructions. If a proprietary repair material is not used, saturate the area with water. Immediately prior to repair, the area should be damp, but free of excess water. Apply a cement-sand grout or an approved bonding agent to the chipped surfaces, followed immediately by consolidating an appropriate repair material into the cavity.

3.2.6.3 Repairing Major Defects

Evaluate, by qualified personnel, defects in precast concrete products which impair the functional use or the expected life of products to determine if repairs are feasible and, if so, to establish the repair procedure.

3.2.7 Shipping Products

Do not ship products until they are at least 5 days old, unless it can be shown that the concrete strength has reached at least 75 percent of the specified 28-day strength, or that damage will not result, impairing the performance of the product.

3.3 INSTALLATION

3.3.1 Site Access

It is the Contractor's responsibility to provide adequate access to the site to facilitate hauling, storage and proper handling of the precast concrete products.

3.3.2 Precast Structure Installation

Precast section ends shall be clean of foreign materials and carefully inspected for chips or cracks. Any sections with damaged joint tongue shall not be used. Preformed plastic gaskets and joint sealant shall be installed in strict conformance with the manufacturer's recommendations. Only primer furnished by the gasket manufacturer will be approved.

Invert elevations shall be in strict conformance with the drawings. All sharp edges or rough sections that obstruct flow shall be removed.

Access door framing shall be case in top slabs in methods approved by the Contracting Officer and shall be flush and level with the top of concrete. Reference Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS for additional criteria.

Set precast concrete sections vertical and in true alignment. Install O-ring rubber gasket in the recess in the base of previously set section or prime and double seal joint surfaces with "RAM-NEK" premolded plastic joint sealer or Contracting Officer-approved equal.

Completely plug, seal, and smooth all holes in sections used for their handling and the annular space between the wall and entering pipes with nonshrink grout. Finish grout smooth and flush with the adjoining interior and exterior manhole wall surfaces and make watertight.

All structures shall be installed plumb.

3.3.2.1 Dampproofing

Paint outer surfaces of precast structures with two coats of bituminous dampproofing at the rate of 30 to 60 square feet per gallon, in accordance with the manufacturer's instructions.

3.3.3 Manhole Installation

Manholes shall be constructed to the dimensions shown on the drawings and as specified in this Section. Protect all work against flooding and flotation.

Place the manhole base on a bed of 12-inch crushed stone as shown on the drawings. Minimum diameter of the stone foundation shall be the outside diameter of the base plus 2 feet. Set the manhole base grade so that a maximum grade adjustment of 12 inches in required to bring the manhole

frame and cover to final grade.

Use precast concrete grade rings or brick and non-shrink mortar to adjust the manhole frame and cover to final grade.

Set precast concrete manhole sections plumb with a 1/4-inch maximum out-of-plumb tolerance allowed. Seal joints of precast barrel sections with either a rubber O-ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finish flush with the adjoining surfaces. Caulk the inside of any leaking barrel section joint with lead wool or non-shrink grout to the satisfaction of the Contracting Officer.

Allow joints to set for 14 hours before backfilling unless the Contracting Officer specifically approves a shorter period.

Plug holes in the concrete barrel sections required for handling with a non-shrinking grout or non-shrinking grout in combination with concrete plugs. Finish flush on the inside.

The ends of the pipe shall be accurately positioned in the openings and properly secured against movement.

Backfill carefully and evenly around manhole sections.

3.3.3.1 Manhole Pipe Connections

Construct manhole pipe connections, including pipe stubs, as specified above. Close or seal pipe stubs for future connections with a gasketed watertight plug.

3.3.3.2 Mortar

Mix mortar only in such quantity as may be required for immediate use. Use mortar before initial set has taken place. Mortar shall be used within 1-1/2 hours and shall be constantly worked with hoe or shovel until used. Anti-freeze mixtures shall not be included in the mortar. Install masonry when the outside temperature is above 40 degrees F unless provisions are made to protect the mortar and finished work from frost by heating and enclosing the work with tarpaulins or other suitable material. The Contracting Officer's decision regarding the adequacy of protection against freezing shall be final.

3.3.3.3 Setting Manhole Frame and Cover

Set manhole covers and frames in a full mortar bed so that the space between the top of the manhole masonry and the bottom flanges of the frame will be completely filled and made watertight. Precast concrete grade rings a maximum of 12 inches thick shall be used to ensure that the frame and cover are set to the finished grade. Set the manhole frame and cover to final grade before placing permanent paving. Install curb inlet stones as shown on the drawings.

Set manhole frames and covers flush with finish pavement or 3 inches above the finished grade in unpaved areas. Place a ring of mortar around the outside of the bottom flange at least 1 inch thick and pitched to shed water away from the frame. Extend mortar to the outer edge of the masonry and finish smooth and flush with the top of the flange.

3.3.3.4 Dampproofing

Paint outer surfaces of manholes with two coats of bituminous dampproofing at the rate of 30 to 60 square feet per gallon, in accordance with the manufacturer's instructions.

3.3.4 Leakage Tests

Test each sewer manhole and wetwell for leakage by one of the methods described below. The Contracting Officer shall observe each test.

3.3.4.1 Exfiltration Test

Assemble precast structure in place; fill and point all lifting holes and exterior joints within 6 feet of the ground surface with an approved non-shrinking mortar. Test before placing the shelf and invert and before filling and pointing the horizontal joints below 6 feet of depth. Lower the groundwater table below the bottom of the structure for the duration of the test. Plug all pipes and other openings into the precast structures and brace to prevent blow out.

Fill the manhole or wetwell with water to the top of the structure. If the excavation has not been backfilled and no water is observed moving down the surface of the structure, the manhole or wetwell is satisfactorily watertight. If the test as described above is unsatisfactory as determined by the Contracting Officer or if the excavation has been backfilled, continue the test. A period of time may be permitted to allow for absorption. Following this period, refill the manhole or wetwell to the top of the structure, if necessary, and wait at least 8 hours. At the end of the test period, refill the manhole or wetwell to the top of the structure again, measuring the volume of water added. Extrapolate the refill amount to a 24-hour leakage rate. The leakage for each manhole or wetwell shall not exceed 1 gallon per vertical foot for a 24-hour period. If the manhole or wetwell fails this requirement, but the leakage does not exceed 3 gallons per vertical foot per day, the Contractor may make repairs by approved methods as directed by the Contracting Officer. If leakage due to a defective section of joint exceeds 3 gallons per vertical foot per day, the structure shall be rejected. Uncover the rejected structure as necessary to disassemble, reconstruct, or replace it as directed by the Contracting Officer. Retest the manhole or wetwell and, if satisfactory, fill and paint the interior joints.

No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.

An infiltration test may be substituted for an exfiltration test if the groundwater table is above the highest joint in the manhole. If the Contracting Officer determines there is no leakage into the manhole, the manhole will be considered watertight. if the Contracting Officer is not satisfied, the Contractor shall perform an exfiltration or air testing.

3.3.4.2 Vacuum Test

Vacuum testing shall conform to ASTM C 1244.

If the pressure drop exceeds the acceptable limits, the Contractor will be

allowed to make necessary repairs, as approved by the Contracting officer. The manhole shall then be retested.

When a successful vacuum test has been completed, fill and point the interior and exterior joints.

3.3.4.3 Leakage Tests for Drain Manholes

The Contracting Officer will visually inspect drain manholes for possible leaks before backfilling is allowed. All joints shall be sealed to the satisfaction of the Contracting Officer.

The Contracting Officer may require an exfiltration test as described for sewer manholes on any structure for which the Contracting Officer deems such a test appropriate.

3.3.5 Cleaning

Thoroughly clean all precast structures of all silt, debris, and foreign matter of any kind before final inspections.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 05 - METALS

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 QUALIFICATION OF WELDERS
1.4 DELIVERY, STORAGE, AND PROTECTION

PART 2 PRODUCTS

2.1 MATERIALS
2.1.1 Steel Pipe
2.1.2 Fittings for Steel Pipe
2.1.3 Anchor Bolts
2.1.3.1 Expansion Anchors, Sleeve Anchors, and Adhesive Anchors
2.1.3.2 Lag Screws and Bolts
2.1.3.3 Toggle Bolts
2.1.3.4 Bolts, Nuts, Studs and Rivets
2.1.3.5 Screws
2.1.3.6 Washers
2.1.4 Aluminum Alloy Products
2.2 FABRICATION FINISHES
2.2.1 Galvanizing
2.2.2 Galvanize
2.2.3 Repair of Zinc-Coated Surfaces
2.2.4 Shop Cleaning and Painting
2.2.4.1 Surface Preparation
2.2.4.2 Pretreatment, Priming and Painting
2.2.5 Nonferrous Metal Surfaces
2.2.6 Aluminum Surfaces
2.2.6.1 Surface Condition
2.2.6.2 Aluminum Finishes
2.3 ACCESS DOORS AND PANELS
2.4 GUARD POSTS (BOLLARDS/PIPE GUARDS)
2.5 SAFETY CHAINS

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS
3.2 WORKMANSHIP
3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS
3.4 BUILT-IN WORK
3.5 WELDING
3.6 FINISHES
3.6.1 Dissimilar Materials
3.6.2 Field Preparation
3.6.3 Environmental Conditions

3.7 ACCESS PANELS
3.8 INSTALLATION OF GUARD POSTS (BOLLARDS/PIPE GUARDS)

-- End of Section Table of Contents --

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996; R 2005) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 2005) Standard for Square and Hex Nuts
ASME B18.21.1	(2009) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.6.2	(1998; R 2005) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series
ASME B18.6.3	(2003; R 2008) Machine Screws and Machine Screw Nuts

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 467/A 467M	(2007) Standard Specification for Machine Coil Chain

ASTM A 47/A 47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 653/A 653M	(2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780/A 780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 924/A 924M	(2009a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 108/B 108M	(2008) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B 209	(2007) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2008) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 26/B 26M	(2009) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C 1513	(2004; E 2009; R 2009) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM D 1187	(1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E 488	(1996; R 2003) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Access doors and panels; G

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Pipe

ASTM A 53/A 53M, Type E or S, Grade B.

2.1.2 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A 47/A 47M.

2.1.3 Anchor Bolts

ASTM A 307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.3.1 Expansion Anchors, Sleeve Anchors, and Adhesive Anchors

Provide 3/4-inch diameter expansion anchors, sleeve anchors, or adhesive anchors as indicated on the drawings. Minimum concrete embedment shall be as indicated on the drawings. Design values listed shall be as tested according to ASTM E 488.

a. Minimum allowable pullout value shall be 4,000 lb.

b. Minimum allowable shear value shall be 5,000 lb.

2.1.3.2 Lag Screws and Bolts

ASME B18.2.1, type and grade best suited for the purpose.

2.1.3.3 Toggle Bolts

ASME B18.2.1.

2.1.3.4 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 or ASTM A 307.

2.1.3.5 Screws

ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C 1513.

2.1.3.6 Washers

Provide plain washers to conform to ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

2.1.4 Aluminum Alloy Products

Conform to ASTM B 209 for sheet plate, ASTM B 221 for extrusions and ASTM B 26/B 26M or ASTM B 108/B 108M for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123/A 123M, ASTM A 153/A 153M, ASTM A 653/A 653M or ASTM A 924/A 924M, G90, as applicable.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780/A 780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative applied in the shop.

2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction

or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF-45. Unless otherwise specified, provide all other aluminum items with a standard mill finish or anodized finish as indicated. Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Provide a polished satin finish on items to be anodized.

2.3 ACCESS DOORS AND PANELS

Provide flush type access doors and panels unless otherwise indicated. Fabricate frames for access doors of steel not lighter than 14 gage with welded joints and anchorage for securing into construction. Provide access doors with a minimum of 14 by 20 inches or as indicated on the drawings and of not lighter than 14 gage steel, with stiffened edges and welded attachments. Provide access doors hinged to frame and with a flush-face, turn-screw-operated latch. Provide exposed metal surfaces with a shop applied prime coat. Design access door to withstand a minimum of 250 psf live load with maximum deflection of L/240.

2.4 GUARD POSTS (BOLLARDS/PIPE GUARDS)

Provide 6-inch galvanized standard weight steel pipe as specified in ASTM A 53/A 53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 2500 psi.

2.5 SAFETY CHAINS

Construct safety chains of galvanized steel, straight link type, 3/16 inch diameter, with at least twelve links per foot, and with snap hooks on each end. Test safety chain in accordance with ASTM A 467/A 467M, Class CS. Provide snap hooks of boat type. Provide galvanized 3/8 inch bolt with 3/4 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area. Locate safety chain where indicated. Mount the top chain 3 feet 6 inches above the floor and mount the lower chain 2 feet above the floor.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners shall be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Form joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections of work in place and ground smooth. Provide a smooth finish on exposed surfaces of work in place and unless otherwise approved, flush exposed riveting. Mill joints where tight fits are required. Corner joints shall be coped or mitered, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fastened in place. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 BUILT-IN WORK

Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

3.5 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.6 FINISHES

3.6.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat

conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

3.6.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

3.6.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer.

3.7 ACCESS PANELS

Install a removable access panel not less than 12 by 12 inches directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

3.8 INSTALLATION OF GUARD POSTS (BOLLARDS/PIPE GUARDS)

Set pipe guards vertically in concrete piers. Construct piers of, and the hollow cores of the pipe filled with, concrete having a compressive strength of 3,000 psi.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 90 00.00 98

PAINTING AND COATING

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 DELIVERY, HANDLING AND STORAGE
1.4 CONTRACTOR PERSONNEL QUALIFICATION
1.5 WARRANTY

PART 2 PRODUCTS

2.1 GENERAL
2.2 EXTERIOR PRODUCTS
2.3 HIGH PERFORMANCE PRODUCTS
2.3.1 Submerged and Alternately Submerged Metal Coating Systems
2.3.2 Exposed Metal Coating Systems
2.3.3 Buried Metal Coating Systems
2.3.4 PVC, CPVC, and FRP Coating System
2.3.5 Coating Systems for Nonferrous Metals

PART 3 EXECUTION

3.1 GENERAL
3.2 PROTECTION
3.3 SURFACE PREPARATION
3.3.1 General Surface Preparation
3.3.2 Metal Surfaces
3.3.3 Sealing
3.4 MIXING AND APPLICATION
3.4.1 General
3.4.2 Procedures
3.4.3 Exterior Surfaces
3.5 SPOT-PAINTING
3.6 ACCEPTANCE PROVISIONS
3.6.1 Inspection
3.6.2 Cleanup
3.7 PAINT SCHEDULE
3.7.1 Exterior Paint Schedule

-- End of Section Table of Contents --

SECTION 09 90 00.00 98

PAINTING AND COATING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM D 2697	(2003; R 2008) Volume Nonvolatile Matter in Clear or Pigmented Coatings

MASTER PAINTERS INSTITUTE (MPI)

MPI 4	(Jan 2004) Interior/Exterior Latex Block Filler
MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer

NATIONAL ASSOCIATION OF PIPE FABRICATORS (NAPF)

NAPF 500-03-04	(2006) Abrasive Blast Cleaning for Ductile Iron Pipe

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning
SSPC SP 11	(1987; E 2004) Power Tool Cleaning to Bare Metal
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-P-21035	(1991; Rev B; Notice 2 2003) Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev C, 2008) Colors Used in Government Procurement
FS A-A-1500	Performance Alternates
FS TT-P-102	(Rev F) Paint, Oil, (Alkyd Modified, Exterior, Low VOC)
FS TT-P-664	(Rev D) Lacquer-Resisting L&C Free Alkyd Primer

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material Safety Data Sheets shall be submitted to the Contracting Officer.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items including designated name, formula or specification number, manufacturer's instructions and name of manufacturer. Data shall include detailed analysis of each coating material required, with constituents measured as percentages of the total weight of coating; and details of application, thinning, and average coverage per gallon.

Caulk/Sealer
Inhibitive Metal Primer
Latex Block Filler
Enamel

1.3 DELIVERY, HANDLING AND STORAGE

Materials shall be delivered in their original, unbroken containers bearing the manufacturer's name and product identification.

All paint materials, thinners, and cleaners shall be stored in tightly closed containers in a covered, well-ventilated area where they will not be exposed to excessive heat, sparks, flame, or direct sunlight. Water-based materials shall be protected against freezing.

Material Safety Data Sheets shall be submitted by the Contracting Officer.

1.4 CONTRACTOR PERSONNEL QUALIFICATION

Personnel assigned to the work shall be certified by the Contractor to have had adequate previous experience in the successful application of paints and coatings similar to those specified.

1.5 WARRANTY

Contractor shall guarantee all work against defects in labor and material for a period of one year.

PART 2 PRODUCTS

2.1 GENERAL

The following are suggested paint manufacturers and their products. Other paint manufacturers' products of equal quality will be considered when approved by the Contracting Officer. All thinners and cleaners shall be products of the coating manufacturer. Primer and finish coats of the paint system shall be products of the same manufacturer.

2.2 EXTERIOR PRODUCTS

	FEDERAL SPECIFICATION	PITTSBURGH	SHERWIN WILLIAMS	ICI / GLIDDEN
Caulk/Sealer	ASTM C 920	Chem Calk	Elastomeric	--
Latex Block Filler, MPI 4	FS A-A-1500	6-15	B25W25	4000
Enamel	FS TT-P-102	1-934	A-2	2518
Inhibitive Metal Primer, MPI 79	FS TT-P-664 FS TT-P-664	--	B50NN26 B50W21	4160

2.3 HIGH PERFORMANCE PRODUCTS

2.3.1 Submerged and Alternately Submerged Metal Coating Systems

System No. 1: Submerged and alternately submerged metal - raw water (nonpotable) or raw sewage with shop applied primer:

a. Type: hydrophobic aromatic polyurethane, 2-coat system.

b. Service Conditions: For use with metal pipes or structures alternately submerged in raw sewage or raw water (nonpotable) and exposed to a moist saturated hydrogen sulfide atmosphere, as in raw sewage wet wells. Minimum temperature resistance of the coating shall be 140 degrees F for moist heat conditions.

1. All ferrous metal surfaces inside of raw sewage wetwells and valve vaults.

c. Surface Preparation (Shop): Brush-off blast cleaning in accordance with NAPF 500-03-04 to a minimum surface profile of 1.5 mils.

d. Shop Prime: Apply Tnemec Series N69 Hi-Build Epoxoline II polyamidoamine epoxy at 4.0 to 6.0 mils dft.

e. Spot Prime: Pressure wash to remove all dirt grease and contamination. Power Tool clean all bare and damaged areas per SSPC SP 3. Featheredge to tightly adhered coating. Thoroughly abrade the entire surface before proceeding. All surfaces must be clean, dry and thoroughly abraded prior to the application of any coatings. Spot prime all bare areas with one coat of Tnemec Series 446 Perma-Shield

MCU hydrophobic aromatic polyurethane at 4.0 to 6.0 mils dft

f. Intermediate Coat: Apply Tnemec Series 446 Perma-Shield MCU hydrophobic aromatic polyurethane at 7.0 to 9.0 mils dft.

g. Finish Coat: Apply Enemec Series 446 Perma-Shield MCU hydrophobic aromatic polyurethane at 7.0 to 9.0 mils dft.

2.3.2 Exposed Metal Coating Systems

System No. 10: Exposed Metal, Corrosive Environment:

a. Type: High-build epoxy intermediate coat having a minimum volume solids of 84 percent, with an inorganic zinc prime coat and a pigmented polyurethane finish coat having a minimum volume solids of 73 percent.

b. Service Conditions: For use with metal structures or pipes subjected to water condensation, chemical fumes such as hydrogen sulfide, salt spray, and chemical contact.

c. Surface Preparation: Solvent clean in accordance with SSPC SP 1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP 10/NACE No. 2.

d. Prime Coat: Self-curing, two-component inorganic zinc-rich coating recommended by the manufacturer for overcoating with a high-build epoxy finish coat. Minimum zinc content shall be 12 pounds per gallon. Apply to a thickness of 3 mils. Products: Tnemec Series 90-97; Sherwin-Williams Zinc-Clad II Plus, or equal.

e. Intermediate Coat: Tnemec Series 135; Sherwin-Williams Macropoxy 646 B58-600/B58V600 or equal. Film thickness 5.0 to 8.0 mils/coat. Minimum solids by volume should be 84 percent.

f. Finish Coat: Two-component pigmented acrylic or aliphatic polyurethane, recommended by the manufacturer for overcoating a high-build epoxy coating. Apply to a thickness of at least 3 mils. Products: Tnemec Series 740 Sherwin-Williams Hi-Solids Polyurethane B65-300 Series/B60V30; or equal

System No. 18: Exposed Metal Organic Zinc Primer for Shop Coating and Field Touch-Up:

a. Type: Organic zinc primer having a minimum zinc content of 14 pounds per gallon.

b. Service Conditions: For use as a shop-applied primer or field touch-up primer over inorganic zinc prime coatings on exposed metal

c. Surface Preparation: Solvent clean in accordance with SSPC SP 1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP 10/NACE No. 2.

d. Coating: Coating shall be of the two- or three-component converted epoxy, epoxy phenolic, or urethane type. Products: Tnemec 90-97; Sherwin-Williams Zinc-Clad III HS B69A100/B69D11/B69D11; or equal. Applied to a minimum dry-film thickness of 3 mils. Organic zinc primer shall be manufactured by the prime coat manufacturer.

2.3.3 Buried Metal Coating Systems

System No. 21: Buried Metal:

a. Type: High solids Cycloaliphatic Amine epoxy or phenolic epoxy having minimum volume solids of 80 percent (ASTM D 2697).

b. Service Conditions: Buried metal, such as valves, flanges, bolts, nuts, structural steel, and fittings.

c. Surface Preparation: Solvent clean in accordance with SSPC SP 1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP 10/NACE No. 2.

d. Coating System: Apply three or more coats of Tnemec 104 HS (6.0 to 8.0 mils per coat); Sherwin-Williams Tank Clad HS B62-80 Series/B60V80 Series at 5.0 to 8.0 mils/coat; or equal; 30 mils total. Maximum thickness of an individual coating shall not exceed the manufacturer's recommendation.

System No. 24: Buried Metal:

a. Type: Corrosion-resisting grease.

b. Service Conditions: Buried metal, such as bolts, bolt threads, tie rods, and nuts.

c. Surface Preparation: Solvent clean in accordance with SSPC SP 1 to remove contaminants from the surface. Power Tool Clean in accordance with SSPC SP 3 as a minimum. Abrasive blasting in accordance with SSPC SP 6/NACE No.3 is preferred.

d. Coating: NO-OX-ID GG-2 as manufactured by Sanchem, Inc. Apply to a minimum thickness of 1/4-inch.

2.3.4 PVC, CPVC, and FRP Coating System

System No. 41: PVC, CPVC, and FRP, Ultraviolet Exposure or Color Coding:

a. Type: Epoxy primer with minimum volume solids of 54 percent and a pigmented polyurethane enamel having a minimum volume solids of 73 percent.

b. Service Conditions: PVC or CPVC or FRP exposed to sunlight.

c. Surface Preparation: Clean the surface in accordance with SSPC SP 1. Then, lightly abrade the surface with medium-grain sandpaper.

d. Prime Coat: One coat of Tnemec Series N69 Epoxoline; Sherwin-Williams Macropoxy 646 B58 Series/B58V600; or equal. Apply to a minimum dry-film thickness of 4 mils.

e. Finish Coat: One coat of Tnemec Series 740; Sherwin-Williams Hi-Solids Polyurethane B65-300 Series/B60V30; or equal. Apply to a dry-film thickness of 3 to 5 mils.

2.3.5 Coating Systems for Nonferrous Metals

System No. 51: Insulate Aluminum (Insulation) from Concrete and Carbon

Steel:

Type: Bituminous paint having a minimum volume solids of 68 percent coal-tar pitch based.

b. Service Conditions: Coat areas of aluminum grating, stairs, structural members or aluminum fabrications, in contact with concrete or carbon steel with this system.

c. Surface Preparation: Solvent or steam clean in accordance with SSPC SP 1; do not use alkali cleaning. Then dust blast. Option to hand or power scarify.

d. Finish Coat: Tnemec 46-465; or equal. Apply two coats to a minimum dry-film thickness of 8.0 to 12.0 mils per coat.

System No. 55: Repair of Galvanized Steel Surfaces:

a. Type: Cold galvanizing compound consisting of paint containing oils, solvents, and zinc dust and complying with MIL-P-21035. Minimum metallic zinc content in the cured coating shall be 90 percent.

b. Service Conditions: Repair of damaged galvanized coatings on steel surfaces.

c. Surface Preparation: Clean damaged surfaces in accordance with SSPC SP 1 and SSPC SP 11.

d. Coating System: Apply Z.R.C. Galvanizing Compound; RAMCO Specialty Products "Zinckit"; NuWave "Galv-Match-Plus"; Devcon "Cold Galvanizing"; Clearco "Cold Galvanizing Spray"; or equal; to a minimum dry-film thickness of 3 mils. Apply as specified in ASTM A780/A780M, Annex A2.

PART 3 EXECUTION

3.1 GENERAL

Manufacturer's recommendations for surface preparation, thinning, mixing, handling, and applying his product shall be considered a part of this specification. In case of conflict between the manufacturer's recommendations and the requirements of this specification, the latter shall take precedence.

3.2 PROTECTION

Contractor shall remove and reinstall, or provide acceptable protection for, all hardware, accessories, electrical components, factory-finished materials, and any other materials that may become splattered or damaged by the painting work. "WET PAINT" signs shall be posted to indicate newly painted surfaces.

Every precaution shall be taken to prevent damage to adjacent buildings, shrubs and motor vehicles. Roping, barricading or covering to preclude damage to personal and real property during surface preparation and painting shall be the Contractor's responsibility. When spray painting, the Contractor must give 24 hours advance warning, coordinated with the Contracting Officer or his representative, and post signs to ensure parking arrangements can be made. Repairs to damaged surfaces shall be effected at

no additional cost to the Government.

3.3 SURFACE PREPARATION

3.3.1 General Surface Preparation

All surfaces shall be clean, dry, and free from contaminants and foreign matter. Mildew and chalking shall be removed and the surface thoroughly sterilized. All chipped, peeling, or blistered paint shall be removed and the surface spot-primed. Hard, glossy surfaces shall be dulled and roughened to ensure proper adhesion.

3.3.2 Metal Surfaces

All heavy rust and loose mill scale shall be removed from steel in accordance with SSPC SP 3, Power Tool Cleaning.

Minor aluminum oxide film and corrosion shall be removed by hand or power tool cleaning.

Previously unpainted galvanized and aluminum surfaces shall be treated with wash primer in accordance with manufacturer's instructions.

3.3.3 Sealing

All cracks, crevices, and joints such as those along the perimeter of windows and doors shall be sealed with a paintable latex type caulking conforming to ASTM C 920.

3.4 MIXING AND APPLICATION

3.4.1 General

All painting shall be accomplished in accordance with the painting schedule.

No exterior painting shall be allowed in rainy weather or when rain is imminent. No paints or coatings shall be applied when the temperature or humidity is outside the limits recommended by the manufacturer.

Paints and coatings shall be applied by brush, roller, or airless spray.

Each coat of material applied shall be free from runs, sags, bubbles, and foreign contaminants; variations in color, gloss and texture; dry overspray, brush, and roller marks; holidays (missed areas); or other evidence of poor application.

All paints and coatings shall be thoroughly worked into corners and crevices.

Paints and coatings shall be neatly "cut-in" around doors, windows, ceilings, etc.

All newly painted surfaces shall be adequately protected from damage.

3.4.2 Procedures

Coatings shall be applied as follows:

a. Material shall be thoroughly stirred to produce a uniform mixture.

b. Material shall be thinned for workability and improved spray characteristics, but only according to the manufacturer's instructions.

c. Each coat shall be applied uniformly at the minimum wet-film thickness specified by the manufacturer.

d. Special attention shall be given when coating sharp edges, corners, and crevices to ensure complete coverage.

e. Finish coats shall show good hiding characteristics and uniform appearance.

3.4.3 Exterior Surfaces

Metal surfaces shall be primed with alkyd primer in accordance with manufacturer's instructions, and topcoated with two coats enamel in accordance with manufacturer's instructions.

Paint shall be allowed to dry overnight before re-coating.

3.5 SPOT-PAINTING

Spot-painting to correct damaged surfaces will be allowed only when touchup area blends into the surrounding finish. Otherwise, the entire area shall be recoated. Touchup shall be accomplished using the same method of application as was used to apply the original material.

3.6 ACCEPTANCE PROVISIONS

3.6.1 Inspection

Contractor shall provide for inspection of his work to ensure that the requirements of this section have been fulfilled.

3.6.2 Cleanup

Contractor shall be responsible for removal of all paint or coating splatter and spills from floors, adjacent walls, hardware, and all other finished surfaces.

Contractor shall leave the work area clean and free from all rubbish and accumulated material left from his work.

3.7 PAINT SCHEDULE

3.7.1 Exterior Paint Schedule

Colors shall be in accordance with FED-STD-595.

SURFACE	PRIMER	FINISH COAT	FINISH COLOR AND SHEEN
Exterior masonry (rough/ porous)	Latex block filler	Acrylic emulsion latex	Gray - flat

SURFACE	PRIMER	FINISH COAT	FINISH COLOR AND SHEEN
Exterior metal	Exterior metal primer	Enamel	Gray - semi-gloss

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 97 24

CONCRETE REPAIR AND HYDROGEN SULFIDE PROTECTIVE COATING

PART 1 GENERAL

1.1 SCOPE OF WORK
1.2 RELATED WORK
1.3 REFERENCES
1.4 SUBMITTALS
1.5 SHOP DRAWINGS
1.6 QUALIFICATIONS
1.7 DELIVERY, STORAGE, AND HANDLING
1.8 SITE CONDITIONS
1.8.1 Weather Constraints
1.9 WARRANTIES
1.10 PATENTS AND LICENSES

PART 2 PRODUCTS

2.1 MATERIALS
2.1.1 Products - Sauereisen
2.1.1.1 Cementitious Resurfacer/Underlayment
2.1.1.2 Protective (Corrosion Resistant) Epoxy Lining
2.1.1.3 Epoxy Protective Lining Sealer Coat
2.1.2 Products - Tnemec
2.1.2.1 Option 1
2.1.2.2 Option 2

PART 3 EXECUTION

3.1 INSTALLATION
3.2 INSPECTION
3.3 SURFACE PREPARATION
3.3.1 New Concrete Surfaces on New Structures
3.3.2 Existing Concrete Surfaces
3.3.3 Metal Surfaces
3.3.4 Removal of Surface Preparation Material(s)
3.4 APPLICATION
3.5 FIELD QUALITY CONTROL
3.5.1 Inspections
3.5.2 High Voltage Spark Testing

-- End of Section Table of Contents --

SECTION 09 97 24

CONCRETE REPAIR AND HYDROGEN SULFIDE PROTECTIVE COATING

PART 1 GENERAL

1.1 SCOPE OF WORK

Furnish all labor, materials, equipment, and incidentals required to install and test, complete, and ready for operation, the repair and protective coating/lining of existing and new concrete structure(s) as specified herein and as shown on the drawings, including existing manholes, new manholes, existing lift stations/wet wells, and new lift stations/wet wells.

Provide all labor, materials, equipment, and incidentals required:

a. To meet all of the OSHA requirements for performing work in a confined space.

b. To provide positive ventilation in the confined space.

c. To provide all bypass pumping to perform the required work.

d. To provide all wastewater flow control(s) and diversion(s) to properly isolate the work area(s).

Concrete repair or concrete preparation work of 1/2 inch depth or less shall be the subsidiary/ancillary obligation of the Contractor and no additional payment shall be made for this work.

A National Association of Corrosion Engineers (NACE) certified inspector is required to observe the application and the testing of the protective epoxy lining coats, provide daily reports, and certify that the protective epoxy lining coats were applied in accordance with the manufacturer's recommendations. The NACE inspector shall be appropriate certified in the inspection of the application and testing of coatings.

1.2 RELATED WORK

Concrete work is included under Division 3.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 308R (2001; R 2008) Guide to Curing Concrete

ASTM INTERNATIONAL (ASTM)

ASTM D 4787 (2008) Standard Practice for Continuity Verification of Liquid or Sheet Linings

Applied to Concrete Substrates

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 03732	(1997) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
ICRI CSP 5	(1997) Concrete Surface Profile 65-70 mils
ICRI CSP 6	(1997) Concrete Surface Profile 70-75 mils
ICRI CSP 8	(1997) Concrete Surface Profile 80-85 mils

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning
SSPC SP 5/NACE No. 1	(2007) White Metal Blast Cleaning
SSPC VIS 1	(2002) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Certified Shop Drawings; G

SD-03 Product Data

Product Data; G

SD-06 Test Reports

High Voltage Spark Testing; G

SD-07 Certificates

NACE Certification; G

SD-08 Manufacturer's Instructions

Non-conforming aspects; G

1.5 SHOP DRAWINGS

Submit certified shop drawings showing all important details of concrete repair and protective coating installation.

Submit product data including descriptive literature, bulletins, and/or

catalogs of the protective coating and concrete repair materials and cleaning procedures.

1.6 QUALIFICATIONS

Furnish all of the protective coating material specified herein from a single manufacturer who regularly engages in the production of this type of hydrogen sulfide protective coating material who is fully experienced, reputable, and qualified in the manufacture of the coating to be furnished. If resurfacing greater than 1/2 inch in depth is required, a different manufacturer may be used for these deep concrete repairs. Ensure that material furnished under this specification is new and unused, of the type, components, and efficiency installed on previous projects and the product of a manufacturer having a successful record of operation, manufacturing and service for a minimum of 5 years before bid date. The manufacturer shall supply the Contracting officer with previous installation details including references with current phone numbers for a minimum of 10 previous projects which used the specified protective coating/lining system(s).

The protective coating manufacturer shall instruct the protective coating manufacturer applicator or the Contractor in the proper procedures in applying the protective coatings. The Contractor shall guarantee that the prepared surfaces to be coated and the application of the protective coating are suitable for the purpose intended and free from defects of material and workmanship. The protective coating manufacturer shall provide a certification to the Contracting Officer that the surfaces were properly prepared and properly coated.

The protective coating shall be Tnemec Series 218 MortarClad/Tnemec Series 434 Perma-Shield/Tnemec Series 435 Tnemec-Glaze by Tnemec Company, Sauereisen series F-120 or 121/210T or RS/210G by Sauereisen Inc., or approved equal.

If it is impossible to conform to certain details of the specifications due to different manufacturer's products, describe all non-conforming aspects and the reason for non-conformance.

1.7 DELIVERY, STORAGE, AND HANDLING

Properly protect all materials so that no damage or deterioration occurs during a prolonged delay from the time of shipment until installation is completed.

Properly protect all materials, equipment, and parts against any damage during a prolonged period at the site.

Properly mark each box or package to show its net weight in addition to its contents.

1.8 SITE CONDITIONS

1.8.1 Weather Constraints

Maintain substrate temperatures and air temperature before, during, and after installation in accordance with the protective coating manufacturer's written recommendations and instructions. Protect areas to be coated from the elements of direct weather (sunlight, rain, wind, etc.) and inclement weather during the application and curing period of the coatings.

Provide adequate ventilation during application and curing periods.

1.9 WARRANTIES

Warranties shall be in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS. Additionally, the protective coating manufacturer shall warranty its products as free from material defects for a minimum period of one year.

The Contractor shall warranty the installed protective coating/lining system as free from material and workmanship.

1.10 PATENTS AND LICENSES

The Contractor is responsible for all patents or licenses that exist on the materials that are provided.

The Contractor and manufacturer shall assume all costs of patent fees or licenses for the materials or process and shall safeguard and save harmless the Government from all damages, judgments, claims, and expenses arising from license fees or claimed infringement of any letters, patent or patent rights, or fees for the use of any equipment or process structural feature or arrangement of any of the component parts of the installation and the price bid shall be deemed to include payment of all such patent fees, licenses, or other costs pertaining thereto.

PART 2 PRODUCTS

2.1 MATERIALS

The protective lining system shall be a multi-component protective lining system, including:

a. Concrete restoration where required with epoxy or cementitious resurfacing/underlayment materials as specified herein and in accordance with protective coating/lining manufacturer's recommendations.

b. A basecoat of trowelable or sprayable aggregate filled epoxy lining at 125 mils dry film thickness (dft) for corrosion and abrasion resistance against the physical and chemical attack phenomena typically associated with municipal wastewater service conditions.

c. Epoxy sealer coat at 15 to 20 mils dft to provide a smooth and sealed finished surface profile.

d. Applicator or Contractor shall provide all accessory components of the system such as infiltration control products or other compounds as recommended by the protective coating manufacturer for maximum protective lining adherence to substrate and long-term service performance.

e. Cure and prepare all cementitious materials in accordance with ACI 308R.

2.1.1 Products - Sauereisen

2.1.1.1 Cementitious Resurfacer/Underlayment

Sauereisen F-120 Underlayment or F-121 Substrate Resurfacer. Minimum thickness - 1/8 inch.

Where existing concrete has been damaged to depth of 1/2 to 2 inches, apply the cementitious resurfacer/underlayment in accordance with the manufacturer's instructions and requirements.

2.1.1.2 Protective (Corrosion Resistant) Epoxy Lining

Sauereisen SewerGard No. 210T or 210RS. Minimum applied thickness (dry film) 120 mils.

Epoxy lining shall be an aggregate-filled, trowel- or spray-applied epoxy polymer protective lining material specifically designed to protect concrete and steel surfaces of wastewater structures subjected to municipal wastewater service conditions, including associated abrasive physical attack and chemical attack mechanisms related to hydrogen sulfide and organic acids generated by microbial sources.

2.1.1.3 Epoxy Protective Lining Sealer Coat

Sealer coat - SewerGard No. 210 Glaze. Minimum applied dft 15 mils.

The unfilled epoxy sealer coat at 15 to 20 dft mils is required to enhance corrosion and abrasion resistance and reduce permeability.

2.1.2 Products - Tnemec

Use Option 1 or Option 2 depending on the condition of the concrete after abrasive blasting. The Contracting Officer will determine where each option will be installed.

2.1.2.1 Option 1

For concrete surfacing from a depth of 1/2 to 2 inches use the following:

Cementitious Resurfacer

a. Sika 123 Substrate Resurfacer, Xypex Mega-Mix II, or other as approved by Tnemec. Minimum thickness - 1/2 inch.

b. Where existing concrete has been damaged to a depth of 1/2 to 2 inches, apply and cure the cementitious resurfacer/underlayment in accordance with the manufacturer's instructions and requirements. This product can be applied to bare, abrasive-blasted rebar. Following proper curing of the resurfacer, abrasive blast to minimum ICRI CSP 5.

c. Apply one coat of Tnemec Series 1 Omnithane at 3.0 to 4.0 mils dft.

2.1.2.2 Option 2

For concrete surfacing for a depth of up to 1/2 inch use the following:

1. Cementitious Mortar Surfacer

   a. Tnemec Series 218 MortarClad Mortar. Minimum thickness - 1/8 to 1/4 inch. Maximum thickness - 1/2 inch.

   b. To be used directly to the existing concrete if surfacing of less than 1/2 inch is required. May also be required if the surface preparation of the Sika 123 or resurfacer used exceeds ICRI CSP 8.

2. Protective (Corrosion Resistant) Epoxy Lining

   a. Tnemec Series 434 Perma-Shield. Minimum applied dft 125 mils.

   b. Epoxy lining shall be an aggregate-filled, trowel- or spray-applied epoxy polymer protective lining material specifically designed to protect concrete and steel surfaces of wastewater structures subjected to municipal wastewater service conditions, including associated abrasive physical attack and chemical attack mechanisms related to hydrogen sulfide and organic acids generated by microbial sources.

3. Epoxy Protective Lining Sealer Coat

   a. Tnemec Series 435 Perma-Glaze. Minimum applied dft 15 mils.

   b. The unfilled epoxy sealer coat at 15 to 20 dft mils required to enhance corrosion and abrasion resistance and reduce permeability.

PART 3 EXECUTION

3.1 INSTALLATION

Install the protective coating in strict accordance with the manufacturer's instructions and recommendations. Preparation of the existing concrete surfaces for the application of the protective coatings shall also meet the protective coating/lining manufacturer's requirements. Remove and properly dispose of all sand or abrasive material used in the sandblasting operation from the wet well structure. None of this material or any other coating-related material shall enter the treatment facility.

3.2 INSPECTION

High-pressure clean and wash as necessary the areas to be coated as required for observation by the Contracting Officer to determine the concrete area that is going to require concrete repair of a depth of 1/2 to 2 inches in depth. This observation shall also determine areas of concrete repair and/or rebar repair that will exceed 2 inches in depth. Schedule the inspection of the cleaned areas at least 7 days in advance. Provide all equipment necessary for the Contracting Officer to safely enter into the manhole/wet well during this inspection(s). Provide proper ventilation, sufficient lighting, protective gear, safety equipment, etc. as required to enter the interior of the manhole/wet well.

Upon the determination of the damaged concrete areas requiring repair, locate (on the asbuilt drawings) and measure in the presence of the Contracting Officer. The agreed-to quantities shall be the basis for the Contractor's applicable unit cost payment. Repair these areas as

required. Should the damaged area become more extensive than originally determined (i.e. to a depth of more than 2 inches), the Contractor and the Government shall agree to the cost for this additional work before proceeding. No additional repair work shall be paid for unless the Government agrees to the cost before the pair being started.

Do not proceed with the final two protective coatings until concrete surface preparation has been completed and unsatisfactory concrete surface conditions have been corrected in a manner acceptable to the Contracting Officer and the coating manufacturer/supplier.

Provide a National Association of Corrosion Engineers (NACE) certified coatings inspector to observe the application and testing of the protective epoxy lining coats, provide daily reports, and certify that the protective epoxy lining coats were applied in accordance with the manufacturer's recommendations. Ensure that the NACE inspector is appropriately certified in the inspection of the application and testing of coatings.

3.3 SURFACE PREPARATION

3.3.1 New Concrete Surfaces on New Structures

Cast concrete surfaces on new concrete structures (freshly poured) to receive protective coating with rough form finish. Do not rub, trowel, or otherwise finish surfaces in any manner that will obscure or cover the firm substrate surface. Complete all subsequent surface washing, abrasive blasting, grinding, patching, filling, and preparation in accordance with the protective coating manufacturer's recommendations.

Allow new concrete (freshly poured concrete) to cure for 28 days before protective lining system is installed unless otherwise recommended by the protective coating manufacturer. Ensure that concrete surfaces to be coated are free of curing compounds and form release agents, laitance and foreign particles that may inhibit bonding. Before starting protective coating systems application, vacuum blast, hydroblast, or abrasive blast surfaces to be covered as required and inspect the substrate. Start of application operations shall indicate acceptance of substrate conditions and full responsibility for the completed work. Ensure that surface preparation procedures are in accordance with ICRI 03732 or comparably approved method. Surface preparation requirement is to expose aggregate and obtain a uniform surface texture resembling an ICRI CSP 5 to ICRI CSP 6 comparators.

Level or grind all concrete substrates to protective coating manufacturer's recommended tolerances to produce a uniform surface profile, including removal of all sharp edges, ridges, or depressions.

New concrete application: Fill new concrete voids and depressions with resurfacer/underlayment material, re-establishing plan finished grades and surface profiles.

3.3.2 Existing Concrete Surfaces

Ensure that existing concrete structures to receive protective lining system are capable of withstanding imposed loads. Remove all oil, grease, and chemical contaminants from the surface of the concrete. Ensure that all surfaces are firm, free of damaged or contaminated concrete, laitance, form release agents, and standing water and are structurally sound as determined by the Contracting Officer. Suitable surface preparation

methods include shot blasting, abrasive blasting, or hydroblasting. Surface preparation procedures shall be in accordance with ICRI 03732. Surface preparation requirements is to expose aggregate and obtain a uniform surface texture resembling an ICRI CSP 5 to ICRI CSP 6 comparators.

Open all voids and bugholes in the concrete (via abrasion, sandblasting, grinding, etc.) to the degree that coating can completely fill these voids and no off-gassing occurs after the coatings are applied and allowed to dry.

3.3.3 Metal Surfaces

Metal application: Remove all visible oils and grease in accordance with SSPC SP 1, section 2.1. Remove contaminants from surface in accordance with SSPC SP 1, section 3.2. Using CHLOR*RID INTERNATIONAL "CHLOR*TEST" test kits, or approved equivalent method, determine level of chlorides on the metal surfaces. Level of acceptable chlorides shall be no more than 3 micro-g/cm^2 for immersion and no more than 5 micro-g/cm^2 for atmospheric conditions. Surfaces with unacceptable levels must be washed with CHLOR*RID, or approved equal, in accordance with the protective coating manufacturer's recommendations and then retested.

Using SSPC VIS 1 as a guide, abrasive blast to a SSPC SP 5/NACE No. 1 for immersion and a SSPC SP 10/NACE No. 2 for other service conditions. An anchor profile range of 2.5 to 3.0 mil is preferable. Ensure that all welds are continuous, free of flux, and have a smooth rounded radius without any sharp edges or are ground flat and free of flux, fins, and spatter.

Consult protective coating manufacturer for primer recommendations on metal.

3.3.4 Removal of Surface Preparation Material(s)

Remove all surface preparation materials including, but not limited to, sand, sot, abrasive materials, degreasers, etc. as well as removed materials (concrete particulates, metal filings, damaged materials, rusted metal, etc.) from the work site and properly dispose of offsite. Do not allow any of the surface preparation material(s) or removed materials to enter the treatment plant process.

3.4 APPLICATION

Install protective coating systems when ambient air and surface temperatures are between 60 and 85 degrees F. Store coating materials within the 60 to 85 degrees F range for 48 hours before use. Application and storage temperatures outside this range will require written instruction and approval from the protective coating manufacturer. Ensure that moisture content is in accordance with manufacturer's requirements.

Application in direct sunlight and/or with rising surface temperatures is not recommended as this may result in blistering outgassing of the materials due to expansion of entrapped air or moisture (outgassing) in the concrete. In such cases, postponement will be necessary until later in the day when the temperature of the substrate is falling. Concrete surfaces that have been in direct sunlight must be shaded for at least 24 hours before application and remain shaded until the initial set has taken place. Consult protective coating manufacturer for application schedule guidelines specific to temperature conditions and possible sealer application recommendations to reduce/eliminate outgassing.

Substrate repairs: Ensure that all substrate repairs required by the Contracting Officer or as specified in the contract documents are in accordance with the recommendations and requirements of the protective coating manufacturer. Written approval by the protective coating manufacturer is required for all substrate repairs before applying the coatings. Concrete substrate repair shall consist of removing all damaged or defective concrete to a depth of 1/8 inch into sound concrete in all directions from the damaged area(s). Ensure that no rebar, expansion joints, embedments, or other items are damaged during this process. The Contracting Officer shall agree that sound concrete has been reached. Properly repair any damaged items at no cost to the Government.

Should the repair area include an area around any existing exposed rebar, sandblast off all rust on the rebar. If the rebar has been damaged, contact the Contracting officer to determine if rebar replacement is required.

Apply and cure protective epoxy lining and epoxy protective lining sealer coat on the properly prepared surface(s) in accordance with protective coating system manufacturer's written guidelines and as specified herein. It is very important that the substrate (floors, walls, ceilings, etc.) to be coated are properly prepared with all laitance and contaminants removed and kept dry during application and cure.

Form and fill expansion and construction joints as recommended by the protective coating manufacturer.

3.5 FIELD QUALITY CONTROL

3.5.1 Inspections

Provide the resume of the NACE certified inspector who will observe the application and testing of the protective epoxy lining coats. In addition, provide a copy of the inspector's NACE certification with the resume.

3.5.2 High Voltage Spark Testing

Test installed protective epoxy lining in the presence of the Contracting officer and a NACE inspector for pinholes after a minimum 24-hour cure at a temperature of 70 degrees F. Before the park testing, determine and certify that the dft of the epoxy coatings is the same as recommended by the coating supplier. Accomplish pinhole testing in accordance with ASTM D 4787 using a Tinker Razor Holiday Detector, San Gabriel, CA, Model AP/W, or an approved equal device. Apply a test voltage of 100 volts/mil of coating thickness. Mark and repair all pinholes using manufacturer's approved patch kit or other approved method in accordance with written recommendations from the protective coating manufacturer. Repair other areas damaged by the spark testing as recommended by the protective coating manufacturer/supplier at no additional cost to the Government.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 REFERENCES
1.2 DEFINITIONS
1.3 ADDITIONAL SUBMITTALS INFORMATION
1.3.1 Shop Drawings (SD-02)
1.3.2 Product Data (SD-03)
1.4 QUALITY ASSURANCE
1.4.1 Regulatory Requirements
1.4.2 Standard Products
1.4.2.1 Alternative Qualifications
1.4.2.2 Material and Equipment Manufacturing Date
1.5 WARRANTY
1.6 POSTED OPERATING INSTRUCTIONS
1.7 MANUFACTURER'S NAMEPLATE
1.8 WARNING SIGNS
1.9 ELECTRICAL REQUIREMENTS
1.10 INSTRUCTION TO GOVERNMENT PERSONNEL

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING
3.2 WARNING SIGN MOUNTING

-- End of Section Table of Contents --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z535.4	(2007) Product Safety Signs and Labels

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; TIA 2007-1; TIA 2007-2; TIA 2007-3; TIA 2007-4; TIA 2007-5; Errata 2006-1; Errata 2007-2; Errata 2009-3) National Electrical Safety Code
IEEE C57.12.28	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE Std 100	(2000) The Authoritative Dictionary of IEEE Standards Terms

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011) National Electrical Code
NFPA 70E	(2009; Errata 09-1) Standard for Electrical Safety in the Workplace

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.3 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.3.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.3.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.4 QUALITY ASSURANCE

1.4.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.4.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render

satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.7 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.8 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 400 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

b. Provide arc flash warning labels for all electrical equipment in accordance with the provisions of the most recent edition of NFPA 70E. Appearance and format of arc flash warning labels shall conform to ANSI Z535.4. At a minimum arc flash warning labels shall include the following information: working distance; flash protection boundary; incident energy; and appropriate personal

protective equipment (PPE) level respective to Arc Flash/Shock categories 1-4..

1.9 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.10 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00.00 98 PAINTING AND COATINGING.

3.2 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 05 00.00 40

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 REFERENCES
1.2 DEFINITIONS
1.3 SUBMITTALS
1.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS
1.5 PREVENTION OF CORROSION
1.6 GENERAL REQUIREMENTS
1.7 POSTED OPERATING INSTRUCTIONS
1.8 MANUFACTURER'S NAMEPLATE
1.9 FIELD FABRICATED NAMEPLATES
1.10 WARNING SIGNS

PART 2 PRODUCTS

2.1 MATERIALS
2.1.1 Rigid Steel Conduit
2.1.2 Electrical Metallic Tubing (EMT)
2.1.3 Rigid Nonmetallic Conduit
2.2 WIRE AND CABLE
2.3 SPLICES AND CONNECTORS
2.4 SWITCHES
2.4.1 Safety Switches
2.5 RECEPTACLES
2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES
2.7 CIRCUIT BREAKERS

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS
3.1.1 Rigid Steel Conduit
3.1.2 Electrical Metallic Tubing (EMT)
3.1.3 Rigid Nonmetallic Conduit
3.1.4 Surface Raceways and Assemblies
3.2 WIRING
3.3 SAFETY SWITCHES
3.4 WIRING DEVICES
3.4.1 Device Plates
3.5 BOXES AND FITTINGS
3.6 IDENTIFICATION PLATES AND WARNINGS
3.7 PAINTING
3.8 FIELD TESTING

-- End of Section Table of Contents --

SECTION 26 05 00.00 40

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C57.12.28	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI Z535.1	(2006) American National Standard for Safety--Color Code
ANSI/NEMA FB 1	(2007) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
ANSI/NEMA OS 2	(2008) Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA KS 1	(2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA RN 1	(2005) Standard for Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2003) Standard for Electrical Polyvinyl

	Chloride (PVC) Conduit
NEMA TC 3	(2004) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA WD 6	(2002; R 2008) Wiring Devices Dimensions Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 489	(2009) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 6	(2007) Standard for Electrical Rigid Metal Conduit-Steel
UL 797	(2007) Electrical Metallic Tubing -- Steel

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Conduits, Raceways and Fittings; G

Wire and Cable; G

Splices and Connectors; G

Switches; G

Receptacles

Outlets, Outlet Boxes, and Pull Boxes; G

Circuit Breakers; G

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Conduits, Raceways and Fittings; G

Wire and Cable; G

Splices and Connectors

Switches

Receptacles

Outlets, Outlet Boxes, and Pull Boxes

Circuit Breakers

Spare Parts

Certification

Submittal for vertical assemblies will be reviewed by a licensed Mechanical, Civil or Structural Engineer to determine that the entire assembly will withstand 135 mph wind loading.

SD-06 Test Reports

Continuity Test

Phase-Rotation Tests

Insulation Resistance Test

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions.

1.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

1.5 PREVENTION OF CORROSION

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action). Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by approved fittings and treatment. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous spare parts not of

corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

1.6 GENERAL REQUIREMENTS

Submit manufacturer's instructions including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

Submit certification required to install equipment components and system packages.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and be secured to prevent easy removal or peeling.

1.8 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.9 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.10 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including pad-mounted transformers, pad-mounted switches, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

PART 2 PRODUCTS

2.1 MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

2.1.1 Rigid Steel Conduit

Rigid steel conduit shall comply with UL 6 and be galvanized by the hot-dip process. Rigid steel conduit shall be polyvinylchloride (PVC) coated in accordance with NEMA RN 1, where underground and in corrosive areas.

Ensure that all hardware and accessories including, but not limited to, couplings, hubs, conduit bodies, straps, hangars and boxes, and elbows are PVC-coated in accordance with NEMA RN 1.

Ensure that all conduit and fittings have an exterior PVC coating with a minimum thickness of 40 mils and an interior PVC coating with a minimum thickness of 2 mils. All hardware and accessories shall have an exterior PVC coating with a minimum thickness of 20 mils.

Fittings for rigid steel conduit shall be threaded.

Gaskets shall be solid. Conduit fittings with blank covers shall have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and be accessible after the work has been completed.

2.1.2 Electrical Metallic Tubing (EMT)

EMT shall be in accordance with UL 797 and be zinc coated steel. Couplings and connectors shall be zinc-coated, raintight, gland compression with insulation throat. Crimp, spring, or setscrew type fittings are not acceptable.

2.1.3 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall comply with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40.

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type THWN. All conductors AWG No. 8 and larger, shall be stranded. All conductors smaller than AWG No. 8 shall be stranded.

Flexible cable shall be Type SO and contain a grounding conductor with green insulation.

2.3 SPLICES AND CONNECTORS

Make all splices in AWG No. 8 and smaller with approved insulated electrical type.

Make all splices in AWG No. 6 and larger with bolted clamp-type connectors. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

2.4 SWITCHES

2.4.1 Safety Switches

Safety switches shall comply with NEMA KS 1, and be the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated. Switch construction shall be such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and be so constructed that an external tool shall be used to open the cover. Make provisions to lock the handle in the "OFF" position, but the switch shall not be capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type. Approve terminal lugs for use with copper conductors.

Safety color coding for identification of safety switches shall conform to ANSI Z535.1.

2.5 RECEPTACLES

Receptacles shall be commercial grade, 20A, 125 VAC, 2-pole, 3-wire duplex conforming to NEMA WD 6, NEMA 5-20R.

2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES

Outlet boxes for use with conduit systems shall be in accordance with ANSI/NEMA FB 1 and ANSI/NEMA OS 2 and be not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.7 CIRCUIT BREAKERS

Circuit-breaker interrupting rating shall be not less than those indicated and in no event less than 10,000 amperes root-mean-square (rms) symmetrical at 208 volts and 22,000 amperes rms symmetrical at 480 volts, respectively. Multipole circuit breakers shall be the common-trip type with a single handle. Molded case circuit breakers shall be bolt-on type conforming to UL 489.

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or be replaced.

Conduit and raceway runs concealed in or behind walls, above ceilings, or exposed on walls and ceilings 5 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

3.1.1 Rigid Steel Conduit

Follow manufacturer's recommended installation practices for installing PVC-coated rigid galvanized steel conduit. Use tools specifically designed for PVC-coated conduit during the installation process including, but not limited to, clamping, cutting, threading, bending, and assembly of conduit.

Touch up damaged coating according to manufacturer's instructions using manufacturer's approved touchup compound.

Where the conduit is field threaded, apply electrically conductive, corrosion resistance compound to the threads in accordance with NFPA 70 NEC 300.6 A.

Make field-made bends and offsets with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

Provide all conduit stubbed-up through concrete floors or slabs for connections to free-standing equipment with a flush coupling. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

All outdoor conduits shall be PVC-coated rigid galvanized steel unless otherwise noted.

3.1.2 Electrical Metallic Tubing (EMT)

EMT shall be grounded in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

3.1.3 Rigid Nonmetallic Conduit

Rigid PVC conduit may be used for underground conduits where conduits do not extend into lift station wetwells.

Rigid PVC conduit shall be direct buried.

A green insulated copper grounding conductor shall be in conduit with conductors and be solidly connected to ground at each end. Grounding wires shall be sized in accordance with NFPA 70.

3.1.4 Surface Raceways and Assemblies

Surface raceways shall be mounted plumb and level, with the base and cover secured. Minimum circuit run shall be three-wire with one wire designated as ground.

3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

CONDUCTOR	COLOR AC
Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral	White
Equipment Grounds	Green

Conductors up to and including AWG No. 2 shall be manufactured with colored insulating materials. Conductors larger than AWG No. 2 shall have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the NFPA 70. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match as indicated.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation.

3.3 SAFETY SWITCHES

Securely fasten switches to the supporting structure or wall, utilizing a minimum of four 1/4 inch bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible location or where the passageway to the switch may become obstructed. Mounting height shall be 5 feet above floor level, when possible.

3.4 WIRING DEVICES

3.4.1 Device Plates

Device plates for switches that are not within sight of the loads controlled shall be suitably engraved with a description of the loads.

Device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets shall be suitably marked, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Required marking shall consist of a self-adhesive label having 1/4 inch embossed letters.

Device plates for convenience outlets shall be similarly marked indicating the supply panel and circuit number.

3.5 BOXES AND FITTINGS

Furnish and install pullboxes where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

3.6 IDENTIFICATION PLATES AND WARNINGS

Furnish and install identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Process control devices and pilot lights shall have identification plates.

Furnish identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. Circuits 480 volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

3.7 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted as specified in Section 09 90 00.00 98 PAINTS AND COATINGS.

3.8 FIELD TESTING

Submit Test Reports in accordance with referenced standards in this section.

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Contractor shall provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to isolate the circuits under test.

Perform insulation-resistance test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes 8AWG and smaller insulation resistance testing is not required.

Perform continuity test to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to

end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs shall be approved by the CO prior to acceptance of the repair.

Conduct phase-rotation tests on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment clockwise, facing the source.

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the CO.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 05 71.00 40

LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 GENERAL REQUIREMENTS

PART 2 PRODUCTS

2.1 MOTOR CONTROL
2.1.1 Magnetic Motor Controllers
2.1.1.1 Full-Voltage Controllers
2.1.2 Combination Motor Controllers
2.1.2.1 Nonreversing Combination Motor Controllers
2.2 ENCLOSURES
2.2.1 Equipment Enclosures
2.3 CIRCUIT BREAKERS
2.3.1 Molded-Case Circuit Breakers
2.3.2 Enclosed Molded-Case Circuit Breakers
2.4 FUSES

PART 3 EXECUTION

3.1 INSTALLATION
3.2 FIELD TESTING

-- End of Section Table of Contents --

SECTION 26 05 71.00 40

LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 877	(2002; R 2007) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.13	(2008) Standard Requirements for Instrument Transformers

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	(2008) Electric Meters Code for Electricity Metering
NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
NEMA AB 3	(2006) Molded Case Circuit Breakers and Their Application
NEMA FU 1	(2002; R 2007) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; Add/Errata 2000; Errata 2006; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2001; R 2006) Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 489	(2009) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 508	(1999; R thru 2008) Industrial Control Equipment

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit Connection Diagrams and Fabrication Drawings for the following items in accordance with paragraph entitled, "General Requirements," of this section.

Submit Installation drawings for the following items in accordance with the paragraph entitled, "Installation," of this section.

Control Devices
Protective Devices

SD-03 Product Data

Submit manufacturer's equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

Motor Control
Enclosures
Circuit Breakers
Control Devices

SD-08 Manufacturer's Instructions

Submit manufacturer's instructions for the following items, including special provisions required to install equipment components and system packages. Provide detail on resistance impedances, hazards and safety precautions within the special notices.

Control Devices
Protective Devices

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for the following equipment:

Magnetic Motor Controllers
Combination Motor Controllers
Circuit Breakers

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Connection Diagrams showing the relations and connections of control devices and protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit Fabrication Drawings for control devices and protective devices consisting of fabrication and assembly details to be performed in the factory.

PART 2 PRODUCTS

2.1 MOTOR CONTROL

Conform to NEMA ICS 1, NEMA ICS 2, and UL 508 for motor controllers. Provide controllers that have thermal overload protection in each phase.

2.1.1 Magnetic Motor Controllers

2.1.1.1 Full-Voltage Controllers

Provide full-voltage, full magnetic devices in accordance with NEMA ICS 1, NEMA ICS 2, and UL 508for magnetic motor controllers for the control and protection of single- and three-phase, 60-hertz, squirrel-cage induction motors.

Provide operating coil assembly that operates satisfactorily between 85 and 110 percent of rated coil voltage. Provide 120 volts, 60 hertz motor control circuits.

Provide controller with two normally open and two normally closed auxiliary contacts rated per NEMA ICS 1 and NEMA ICS 2 in addition to the sealing-in contact for control circuits.

Provide solderless pressure wire terminal connectors for line-and load-connections to controllers.

Provide solid state overload (SSOL) relays with the following features:

a. Phase loss protection; trips within 3 seconds.

b. Phase unbalance protection.

c. Ground fault trip when selected.

d. Selectable trip class 5, 10, 20, or 30.

e. Reset trip with selected Auto/Manual.

f. Dip switch selectable with the following features:
   i. Set Phase Unbalanced ON or OFF
   ii. Set Phase Loss ON or OFF
   iii. Set Reset to Manual or Automatic
   iv. Set Ground Fault ON or OFF.

g. Overload shall be self-powered with no need for external power source.

Provide an externally operable manual-reset button to re-establish control power to the holding coil of the electromagnet. After the controller has tripped from overload, ensure that resetting the motor-overload device does not restart the motor.

2.1.2 Combination Motor Controllers

Following requirements are in addition to the requirements specified for magnetic motor controller:

Provide combination motor controllers for the control and protection of single-and three-phase 60-hertz alternating-current squirrel-cage induction motors with branch-circuit disconnecting and protective devices in accordance with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

For combination motor controllers include magnetic motor controllers and molded-case circuit breakers or MCP in metal enclosures in accordance with NEMA 250 or motor-control center draw-out assemblies with control-power transformers, selector switches, pushbuttons, and indicating lights as follows:

Provide full-voltage, full-magnetic devices as specified in this section under paragraph entitled, "Remote-Control Station Enclosures." for magnetic motor controllers and enclosures.

Provide thermal-magnetic breakers as specified in paragraph entitled, "Manual Motor Controllers."for molded-case circuit breakers. Manufacturer's standard MCP may be used in lieu of molded-case circuit breakers.

Provide control-power transformers 120-volt ac maximum, selector switches, pushbuttons, and pilot lights as required.

Identify combination motor controllers with identification plates affixed to front cover of the controller.

2.1.2.1 Nonreversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For nonreversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors, include a magnetic controller with molded-case circuit breaker or MCP with selector switch or start/stop pushbutton and indicating light in the cover of the enclosure.

Provide rating of three-phase single-speed full-voltage magnetic controllers for nonplugging and nonjogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide wiring and connections for full-voltage single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

2.2 ENCLOSURES

2.2.1 Equipment Enclosures

Provide enclosures for equipment in accordance with NEMA 250.

Contain equipment installed in wet locations in a NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosure, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 for Type 4 enclosures.

2.3 CIRCUIT BREAKERS

Provide circuit breakers that conform to UL 489, NEMA AB 1, and NEMA AB 3.

2.3.1 Molded-Case Circuit Breakers

Provide molded case, manually operated, trip-free, circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Completely enclose circuit breakers in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.

Locate thermal-magnetic tripping elements in each pole of the circuit breaker, and provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. Provide instantaneous magnetic tripping element, that is adjustable and accessible from the front of the breaker on frame sizes larger than 100 amperes.

Size breaker as required for the continuous current rating of the circuit. Provide breaker class as required.

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers, to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities with a minimum of 10,000 amperes and that conform to NEMA AB 3.

Provide the common-trip type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of 104 degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

Provide phenolic composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

Provide circuit breakers used for meter circuit disconnects that meet the applicable requirements of NFPA 70 and that are of the motor-circuit protector type.

For circuit breakers used for service disconnection, provide an enclosed circuit-breaker type with external handle for manual operation. Provide sheet metal enclosures with a hinged cover suitable for surface mounting.

2.3.2 Enclosed Molded-Case Circuit Breakers

For enclosed circuit breakers, provide thermal-magnetic molded-case circuit breakers in surface-mounted, nonventilated enclosures conforming to the appropriate articles of NEMA 250 and NEMA AB 1.

Provide enclosed circuit breakers in nonhazardous locations as follows:

Contain circuit breakers installed in wet locations, in NEMA Type 4, watertight corrosion-resistant sheet steel enclosures constructed to prevent entrance of water.

2.4 FUSES

Provide a complete set of fuses for all switches and switchgear. Rate fuses that have a voltage rating of not less than the circuit voltage.

Make no change in continuous-current rating, interrupting rating, and clearing or melting time of fuses unless written permission has first been secured.

Provide nonrenewable cartridge type fuses for ratings 30 amperes, 125 volts or less. Provide renewable cartridge type fuses for ratings above 30 amperes 600 volts or less with time-delay dual elements, except where otherwise indicated. Conform to NEMA FU 1 for fuses.

Install special fuses such as extra-high interrupting-capacity fuses, fuses for welding machines, and capacitor fuses where required. Plug fuses are not permitted.

Label fuses showing UL class, interrupting rating, and time-delay characteristics, when applicable. Additionally, clearly list fuse information on equipment drawings.

Provide porcelain fuse holders when field-mounted in a cabinet or box. Do not use fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber for field installation.

PART 3 EXECUTION

3.1 INSTALLATION

Install Control devices and protective devices that are not factory installed in equipment, in accordance with the manufacturer's recommendations and field adjusted and operation tested. Conform to NFPA 70, NEMA ICS 1 and NEMA ICS 2 requirements for installation of control and protective devices.

3.2 FIELD TESTING

Demonstrate to operate as indicated control and protective devices not factory installed in equipment.

Ratio and verify tap settings of instrumentation, potential, and current transformers.

Perform dielectric tests on insulating oil in oil circuit breakers before the breakers are energized. Test oil in accordance with ASTM D 877, and provide breakdown voltage that is not less than 25,000 volts. Provide

manufacturer certification that the oil contains no PCB's, and affix a label to that effect on each breaker tank and on each oil drum containing the insulating oil.

Field adjust reduced-voltage starting devices to obtain optimum operating conditions. Provide test meters and instrument transformers that conform to ANSI C12.1 and IEEE C57.13.

Do not energize control and protective devices until recorded test data has been approved. Provide final test reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 24 16.00 40

PANELBOARDS

PART 1 GENERAL

1.1 REFERENCES
1.2 GENERAL REQUIREMENTS
1.3 SUBMITTALS
1.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

PART 2 PRODUCTS

2.1 PANELBOARDS
2.2 CIRCUIT BREAKERS
2.3 DIRECTORY CARD AND HOLDER
2.4 FACTORY TESTING
2.5 PRECAUTIONARY LABEL

PART 3 EXECUTION

3.1 INSTALLATION
3.2 SITE TESTING

-- End of Section Table of Contents --

SECTION 26 24 16.00 40

PANELBOARDS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z535.4	(2007) Product Safety Signs and Labels

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	(2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
NEMA PB 1	(2006) Panelboards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011) National Electrical Code

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev C, 2008) Colors Used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 67	(2009) Standard for Panelboards

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Detail Drawings for the panelboards consisting of fabrication and assembly drawings for all parts of the work in sufficient detail to enable the Government to check conformity with the requirements of the contract documents. Include within drawings details of bus layout.

Ensure Outline Drawings for panelboards indicate overall physical features,

dimensions, ratings, service requirements, and weights of equipment.

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meet specified requirements. Statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address.

1.3 SUBMITTALS:

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit Detail Drawings for panelboards in accordance with paragraph entitled, "General Requirements," of this section.

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Circuit Breakers; G

Panelboards; G

Directory Card and Holder

SD-06 Test Reports

Submit test reports for the following tests in accordance with the paragraph entitled, "Site Testing," of this section. Do not energize panelboards until the recorded test data has been submitted to and approved by the Contracting Officer.

Continuity Tests

Insulation Tests

SD-07 Certificates

Submit Statements in accordance with paragraph entitled, "General Requirements," of this section.

SD-08 Manufacturer's Instructions

Submit manufacturer's instructions for Panelboards including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

1.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment

and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

PART 2 PRODUCTS

2.1 PANELBOARDS

Main-distribution panelboards (MDPs) shall be service entrance rated. Totally enclose MDPs and lighting and appliance branch-circuit panelboards in a steel cabinet, dead-front circuit breaker type with copper buses, surface- or flush-mounted as indicated. Ensure panelboards conform to NEMA PB 1 and NEMA AB 1. Branch circuit panels shall have buses fabricated for bolt-on type circuit breakers.

An outer door or cover, hinged on one side for door-on-door construction, shall be provided on flush and surface-mounted panelboards to provide gutter space access. Provide a center door for circuit breaker/switch access only.

Voltage and current rating, number of phases, and number of wires shall be as indicated. Provide four-wire distribution panelboards and lighting and appliance branch-circuit panelboards with an isolated full-capacity neutral bus. Ensure panelboards are rated for 120/208-volt, three-phase or 277/480-volt, three-phase, 60-hertz current.

Provide three-phase, 4-wire and single-phase, 3-wire distribution lighting and branch circuit panelboards with an isolated full-capacity bus providing spaces for single-pole circuit breakers/switches and spaces indicated as spare.

Provide panelboards with a separate grounding bus bonded to the enclosure. Grounding bus shall be a solid bus bar of rectangular cross section equipped with binding screws for the connection of equipment grounding conductors.

Each panelboard, as a complete unit, shall have a short-circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or as indicated.

Ensure panelboards and main lugs or main breaker have current ratings as shown on the panelboard schedule.

Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type. Single-phase, three-wire panelboard busing shall be such that when any two adjacent single-pole breakers are connected to opposite phases, two-pole breakers can be installed in any location. Three-phase, four-wire busing shall be such that when any three adjacent single-pole breakers are individually connected to each of the three different phases, two- or three-pole breakers can be installed at any location. Current-carrying parts of the bus assembly shall be plated. Mains ratings shall be as shown.

Mechanical lugs furnished with panelboards shall be cast copper or copper alloys of sizes suitable for the conductors indicated to be connected thereto.

Boxes shall have the manufacturer's standard knockouts and shall be galvanized code-gage sheet steel. Fronts shall be of code-gage sheet steel furnished with hinged doors with adjustable trim clamps for securing the fronts to the boxes.

Panelboard box shall be galvanized code-gage sheet steel without knockouts. Ensure entire panelboard front is hinged on one side with a piano hinge for the full height and has captive screws opposite the hinged side. Where panelboards are installed flush with the walls, the installation details shall be such that the hinged front can be opened without damage to the adjacent wall surfaces. Ensure that the color of the finished coat of trim and front matches the adjacent walls except when the box is installed in electrical closets or equipment rooms, the gray finish as specified is acceptable.

Panelboard enclosures shall be NEMA 250, Type 1. Provide enclosures with hinged fronts and corrosion-resistant steel pin-tumbler cylinder locks. Key locks alike and provide two keys for each enclosure.

Finish panelboards with baked enamel. Finish color is to be No. 61 gray conforming to FED-STD-595.

2.2 CIRCUIT BREAKERS

Circuit breakers shall be the molded-case type as specified in Section 26 05 71.00 40 OVERCORRECT PROTECTIVE DEVICES AND COORDINATION STUDY. Frame and trip ratings shall be as indicated. SPD units shall be part of the panelboard components built into the panelboard for flush-mounted panels. See Section 26 43 00.00 99 SURGE PROTECTIVE DEVICES for additional requirements.

Interrupting rating of circuit breakers shall be as indicated. If not shown, the interrupting rating for circuit breakers in 120/208-volt panelboards shall be not less than 10,000 amperes rms symmetrical, and that for breakers in 277/480-volt panelboards shall be not less than 22,000 amperes rms symmetrical.

Circuit breakers shall be bolt-on type. Plug-in type is not acceptable.

Provide shunt trips where indicated.

In branch circuit panelboards, branch circuit breakers feeding convenience outlets shall have sensitive instantaneous trip settings of not more than 10 times the trip rating of the breaker to prevent repeated arcing shorts resulting from frayed appliance cords. Single-pole 15- and 20-ampere circuit breakers shall be UL listed as "Switching Breakers" at 120 volts ac and 277 volts ac. Provide UL Class A (5-milliampere sensitivity) ground fault circuit protection on 120-volt ac branch circuit as indicated. This protection is an integral part of the branch circuit breaker that also provides overload and short-circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption is not to disturb the feeder circuit to the panelboard. A single-pole circuit breaker with integral ground fault circuit interruption requires no more panelboard branch circuit space than a conventional single pole circuit breaker.

Ensure connections to the bus are bolt-on type.

When multiple wires per phase are specified, furnish the circuit breakers

with connectors made to accommodate multiple wires.

Ensure circuit breaker spaces called out on the drawings are complete with mounting hardware to permit ready installation of the circuit breakers.

2.3 DIRECTORY CARD AND HOLDER

Mount a directory card on the inside of hinged fronts and doors 0.030-inch thick minimum plastic in a metal frame, with spaces for circuit numbers, outlets controlled, and room numbers. Where hinged fronts or doors are not required, provide the directory card 0.030-inch thick minimum plastic in a metal frame mounted on the left-hand side of the front trim. Directory card shall identify each branch circuit with its respective and numbered circuit breaker.

2.4 FACTORY TESTING

Test complete panelboards in accordance with UL 67.

2.5 PRECAUTIONARY LABEL

To ensure persons are aware of immediate or potential hazard in the application, installation, use, or maintenance of panelboards, each panelboard shall be conspicuously marked on the trim or dead front shield with the text (or equivalent) **DANGER** symbol. If the panel is supplied with a door, ensure the label is visible when the door is in the open position. provide arc flash warning signs for all electrical equipment in accordance with the provisions of NFPA 70. Appearance and format of arc flash warning signs shall conform to ANSI Z535.4.

PART 3 EXECUTION

3.1 INSTALLATION

Install panelboards as indicated and in accordance with the manufacturer's instructions. Fully align and mount panels so that the height of the top operating handle does not exceed 72-inches above the finished floor.

Directory-card information shall be typewritten in capital letters to indicate outlets controlled and final room numbers served by each circuit and shall be mounted in holders behind protective covering.

3.2 SITE TESTING

Submit test reports in accordance with referenced standards in this section.

Each panelboard enclosure key shall be shown to operate the enclosure locks in the presence of the Contracting Officer.

Panelboards shall be given continuity and insulation tests after the installation has been completed and before the panelboard is energized.

Provide test equipment, labor, and personnel as required to perform the tests as specified. Conduct Continuity tests using a dc device with bell.

Conduct insulation tests on 480-volt panelboards using a 1,000-volt insulation-resistance test set. Record readings every minute until three equal and consecutive readings have been obtained. Resistance between phase conductors and between phase conductors and ground shall be not less

than 50 megohms.

Conduct insulation tests on panelboards rated 300 volts or less using a 500-volt minimum insulation-resistance test set. Record readings after 1 minute and until the reading is constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Record test data and include the location and identification of panelboards and megohm readings versus time.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 43 00.00 99

SURGE PROTECTIVE DEVICE (SPD)

PART 1 GENERAL

1.1 REFERENCES
1.2 GENERAL REQUIREMENTS
1.3 SUBMITTALS

PART 2 PRODUCTS

2.1 SURGE PROTECTIVE DEVICE (SPD) COMPONENTS
2.1.1 REQUIRED SUPPRESSOR LOCATIONS
2.1.2 LEVEL "I"
2.1.3 LEVEL "II"
2.1.4 LEVEL "III"
2.2 DOCUMENTATION

PART 3 EXECUTION

3.1 INSTALLATION
3.2 SPDs

-- End of Section Table of Contents --

SECTION 26 43 00.00 99

SURGE PROTECTIVE DEVICE (SPD)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

UNDERWRITERS LABORATORIES (UL)

UL 1449	(2006) Transient Voltage Surge Suppressors

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20, BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Surge Protective Device (SPD) Components; G
UL Documentation

PART 2 PRODUCTS

2.1 SURGE PROTECTIVE DEVICE (SPD) COMPONENTS

All SPDs shall be manufactured by a company engaged in the design, development, and manufacture of such devices for electrical and electronics systems equipment. The said firm shall offer a five-year warranty.

The surge protective manufacturer shall offer technical assistance through support by a factory representative and local stocking distributor or local direct factory distribution warehouse and coordinate with the panelboard manufacturer for installation into the panelboards.

Suppressors shall be listed in accordance with UL 1449. Protective modes shall be as follows: Wye = L-N, L-G, N-G; Delta = L-G, L-L.

Suppressors shall be tested with Category C3 high exposure waveform (20KV, 10 KA, 9/200 usec. waveform) per IEEE C62.41.

Surge protective devices shall be installed in all new panelboards installed flush in walls and surface-mounted in shop and mechanical spaces in accordance with requirements of all National Fire Protection Association (NFPA) codes.

Provide Level One, Level Two or Level Three SPDs where indicated. SPD shall have seven(7) mode protection for 3-phase, wye configuration and four (4) mode protection for 3-phase delta configurations. SPD shall be an integral part of the panel and mounted directly to the bus. SPD provided for new switchgear shall be an integral part of the switchgear and mounted in the auxiliary compartment, dead-front design and front accessible.

SPD shall be installed internal to the new equipment being protected. The mounting position of the SPD shall permit a straight and short lead length connection between the SPD and the point of connection to the equipment. The interconnecting leads between the SPD and the point of connection to the bus should be kept as short as possible, 0.5 m (20 in) or less, and should be twisted to minimize lead reactances. Bends should be avoided if possible. Provide overcurrent protection as recommended by the SPD manufacturer.

All SPD units shall be equipped with an audible alarm which shall actuate when any one of the surge current modules has failed. An alarm on/off switch shall be provided to silence the alarm and an alarm push-to-test switch shall be provided to test the alarm. Both switches and audible alarm shall be located on the front cover of the panelboard.

2.1.1 REQUIRED SUPPRESSOR LOCATIONS

In service entrance panelboards.

In distribution and branch circuit panels as indicated on the drawings.

2.1.2 LEVEL "I"

SPD shall meet or exceed the following criteria.

1) Maximum single impulse current rating: 100,000 amperes per mode(8X20 usec current waveform).

2) Pulse life rating (IEEE C62.41-1991, Table 4, Category C3 transient): 1000 occurrences min./mode, based on the highest voltage mode of the device. (20KV/10KA - 8X20usec/1.2X50usec waveform)

Suppression Voltage Ratings (SVR): The maximum UL 1449, Second Edition SVR for the device should not exceed the following:

Nominal Voltage	Configuration	L-N	N-G	L-G	L-L
120/240	Grd. Neutral	400	400	400	700
120/208	Grd. Wye	400	400	400	700
277/480	Grd. Wye	800	800	800	1500
240	Delta			700	700
480	Delta			1500	1500

2.1.3 LEVEL "II"

SPD shall meet or exceed the following criteria.

1) Maximum single impulse current rating: 50,000 amperes per mode (8x20 usec current waveform).

2) Pulse life rating (IEEE C62.41-1991, Table 4, Category C3 transient): 1000 occurrences minimum per mode, based on the highest voltage mode of the device. (6KV/3KA - 8X20usec/1.2X50usec waveform)

Suppression Voltage Ratings (SVR): The maximum UL 1449, Second Edition SVR for the device should not exceed the following:

Nominal Voltage	Configuration	L-N	N-G	L-G	L-L
120/240	Grd. Neutral	400	400	400	700
120/208	Grd. Wye	400	400	400	700
277/480	Grd. Wye	800	800	800	1500
240	Delta			700	700
480	Delta			1500	1500

2.1.4 LEVEL "III"

Suppressors shall be listed in accordance with UL 1449.

For 3 phase, 4-wire configurations, suppressors shall provide suppression elements between each phase conductor and the system neutral, between each phase conductor and the system ground, and between the neutral conductor and ground, for a total of seven suppression modes.

Visible indication of proper suppressor connection and operation shall be provided.

Suppressors shall be designed for a straight and short lead length connection between the suppressor and the point of connection to the panelboard. Other suppressor connections will not be acceptable.

Suppressors shall meet or exceed the following criteria:

1. Maximum single impulse current rating: 80,000 amperes per phase (8/20 usec. waveform).

Note: If the suppressor utilizes internal fuses, the maximum single impulse current cannot exceed the rating of the fuse.

2. Pulse life rating: Category C (8/20 usec. waveform): 2,000 occurrences, with no clamping drift.

3. UL Clamping voltage shall not exceed the following:

Voltage	L-N	N-G	L-G
120/208	400	400	400

Suppressors shall have turn-on and turn-off times of less than one nanosecond.

Suppressors shall be of the solid-state componentry and shall operate

bidirectionally.

2.2 DOCUMENTATION

Submit UL Documentation verifying listing for UL 1449 sections 34, 35,36, 37, 38, 39, 40.

PART 3 EXECUTION

3.1 INSTALLATION

Arresters and SPD units shall be installed and connected in accordance with the manufacturer's installation instructions.

Ground connection shall be made to a driven ground rod, counterpoise, or station grounding system.

Lightning arresters shall be connected as close as practicable to the apparatus being protected.

3.2 SPDs

Install the proper "level" of suppressor at each switchboard/panelboard as indicated on the power one-line diagram and panelboard schedules.

Suppressor shall be installed in the equipment to be protected, per the manufacturer's installation instructions.

Conductors between suppressor and point of attachment to the panelboard shall be kept as short and straight as possible.

Suppressor's ground shall be bonded to the service entrance ground or point of ground for the respective panelboard.

Include the costs for the manufacturer's certified representative to inspect and approve the installation upon completion of the project.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 60 13.00 40

LOW-VOLTAGE MOTORS

PART 1 GENERAL

1.1 REFERENCES
1.2 GENERAL REQUIREMENTS
1.3 SUBMITTALS
1.4 DESIGN REQUIREMENTS

PART 2 PRODUCTS

2.1 EQUIPMENT
2.1.1 Efficiency
2.2 MOTOR TYPES
2.3 SIZES OF MOTORS
2.3.1 Motors
2.3.2 Electrically Driven Equipment
2.4 VOLTAGE RATINGS
2.5 TEMPERATURE RATING AND INSULATION
2.6 MOTOR HOUSINGS
2.7 MOTOR ENCLOSURES
2.8 SERVICE FACTOR
2.9 FACTORY TESTS

PART 3 EXECUTION

3.1 INSTALLATION
3.2 ALIGNMENT
3.3 ELECTRICAL TESTS
3.4 VIBRATION TESTS
3.4.1 Vibration Analyzer
3.4.2 Vibration Data

-- End of Section Table of Contents --

SECTION 26 60 13.00 40

LOW-VOLTAGE MOTORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	(1990; R 1999) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9	(1990; R 2008) Load Ratings and Fatigue Life for Ball Bearings

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 112	(2004) Standard Test Procedure for Polyphase Induction Motors and Generators

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ACCEPT	(2003) The NETA Acceptance Testing Specifications
NETA MAINT	(2005) Maintenance Testing Specifications for Electric Power Distribution Equipment and Systems

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1940-1	(2003; Cor 2005) Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2009) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011) National Electrical Code

U.S. DEPARTMENT OF ENERGY (DOE)

DOE CI-1	(2001) How to Buy a Premium Energy-Efficient Electric Motor

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Outline drawings for Motors shall indicate overall physical features, dimensions, ratings, service requirements, and weights of equipment.

SD-03 Product Data

Equipment and performance data shall be submitted for Motors consisting of use life, system functional flows, safety features, and mechanical automated details. Curves indicating tested and certified equipment response and performance characteristics shall also be submitted.

Submit Manufacturer's Catalog Data in accordance with paragraph entitled, "Equipment," of this section

For Electric Motors rated over 7.5 and those specified to meet a special vibration class in accordance with NEMA MG 1 indicate number of:

Rotor Bars
Stator Slots
Rotational Speed
Cooling Fan Blades
Bearing Manufacturer
Bearing Style
Bearing Type
Balls/Elements
Commutator Bars
Commutator Brushes
SCR Firing Frequencies (for variable speed motors)

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted for Motors including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

1.4 DESIGN REQUIREMENTS

The following motor design data shall be provided prior to final turnover-number of motor rotor bars, Stator slots, rotational speed; number of cooling fan blades; RPM of motor; bearing manufacturer, bearing type, bearing style and number of balls/elements; number of commutator bars and commutator brushes; and SCR firing frequencies.

PART 2 PRODUCTS

2.1 EQUIPMENT

Submit manufacturer's catalog data for motors and enclosures.

Design, fabrication, testing, and performance of motors shall be in accordance with NEMA MG 1 and ISO 1940-1 and shall meet or exceed the requirements as specified herein.

Testing and performance of polyphase induction motors shall be in accordance with IEEE 112, Method B.

Efficiency labeling shall be in accordance with NEMA MG 1.

Allowable balance limits shall be in accordance with ISO 1940-1, Table 1

2.1.1 Efficiency

Motors shall have efficiencies in accordance with the recommended levels specified in DOE CI-1.

2.2 MOTOR TYPES

Motor shall be marked to show the index letter, which shall be the letter shown or a letter that indicates a higher efficiency.

Motors shall be of the following types:

1/3 HP and smaller, single phase - capacitor start

1/2 HP and larger, three-phase - induction squirrel-cage type, NEMA Design B, having normal starting torque and low starting current

Motors shall be designed for across-the-line starting and shall be designed with torque characteristics to carry the specified rated starting load.

Motors shall have factory-sealed ball bearings with an L-10 rated life of not less than 30,000 hours in accordance with ABMA 9 or ABMA 11.

2.3 SIZES OF MOTORS

2.3.1 Motors

Motors shall be of a sufficient size for the duty to be performed and shall not exceed the full-load rating when the driven equipment is operating at specified capacity under the most severe loading conditions.

2.3.2 Electrically Driven Equipment

When electrically driven equipment differs from that indicated, adjustments shall be made to the motor size, wiring and conduit systems, disconnect devices, and circuit protection to accommodate the equipment actually installed, at no additional cost to the Government. Control and protective devices shall be in accordance with Section 26 05 71.00 40.00 40 LOW-VOLTAGE OVERCURRECT PROTECTIVE DEVICES.

2.4 VOLTAGE RATINGS

Motors shall have the following minimum voltage ratings:

MOTOR TYPE	MOTOR SIZE HORSEPOWER	SERVICE	MOTOR VOLTAGE RATING
Fractional horsepower, single-phase	1/3 and smaller	120/208-volt, 3-phase, 4-wire	115-volt, 60-hertz
Fractional and integral horsepower, 3-phase	1/2 and larger	120/208-volt, 3-phase, 4-wire	200-volt, 3-phase 60-hertz
Fractional and integral horsepower, 3-phase	1/2 and larger	480-volt, 3-phase, 3-wire	230/460-volt, 3-phase, 60-hertz

2.5 TEMPERATURE RATING AND INSULATION

Motors shall be designed for continuous operation at the rated full load in an ambient temperature of 104 degrees F.

Insulation level shall be at least Class B.

2.6 MOTOR HOUSINGS

The motor housing shall have a smooth surface in the vertical, horizontal, and axial directions at each bearing housing for attaching a magnet mounted accelerometer in order to monitor the motor vibration. The surface shall be on the bearing housing. The axial surface will be as close to the motor centerline as possible. The surface will have a finish of 63 micro-inch minimum. Diameter of finished surface shall be 2 inch minimum and must be corrosion resistant. As an option sound disks can be used to meet the smooth surface requirement. Disk shall have a minimum thickness of 3/8 inch.

Surface shall be level within 1 degree or .001 inch.

The smooth surface shall be identified(using a label or plate) "Vibration data collection point - Do Not Paint"

2.7 MOTOR ENCLOSURES

Motors installed in outdoor, nonhazardous locations shall have waterproof enclosures.

Motors installed in hazardous locations for Classification I, Division 1 or Division 2 shall meet or exceed the minimum requirements of NFPA 70, Article 501.8. Type of enclosure shall be approved by the Contracting Officer prior to fabrication for the class and group of hazard in which the motors are located.

Motors with weatherproof/waterproof enclosures shall have permanent accelerometers installed in the horizontal, vertical, and axial directions. The enclosure shall have a penetration installed to enable the

accelerometer cables to be routed to outside the enclosure. A data collection box shall be mounted to the outside of the motor enclosure in a location that is easily accessible. Data collection box shall be rated NEMA 4R.

2.8 SERVICE FACTOR

Service factor of general purpose and other open ac motors shall be in accordance with NEMA MG 1.

Totally enclosed ac motors shall have a service factor of 1.15.

2.9 FACTORY TESTS

Factory test all motors in accordance with the requirements of NEMA MG 1. Polyphase induction motors shall be factory-tested in accordance with IEEE 112, Method B. Tests shall consist of measurements of voltage, frequency, speed, and current under no-load conditions; voltage, frequency, and current under locked-rotor conditions; and efficiency, noise, power factor, and thermal protection. Routine tests on wound-rotor induction motors shall include the measurement of wound-rotor open-circuit voltage across the slip rings under locked-rotor conditions. Electrical tests shall consist of winding resistance, insulation resistance, and high-potential tests.

PART 3 EXECUTION

3.1 INSTALLATION

Motors shall be installed, aligned, and connected in accordance with the equipment manufacturer's instructions.

Motors shall be bolt mounted. Motor feet shall be coplanar within 0.001 inch. Base mounting points shall be accessible and adjustable to enable machine alignment. Motors over 7.5 hp shall have alignment jack bolts installed to enable alignment.

Alignment of motors shall be rechecked and adjusted as required after the motor has been in operation for not less than 48 hours.

3.2 ALIGNMENT

Before attempting alignment, the contractor will demonstrate that the load does not have any load/force imposed by the piping system. Minimum alignment values (below) are for motor and load at normal running temperatures. Values must be compensated for thermal growth. Limited movement of the motor or load (commonly known as bolt-bound) must be corrected to ensure alignment capability. Hold down bolts shall not be undercut in order to perform adjustment.

Shims shall be commercially die-cut, without seams or folds, and be made of corrosion resistant stainless steel. No more than four shims shall be used at any single point.

Motor and load shall be aligned to the following minimum specifications:

Speed(RPM)	Close-Coupled Offset (mils)	Close-Coupled Angle(mils/in.)	Spool Piece Angle (mils/in. @ coupling pt.)
600	6.0	2.0	3.0
900	5.0	1.5	2.0
1200	4.0	1.0	1.5
1800	3.0	0.5	1.0
3600	1.5	0.4	0.5
7200	1.0	0.3	0.4

Motor/load alignment shall be performed under the direction of the manufacturer's representative.

Final alignment settings shall be provided as part of the final test data.

3.3 ELECTRICAL TESTS

Perform continuity test on all phases.

Perform insulation resistance and polarization index test on each phase of motor. Insulation tests on 480-volt and 600-volt motors shall be conducted using a 1000-volt insulation test set. Insulation tests on motors rated less than 480-volts shall be conducted using 500-volt insulation test set.

Test data shall include the location and identification of motors and megohm readings versus time. Test data shall be recorded at 15, 30, 45 seconds, and in 1 minute increments thereafter up to 10 minutes. Megohm readings shall not be less than 25 megohms for each phase and each phase reading shall be within 10 percent of the other two.

Perform inspections and test procedures on all motors in accordance with NETA ACCEPT and NETA MAINT 7.15.1 for rotating machinery, AC motors.

Calculate the polarization index of each phase by dividing the 10 minute reading by the 1 minute reading. The polarization index shall be greater than 1.25. Any values lower shall be rejected and the motor returned to the factory.

3.4 VIBRATION TESTS

3.4.1 Vibration Analyzer

Contractor shall use an Fast Fourier Transformer (FFT) analyzer to measure vibration levels. It shall have the following characteristics: A dynamic range greater than 70 dB; a minimum of 400 line resolution; a frequency response range of 5 Hz-10 KHz(300-600000 cpm); the capacity to perform ensemble averaging, the capability to use a Hanning window; auto-ranging frequency amplitude; a minimum amplitude accuracy over the selected frequency range of plus or minus 20 percent or plus or minus 1.5 dB.

An accelerometer, either stud-mounted or mounted using a rare earth, low mass magnet and sound disk(or finished surface) shall be used with the FFT analyzer to collect data. The mass of the accelerometer and its mounting shall have minimal influence on the frequency response of the system over the selected measurement range.

3.4.2 Vibration Data

Vibration data shall be collected in the axial, vertical, and horizontal

direction for each motor bearing.

Two narrowband spectra for each data collection point shall be obtained in the following manner: For all machines regardless of operating speed, a 5 to 500 Hz spectrum with a minimum of 400 lines of resolution shall be obtained. An additional spectrum of 5 to 2500 or 5 to 5000 Hz shall be acquired for machines operating at or below 1800 RPM or greater than 1800 RPM, respectively.

Vibration limits shall conform to the following:

Frequency Range(CPM)	Vibration limit(inch/sec)
0.3xRPM to 0.8xRPM	0.04
0.8xRPM to 1.2xRPM	0.75
1.2xRPM to 3.5xRPM	0.04
3.5xRPM to 120,000cpm	0.03

Final test reports shall be provided to the Contracting Officer. Reports shall have a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 27 - COMMUNICATIONS

SECTION 27 13 23.00 40

COMMUNICATIONS OPTICAL BACKBONE CABLING

PART 1 GENERAL

1.1 REFERENCES
1.2 GENERAL REQUIREMENTS
1.3 SUBMITTALS
1.4 QUALITY ASSURANCE PLAN
1.4.1 Fiber Optic System
1.4.2 Fiber Optic Cable Installer and Splicer Qualifications
1.4.3 Fiber Optic Field Tests Plan
1.5 DELIVERY, STORAGE, AND HANDLING
1.6 RELATED REQUIREMENTS

PART 2 PRODUCTS

2.1 FIBER OPTIC CABLE DESIGN
2.1.1 Fiber Optic Media Types
2.1.1.1 Multi-Mode Fiber Media
2.1.1.2 Single-Mode Fiber Media
2.1.2 Cable Length
2.1.3 Materials and Construction
2.1.3.1 Central Core Member
2.1.3.2 Optical Fibers
2.1.3.3 Fiber Primary Protective Coating
2.1.3.4 Optical Fiber Color-Code Coating
2.1.3.5 Loose Tube Buffering
2.1.3.6 Colorants
2.1.3.7 Number of Fibers Per Tube Per Cable
2.1.3.8 Inner Jacket
2.1.3.9 Pulling Strength Member
2.1.3.10 Cable Outer Jacket
2.1.3.11 Metallic Armor
2.2 CABLE IDENTIFICATION SYMBOL
2.3 REPLACEMENT CABLE
2.4 SPLICE TRAYS AND ORGANIZERS
2.5 PRE-CONNECTED CABLE ASSEMBLY
2.6 OPTICAL AND MECHANICAL PERFORMANCE REQUIREMENTS
2.6.1 Optical Performance
2.6.1.1 Multi-Mode Fibers in the Cable
2.6.1.2 Single-Mode Fibers in the Cable
2.6.2 Mechanical Performance
2.6.2.1 Minimum Bend Radius
2.6.2.2 Tensile Strength
2.6.2.3 Flexing or Bending Cycles
2.6.2.4 Crush Resistance
2.6.2.5 Impact Resistance
2.6.2.6 Fluid Penetration

2.7 TEMPERATURE ENVIRONMENT
2.8 SPLICE COMPATIBILITY TEST
2.9 FIBER OPTIC TERMINATIONS AND CONNECTORS
2.10 PREPARATION FOR DELIVERY
2.11 FACTORY REEL TEST
2.12 MISCELLANEOUS ITEMS
2.12.1 FO Media Tags
2.12.2 Buried Warning and Identification Tape
2.12.3 Grounding Braid

PART 3 EXECUTION

3.1 FIBER SPLICES
3.2 INSTALLATION
3.2.1 Contractor Damage
3.3 BURIED CABLE INSTALLATION
3.3.1 Location
3.3.2 Field Staking
3.3.3 Method of Cable Placement
3.3.3.1 Open Trench Method
3.3.3.2 Direct Plow Method
3.3.4 Compaction
3.4 UNDERGROUND CABLE INSTALLATION
3.4.1 Securing Cable
3.4.2 Bending
3.4.3 Pulling
3.4.4 Lubricant
3.4.5 Damage and Defects
3.4.6 Seal
3.5 CABLE INSTALLATION IN CABLE TRAYS
3.6 GROUNDING SYSTEMS
3.7 DIRECT BURIAL SYSTEM INSTALLATION
3.7.1 Media Placement
3.7.2 Identification Slabs (Markers)
3.8 RECONDITIONING OF SURFACES INSTALLATION
3.8.1 Unpaved Surface Treatment
3.9 CABLE PULLING
3.9.1 FO Media Tensions
3.9.2 Pulling Eyes
3.9.3 Installation of Media in Maintenance Manholes, Handholes, and Vaults
3.10 GROUNDING
3.11 HOUSEKEEPING
3.12 CABLE DELIVERY
3.13 TESTING
3.13.1 Field Reel Tests
3.13.1.1 Reel Test Results
3.13.2 Final Acceptance Tests
3.13.2.1 Test Results
3.14 TEST REQUIREMENTS
3.14.1 Single-mode and Multi-mode OTDR Test
3.14.2 End-to-End Attenuation Tests
3.14.3 End-to-End Bandwidth Tests

-- End of Section Table of Contents --

SECTION 27 13 23.00 40

COMMUNICATIONS OPTICAL BACKBONE CABLING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 338	(1993; R 2008) Standard Test Method Softening Point of Glass
ASTM D 4976	(2006) Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 455-25C	(2002) FOTP-25 Repeated Impact Testing of Single-Mode Fiber Optic Cables and Cable Assemblies
EIA 455-33B	(2005) FOTP-33 Fiber Optic Cable Tensile Loading and Bending Test
EIA 455-41A	(1993; R 2001) FOTP-41 Compressive Loading Resistance of Fiber Optic Cables
EIA 455-80C	(1998) FOTP-80 Cutoff Wavelength of Un-cabled Single-Mode Fiber by Transmitted Power
EIA 455-82B	(1992) FOTP-82 Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; TIA 2007-1; TIA 2007-2; TIA 2007-3; TIA 2007-4; TIA 2007-5; Errata 2006-1; Errata 2007-2; Errata 2009-3) National Electrical Safety Code

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-87-640	(2006) Fiber Optic Outside Plant Communications Cable

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

EIA/TIA 455-165A	(1993) Standard for Mode-Field Diameter Measurement by Near-Field Scanning Technique
TIA-455-104-A	(1993; R 2005) Standard for FOTP-104 Fiber Optic Cable Cyclic Flexing Test
TIA-455-175-B	(2003) FOTP-175 IEC-60793-1-42 Optical Fibres - Part 1-42: Measurement Methods and Test Procedures - Chromatic Dispersion
TIA-455-177-B	(2003) FOTP-177 IEC-60793-1-43 Optical Fibres - Part 1-43: Measurement Methods and Test Procedures - Numerical Aperture
TIA-455-78	(2002B) FOTP-78 Optical Fibres - Part 1-40: Measurement Methods and Test Procedures - Attenuation
TIA-526-14-A	(1998) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
TIA-526-7	(2002; R 2008) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant OFSTP-7
TIA-568-C.1	(2009) Commercial Building Telecommunications Cabling Standard
TIA-568-C.3	(2008e1) Optical Fiber Cabling Components Standard
TIA-590-A	(1997) Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant
TIA-758-A	(2004) Customer-Owned Outside Plant Telecommunications Cabling Standard
TIA/EIA-472DAAA	(1993) Detail Specification for All Dielectric Fiber Optic Communications Cable for Outside Plant Use Containing Class 1a 62.5 Um Core Diameter/125 um Cladding Diameter/250 um Coating Diameter Fiber(s).
TIA/EIA-4750000-C	(1996) Generic Specifications for Fiber Optic Connectors (ANSI)
TIA/EIA-526-14A	(1998) Optical Power Loss Measurements of Installed Multimode Fiber Cable
TIA/EIA-598-B	(2001) Optical Fiber Cable Color Coding
TIA/EIA-604-3A	(2000) FOCUS 3 Fiber Optic Connector Intermateability Standard

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-188-176	(Notice 1) Standardized Profile for Asynchronous Transfer Mode (ATM)
MIL-STD-2042	(Rev B; Notice 1) Fiber Optic Cable Topology Installation Standard Methods for Naval Ships

1.2 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Fiber optic cable shall consist of optical fibers, strength members, and jacketing. Associated components shall include optical fiber connectors, optical patch panels, terminal bay cabinets, and splice closures as indicated. Install fiber optic cables in inner duct in the existing cable duct and manhole system and/or directly buried to the facility. Locate fiber optic terminal in existing facility buildings.

References in this section to cable shall refer to fiber optic cable.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit the following preconstruction submittals to the Contracting Officer for approval and approved 30 calendar days prior to installation.

Quality Assurance Plan

SD-02 Shop Drawings

Fiber Optic System; G

Identify the length, number of fibers, splice tray and termination panel locations, and the general routing for each application.

SD-03 Product Data

Submit manufacturer's product data for the following items. Data shall include a complete list of parts, special tools, and supplies with current unit prices and source of supply.

Fiber Optic Cable, including Media Types; G

Pre-Connected Cable Assembly

Splice Trays and Organizers; G

Fiber Optic Terminations and Connectors Material Data; G

SD-06 Test Reports

Submit contractor test reports for approval to the Contracting Officer not later than 14 calendar days after the completion of each test.

Single-mode and Multi-mode OTDR Test

End-to-End Attenuation Tests

End-to-End Bandwidth Tests

1.4 QUALITY ASSURANCE PLAN

Contractor shall prepare and submit a quality assurance plan which provides a detailed outline of all testing to be accomplished. Quality assurance plan shall address whether cladding modes have been stripped prior to testing, source wavelength (peak), spectral width full width/half maximum (FWHM), mode structure, fiber end preparation, and bandwidth measurements of fiber links both greater and less than 1 kilometer. Quality assurance plan shall include, as a minimum, a schedule of when tests will be performed relative to installation milestones, specific test procedure that will be used, a list of test equipment that will be used including manufacturer, model number, range, resolution accuracy and shall conform to the specified requirements.

Submit the test plan to the Contracting Officer for approval at least 30 calendar days before the start of testing.

1.4.1 Fiber Optic System

Provide drawings for the fiber optic cable and pathway system. Provide single line schematic details of the fiber optic and pathway media, splices, and associated construction materials. Drawings shall be in AUTOCAD.DXF or compatible format. Provide Registered Communications Distribution Designer (RCDD) approved drawings of the fiber optic system. Include drawing details of fiber optic terminations. System drawings shall show final configuration, including location, fiber pair count, pathway innerduct arrangement, and pathway assignment of outside plant. FO system shall be compatible with MIL-STD-188-176. Design Pier FO systems for compatibility with MIL-STD-2042 and NAVSEA drawings.

1.4.2 Fiber Optic Cable Installer and Splicer Qualifications

Technicians installing FO media, splices and performing system tests shall be certified and trained in accordance with an approved manufacturers training program. Technicians shall have a minimum of 5 years FO experience in installing equivalent FO systems. Submit FO technician qualifications for approval 30 days before splices are to be made on the cable. Certification shall include the training, and experience of the individual on specific type and classification of FO media to be provided under this contract.

1.4.3 Fiber Optic Field Tests Plan

Prepare and provide technicians and test equipment for field tests of FO media. Conduct OTDR reel tests at the job site prior to installation. Perform OTDR and end to end tests of all installed media. Conduct tests on

single-mode fiber in accordance with TIA-526-7 for single-mode fiber and TIA/EIA-526-14A for multi-mode fiber.

1.5 DELIVERY, STORAGE, AND HANDLING

Ship media to job site on factory reels or in factory cartons. Radius of the reel drum shall not be smaller than the minimum bend radius recommended by the manufacturer for the media. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at each end of the reel must be readily accessible for testing. Provide a permanent label on each reel showing length, media, identification number, and date of manufacture. Provide water resistant label and ink on the labels. Apply end seals to each end of the media after testing and before terminating to prevent moisture from entering the cable while stored at the job site. Reels with cable shall be suitable for outside storage conditions when temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from zero to 100 percent. Equipment, other than FO media, delivered and placed in storage shall be stored with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants.

Exercise care in handling materials during construction. Contractor shall ensure that the buried cable is fed through the plow into the ground at zero tension. Do not allow tension to develop in the cable.

Whenever the plow is stopped, sufficient cable shall be unreeled to guard against sudden jerks when the plow is started.

Exercise caution to ensure that the plow is not backed up while the blade is in the ground. Cable can be severely damaged by the plow backing up even a slight amount. During the plowing operation, the plow may strike a buried object or rock that would stop the equipment and necessitate removal of the plow from the ground. When this occurs, remove the plow carefully without backing up. When it is necessary to back the plow, uncover the cable a sufficient distance back from the plow for inspection by the Contracting Officer to determine if there is any damage. Immediately report any damage to the Contracting Officer. Repair or replace damages as directed by the Contracting Officer.

1.6 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

PART 2 PRODUCTS

2.1 FIBER OPTIC CABLE DESIGN

2.1.1 Fiber Optic Media Types

FO media shall meet all performance requirements of TIA-568-C.1, TIA-568-C.3 and the physical requirements of ICEA S-87-640 and TIA/EIA-598-B.

2.1.1.1 Multi-Mode Fiber Media

Provide FO media with outer sheath jacket, strength member, ripcords, water blocking material, core tube, and core fibers as installed in a permanent underground pathway system as shown on the construction drawings. FO media shall have an all glass, graded index material with a nominal core diameter

of 62.5 microns. Provide a cladding material for the fiber which is compatible with the core. Media transmission window shall be centered at 850 and 1300 nanometer wavelengths, attenuation at 1300 nanometers shall be less than 2.0 dB per kilometer. Minimum bandwidth shall be 500 mHz-Km.

2.1.1.2 Single-Mode Fiber Media

Provide FO single-mode media with outer sheath jacket, strength member, ripcords, water blocking material, core tube, and core fibers as installed in a permanent underground pathway system as shown on the construction drawings. Media shall have all glass, dual window, graded index material with a core diameter of 8.7 microns. Coat fiber with a cladding material which is concentric with the core. Fiber cladding diameter shall be nominal 125 microns. Media shall have a transmission window centered at 1300 and 1550 nanometer wavelengths, attenuation at 1550 nanometers shall be less than 0.5 dB per kilometer. FO media shall comply with TIA/EIA-472DAAA,and TIA-758-A.

2.1.2 Cable Length

Cable shall be manufactured continuous with no factory splices.

2.1.3 Materials and Construction

Materials used within a given cable shall be compatible with all other materials used in the same cable when such materials come into intimate contact. All cable components used shall have no adverse effect on optical transmission or on the mechanical integrity characteristics of the fiber placed in the cable. All materials used shall be non-toxic, non-corrosive, and present no dermal hazard.

Minimum required material components applied to fiber optic cable construction shall be central core member, color-coded optical fiber, color-coded loose tube buffer, with gel-free waterstop, inner jacket, pulling strength members, and outer jacket. Variations in sequence and construction structural components will be considered when necessary.

2.1.3.1 Central Core Member

Include a central core member to serve as a cable core foundation to reduce strain on the fibers but not to serve as a pulling strength member. Material of the central core member shall be non-metallic.

2.1.3.2 Optical Fibers

The cable may contain one of two types of optical fibers, single-mode fiber and multi-mode fiber, as specified. The optical fibers shall be as follows:

Single-Mode (SM) fiber must be the equivalent step index optical glass. Core diameter of the fiber shall be approximately 8.7 micrometer. Cladding diameter shall be 125 plus or minus 3 micrometer. Core cladding offset shall be less than 1 micrometer. Minimum tensile strength of the fiber after primary protective coating shall be greater than 50,000 psi. Softening point of the clad material of the optical fiber shall be 1630 degrees C plus or minus 50 degrees C in accordance with ASTM C 338, or the optical fiber shall meet the requirements in paragraph entitled, "Splice Compatibility Test."

Multi-Mode (MM) fiber shall be the graded index optical glass. Core

diameter of the fiber shall be 62.5 plus or minus 3 micrometer. Cladding diameter shall be 125 plus or minus 3 micrometer. Core-cladding offset shall be less than 3 micrometer. Minimum tensile strength of the fiber after primary protective coating shall be greater than 50,000 psi. Softening point of the clad material of the optical fiber shall be 1630 degrees C plus or minus 50 degrees C in accordance with ASTM C 338, or the optical fiber shall meet the requirements in paragraph entitled, "Splice Compatibility Test."

2.1.3.3 Fiber Primary Protective Coating

Coat optical fiber with suitable material to preserve the intrinsic high tensile strength of the glass fiber. Outside diameter of the coated optical fiber shall be 250 plus or minus 15 micrometer. Coating material shall be readily removable, mechanically or chemically, without damaging the optical fibers when the removal is desired.

2.1.3.4 Optical Fiber Color-Code Coating

Primary protective coated Single-Mode and Multi-Mode fibers shall be coated with a color-code coating for individual fiber identification. Maximum outside diameter of color-code coated fiber shall be less than 300 micrometer.

2.1.3.5 Loose Tube Buffering

Surround color-code coated fibers with a loose tube buffering for protection from external mechanical and environmental influences. Provide with gel-free waterstop material to prevent water migration. Color code loose tube buffering for the tube identification. Material of the buffering tube shall be PVC.

2.1.3.6 Colorants

Color concentrates or inks used to color code the optical fibers and the loose buffer tube shall not be susceptible to migration and chemical reaction with gel filling compound.

2.1.3.7 Number of Fibers Per Tube Per Cable

Unless otherwise indicated on the drawings, all cable shall contain 12-count of multi-mode fiber.

12-count cable shall be comprised of one loose buffer tube containing twelve fibers. The fibers shall be color coded using the standard Munsell color code, Blue, Orange, Green, Brown, Slate, White, Red, Black, Yellow, Violet, Rose, and Aqua.

2.1.3.8 Inner Jacket

Locate buffer tubes concentrically around the cable central core member and covered with a polyethylene inner jacket. Polyethylene inner jacket shall be high density polyethylene in accordance with ASTM D 4976. Space between the buffer tubes and inner jacket shall be filled with a gel-free compound to prevent air, moisture, or water intrusion in the inner jacket.

2.1.3.9 Pulling Strength Member

Use a dielectric type material as pulling strength members in the cable to

provide pulling strength of at least 400 pounds for the cable during installation.

2.1.3.10 Cable Outer Jacket

Black high density, high-molecular weight, polyethylene materials in accordance with ASTM D 4976 shall be applied longitudinally over all the inner jacket and sheathing strength member to form the cable outer jacket. Outer jacket shall be smooth, concentric, non-nutrient to fungus, and free from holes, splits, blisters, or other imperfections. Overall outside cable diameter shall not exceed 0.75 inch.

2.1.3.11 Metallic Armor

Provide a metallic armor shield for direct buried cable for additional tensile strength, rodent protection, and high crush and moisture resistance. Material of the metallic armoring shall be metallic tube or steel corrugation-coated with anti-corrosion material, sealed at the longitudinal overlap.

2.2 CABLE IDENTIFICATION SYMBOL

First of three lines on the ID symbol employ 5 characters.

First and second characters, from left to right, shall denote the number of active optical fibers in the cable.

Third character shall be a slash.

Fourth and fifth characters shall denote optical transmission windows which the optical fiber can support. These windows are defined herein as follows:

Fourth character shall be an "A" or an "O." The "A" denotes a window at a wavelength of 850 nanometers (nm) with an attenuation of 4 dB/kilometer (km) and a bandwidth of 800 MHz-km. Character shall be an "O" if these requirements are not met.

Fifth character shall be a "B" or an "O." The "B" denotes a window at a wavelength of 1,300 nanometer (nm) with an attenuation of 1.0 dB/km and a bandwidth of 1,000 MHz-km. Character shall be an "O" if these requirements are not met.

Two lower lines of the cable ID symbol indicate multi-mode or single-mode fibers, the cable number and the fiber count:

Example: 72/OB	Identifies the number of optical fibers (72) and the optical transmission window (OB - See preceding paragraph).
FM05 : 61-120	Identifies Multi-Mode Fiber Cable 05 with MM Fibers 61 through 120.
and FS05 : 13-24	Identifies Single-Mode Fiber Cable 05 with SM Fibers 13 through 24.

2.3 REPLACEMENT CABLE

In addition to the cable sections indicated, a reel of each size and type

of the manufacturer's furnished cable, provide not less than 0.5 kilometers.

2.4 SPLICE TRAYS AND ORGANIZERS

Single-mode or multi-mode fibers shall be fusion spliced with a protective sleeve covering and stored in an organizer with a minimum of 18 inches spare coiled buffer tubing. Single-mode fibers shall be spliced last in the splice tray.

Complete fiber splice of all fibers in the cable in an outer closure. Provide organizer assembly to hold the splice trays, each tray containing 12 fusion splices.

Fill space between the inner and outer closures with encapsulating fluid. Factory drill end plates to fit the cable(s) outer diameter.

2.5 PRE-CONNECTED CABLE ASSEMBLY

Contractor shall supply factory assembled pre-connectorized cable assembly to interface with the patch panel bulkhead feed-through receptacle. Contractor shall supply and install dust caps for all terminated fibers.

Multi-mode fiber optic cable assembly shall be comprised of a single fiber connector, terminated on three (3) meter length of single fiber, multi-mode cable. Single fiber cable shall contain a buffered optical fiber and be the same as that provided in the multi-fiber cable.

Single-mode fiber optic cable assembly shall be comprised of a single fiber connector terminated on the three (3) meter length of single fiber, single-mode cable. Single fiber cable shall contain a buffered optical fiber and be the same as that provided in the multi-fiber cable. Return loss for single-mode connectors shall be a minimum of minus 30dB.

Connector/cable interface on both the single and multi-mode cable assemblies shall be able to withstand a tensile force of 25 pounds without detrimental affects on the connector loss characteristics.

Each connectorized cable assembly shall have a loss of less than or equal to 0.5 dB.

2.6 OPTICAL AND MECHANICAL PERFORMANCE REQUIREMENTS

Fiber optical cable shall comply with the following optical and mechanical test requirements.

2.6.1 Optical Performance

2.6.1.1 Multi-Mode Fibers in the Cable

Optical attenuation of each optical fiber in the cable (reeled) shall be no greater than 1.0 dB/Km at 1300 plus or minus 50 nm optical spectrum window. Measure attenuation on completed cable reel length, and normalized linearly to 1 Km.

Bandwidth at minus 3 dB optical power of each optical fiber in the cable (reeled) shall be a bandwidth length product, gamma equals 1, greater than 1 GHz-Km at 1300 plus or minus 50 nm optical spectrum window.

Numerical aperture of each optical fiber shall be 0.2 plus or minus 0.015

at 1300 nm optical spectrum window. Method of numerical aperture measurement shall be in accordance with TIA-455-177-B, at central wavelength 1300 nm nominal. When this requirement is not met, apply the fusion splice compatibility test.

2.6.1.2 Single-Mode Fibers in the Cable

Optical attenuation of each optical fiber in the cable (reeled) shall be no greater than 0.5 dB/Km at 1300 plus or minus 50 nm optical spectrum window. Measure attenuation on completed cable reel length, and normalized linearly to 1 Km. Measurement method shall be in accordance with TIA-455-78, at central wavelength 1300 nm nominal.

Pulse dispersion of each optical fiber in the cable (reeled) shall be no greater than 3.5 picosecond/nm-Km within the emissive region of 1285-1330 nm. Measurement method shall be in accordance with TIA-455-175-B.

Mode field diameter at 1300 nm optical spectrum window shall be within 10 plus or minus 1 micrometer. Measurement method shall be in accordance with EIA/TIA 455-165A at central wavelength 1300 nm nominal. When this requirement is not met, apply the fusion splice compatibility test.

Cut-off wavelength for 1300 nm optical spectrum window shall be within 1200 plus or minus 70 nm. Measurement method shall be in accordance with EIA 455-80C.

2.6.2 Mechanical Performance

2.6.2.1 Minimum Bend Radius

Cable shall be able to withstand bending to a minimum radius of 10 times the cable outer diameter without tensile load applied, and of 20 times the cable outer diameter with maximum tensile load applied (during installation), without damage to cable components or degradation of the optical fiber performance at room temperature.

2.6.2.2 Tensile Strength

Fiber optical cable shall withstand a pull force of at least 400 pounds to be applied to the pulling strength member during the installation, and a tensile load of at least 300 newtons during operation without incurring any damage or detriment to fiber optical cable and optical performance. Tensile strength test shall be in accordance with EIA 455-33B.

2.6.2.3 Flexing or Bending Cycles

Fiber optical cable shall withstand at least 20 bending cycles at minimum bend radius without damage to the fiber optic cable components or degrading optical performance. Cyclic flexing test shall be in accordance with TIA-455-104-A.

2.6.2.4 Crush Resistance

Minimum crush resistance of the fiber optical cable shall be greater than 650 newton/centimeter (cm) without damage to cable components or degrading optical performance. Crush resistance test shall be in accordance with EIA 455-41A.

2.6.2.5 Impact Resistance

Fiber optical cable shall be capable of withstanding 20 impacts, at five newton-meters force, without damage to cable components, or degradation of optical performance. Impact resistance test shall be in accordance with EIA 455-25C.

2.6.2.6 Fluid Penetration

Optical cable shall be capable of preventing the entry and axial migration of pressurized water when subjected to fluid penetration testing in accordance with EIA 455-82B.

2.7 TEMPERATURE ENVIRONMENT

Fiber optical cable shall comply with the mechanical performance requirements herein while used in duct applications where the temperature varies from minus 8 degrees C to plus 38 degrees C. Optical performance degradation shall be less than five percent of the optical performance requirements in the temperature range of minus 20 degrees C to plus 60 degrees C. Do not damage fiber optical cable in storage where the temperature may vary from minus 40 degrees C to plus 65 degrees C.

2.8 SPLICE COMPATIBILITY TEST

When the material of the optic fiber is different from Cornings' Class Code No. 1517 for multi-mode graded index fiber and No. 1528 for single-mode fiber, perform and document the Splice Compatibility Test as follows:

Vendor shall select fiber samples from a minimum of 3 different production lots of the fiber type proposed for the job.

Vendor shall fabricate and measure a minimum of 10 fusion splices using fiber from the different production lots and a sample of Corning fiber, Class Code No. 1517 and No. 1528, supplied by the Government.

Measure fusion splices using an Optical Time Domain Reflectometer (OTDR) operating in the region of 1250 through 1350 nm. The insertion loss of the fusion splice shall be the average of two OTDR measurements, one taken with the OTDR installed on the Corning fiber, and the other with the OTDR installed on the vendor's fiber. Vendor's fiber and the Corning fiber shall each be a minimum of 1 Km in length throughout the testing.

Consider vendor's fiber compatible with the Corning fiber if the maximum splice insertion loss of each of 10 fusion splices tested measures less than 0.2 dB.

Vendor shall be allowed a maximum of three retries on any one splice to obtain a loss of 0.2 dB or less.

Perform these tests under Government supervision.

2.9 FIBER OPTIC TERMINATIONS AND CONNECTORS

FO connectors shall be ST type and comply with TIA/EIA-4750000-C and TIA/EIA-604-3A.

2.10 PREPARATION FOR DELIVERY

Ship media on reels. Provide 6 1/2 feet pigtails on each end of media accessible for testing. Reel drum shall comply with manufacturers recommended bend radius for the media. Wind media on reel so that unreeling can be done without kinking the media. Attach a permanent waterproof label with indelible text on reel showing the length, media type, bandwidth, attenuation, and date of manufacture.

2.11 FACTORY REEL TEST

Test 100 percent OTDR test of FO media at the factory prior to shipment in accordance with TIA-568-C.1 and TIA-568-C.3. Use TIA-526-7 for single-mode fiber and EIA TIA/EIA-526-14A Method B for multi-mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Provide digitized or photographic traces to the Contracting Officer.

2.12 MISCELLANEOUS ITEMS

2.12.1 FO Media Tags

Provide stainless steel, 1 5/8 inches in diameter 1/16 inch thick, and circular in shape.

2.12.2 Buried Warning and Identification Tape

Provide color, type and depth of tape as specified in paragraph "Buried Warning and Identification Tape" in Section 31 00 00 EARTHWORK, FO media must be marked and protected as required by TIA-590-A.

2.12.3 Grounding Braid

Grounding braid shall provide low electrical impedance connections for dependable shield bonding. Make braid from flat tin-plated copper.

PART 3 EXECUTION

3.1 FIBER SPLICES

Outside plant fiber splices shall be fusion type and made along the fiber route. Splices shall exhibit an insertion loss not greater than 0.2 dB. Make all splice measurements at 1300 nm, plus or minus 5 nm. Mount all splices in trays. Do not increase number of splices.

Cover completed splice with a protective sleeve heat shrink type to restore the protective properties of the fiber coating and buffering. Deviations to the splice, location and pulling plan will be permitted, upon approval by the Contracting Officer, and shall be provided at no additional cost to the Government.

All fiber colors shall be continuous from end to end. No switching or staggering of color scheme within the cable at splice points shall be allowed. Splice fibers in order with multi-mode fibers identified first and single-mode fibers at the end.

Bring cables out of the manhole in a controlled environment to perform the fiber fusion splice operation. Complete splice by returning the cable to the manhole such that the excess cable does not impede future entrance and utilization. Secure cable at regular intervals.

3.2 INSTALLATION

Install and test the FO media in accordance with contract drawings, specifications, IEEE C2, NFPA 70, and TIA-590-A. Provide all necessary power, utility services, technicians, test equipment, calibration equipment as required to perform reel and final acceptance tests of the media. All media which fail the factory or reel tests or final acceptance field tests shall be replaced and re-tested at the contractors expense. Splices are not permitted unless shown on the construction drawings. Field test splices within 24 hours after splice installation. Test splices to demonstrate a maximum 0.2 dB loss. Provide a splice box for each field splice. Provide a minimum of 2 meters for routing and testing media. Protect media ends of unspliced FO media during splicing operations.

3.2.1 Contractor Damage

Promptly repair indicated utility and communications lines or systems damaged during site preparation and construction. Damage to lines or systems not indicated, which are caused by contractor operations, shall be treated as "Changes" under the terms of the Contract clauses. When Contractor is advised in writing of the location of a non-indicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In every event, immediately notify the Contracting Officer of damage.

3.3 BURIED CABLE INSTALLATION

3.3.1 Location

Location of the cable splice overlaps shall be as indicated. Contractor shall ensure that all cable ends are sufficiently long before cutting.

3.3.2 Field Staking

When staking the cable plow or trench line, place stakes at least every 100 feet in level country and more frequently in rolling country or in dense vegetation, so that the construction force can sight at least two successive stakes at all times. Stakes should be placed at changes in direction, the beginning and end of all turns should be staked clearly. Where existing buried cable is encountered within 2 feet of the proposed line, decrease the distance between stakes to a minimum of 10 feet. When possible, stakes should project above the vegetation along the line. When a road or other crossings are involved, stakes should be placed at both extremes of the right-of-way.

A stake, with the appropriate number or explanation noted on it, should be used to show the location of each caution point, such as underground utility crossings and culverts; miscellaneous points, such as physical cable protection; and buried cable warning sign locations.

3.3.3 Method of Cable Placement

All direct buried cable shall have a warning tape placed above it as indicated.

Depth of buried cable in soil measured from the top of the cable to the surface of the ground shall be a minimum of 36 inches. When existing utilities are crossed, use hand excavation at a distance of no less than 4

feet on each side of the utility.

3.3.3.1 Open Trench Method

Contractor shall observe the following when placing cable by the open trench method:

Trench shall be free of all rock and debris.

Pull cable from cable reel truck or dolly and place in the trench by hand.

Place cable in trench as soon as practical and backfilled immediately to avoid cave-in, and ensure safe operational conditions.

An inspector shall walk closely behind the cable reel dolly and ensure that the cable lies flat on the trench bottom, and is placed at the required minimum depth.

Pull cable by hand on each end simultaneously, to remove excess slack, prior to backfilling.

Backfill trench in 6-inch lifts to ensure proper fill. Each backfill lift shall be compacted with hand tamp tools. First lift shall be hand tamped prior to placing the cable.

3.3.3.2 Direct Plow Method

Contractor shall observe the following when placing cable by the direct plow method:

Plow shall be clear of any obstruction which may damage cable and ensure that all rollers on the tractor and on the plow turn freely and are properly located.

Cable shall be hand fed off the reel at all times to ensure that no damage is done to the cable due to excess tension.

An inspector shall walk closely behind the plow and inspect the cable for any blemish or damage, and ensure a free and continuous flow of the cable from the reel to the plow. Inspector shall ensure that the cable is plowed at the minimum required depth.

3.3.4 Compaction

Plow slot shall be compacted following the plowing in or trenching of wire or cable.

3.4 UNDERGROUND CABLE INSTALLATION

Inner duct assignment of individual cables shall be as indicated. Do not place cables in ducts other than those specified.

Exercise adequate care when handling and storing reels of cable to prevent damage to the cable. Cable with dents, flat spots, or other sheath distortions shall not be installed.

3.4.1 Securing Cable

Immediately after cable placement, attach a permanent identification tag as indicated to visible cable sections. Check cables to ensure that the markings are intact.

Support and secure cables and equipment as indicated. Where the specific method of support is not shown, supports and fasteners shall be used to secure cables and equipment in position. Metallic supports and fasteners shall have a corrosion resistant finish. Rout all cables along the interior sides of manholes.

Two or more cable hooks shall be required per manhole.

Use clamps and straps as necessary to properly secure the cable.

3.4.2 Bending

Use caution when bending cable to avoid kinks or other damage to the sheath. Bend radius shall be as large as possible with a minimum of 10 inches. Increase minimum radius when necessary to meet cable manufacturer's recommendation. Do not rest cables against any sharp edges.

Pull and splice cable in the manner and at the locations shown.

3.4.3 Pulling

Attach pulling lines to both cable ends when cable is destined for bi-directional pull, and fitted with factory-installed pulling eyes. Cables not equipped with a pulling eye shall have the pulling line attached to the cable end by means of a cable grip. Do not use core hitches.

Locate and align cable reels so that the cable is paid out from the top of the reel into the duct or conduit in a long, smooth bend without twisting. Do not pull cable from the bottom of the reel. Use a cable feeder guide of proper dimensions at the mouth to guide the cable into the duct or conduit.

Rigging shall be set up at the pulling end so that the pulling line and cable exit on a line parallel with the duct or conduit to prevent either from rubbing against the edge or mouth. Do not pull cable ends around sheave wheels. When the sheave or pulley cannot be positioned to obtain sufficient cable end slack for proper racking and splicing with the pulling line attached to the end of the cable, a split cable grip may be used to obtain the necessary slack.

3.4.4 Lubricant

Pulling lubricant shall be used to minimize pulling tension and prevent sheath damage when pulling cables into ducts and conduits. Apply lubricant to the cable sheath with a lubricator. When pulling has been completed, the exposed cable ends shall be wiped clean of lubricant.

Lubricants shall be compatible with and intended for use with plastic-sheathed cables. Do not allow soap and grease type lubricants.

All equipment and the pulling set shall be checked to minimize interruptions once pulling begins. Pull cable without stopping until the required amount of the cable has been placed. When the pulling operation is halted before the pull is completed, the tension of the pulling line

shall not be released. When pulling is resumed, the inertia of the cable shall be overcome by increasing the tension in small steps a few seconds apart until the cable is in motion. Cable shall be paid from the top of the reel by rotating the reel in the feed direction at the rate of pull. Cable shall not be stripped off the reel by pulling.

3.4.5 Damage and Defects

Contractor shall use a tension monitoring device to ensure that the maximum pulling tension that may be applied to the cable to be pulled into a conduit section is not exceeded. Any damage to the cable due to exceeding the maximum tension will require a new cable furnished by the Contractor.

Carefully inspect cable for sheath defects or other irregularities as it is paid out form the reel. When defects are detected, pulling shall stop immediately and the cable section shall be repaired or replaced at the discretion of the Contracting Officer. Maintain a system of communications between pulling and feed locations so that pulling can be stopped instantly, when required.

Hand guide cable through intermediate manholes and into the next duct section when making pull-throughs. Use proper rigging in the intermediate manhole to keep the pulling line and cable aligned with the exit duct to prevent the line or cable from rubbing against the edge of the duct. Cables in pull-through manholes shall be set up and racked before the cable ends in adjacent manholes are set up and racked.

Cable ends pulled into manholes, vaults, or terminal locations that are not to be racked or otherwise permanently positioned immediately shall be tied in fixed positions to prevent damage to the cables and provide adequate working space.

3.4.6 Seal

Ducts or innerduct in which cable is placed shall be sealed with urethane foam duct seal. Insert this material between the cable and the duct or innerduct of which it is in, between the innerduct and the duct, and in all unused innerduct, in order to prevent damage to the cable sheath and to prevent the entrance of dirt or water into the manhole or vault.

Provide cables in continuous lengths as required to accomplish the required installation without splices from termination to termination, except where field splices are specifically shown.

3.5 CABLE INSTALLATION IN CABLE TRAYS

Do not install communication cables in the same cable tray with ac power cables.

Cables placed in cable trays shall be installed in a neat and orderly manner and shall not cross or interlace other cables except at breakout points.

Individually retain cables in vertical trays with straps at a maximum of 6 feet on center.

3.6 GROUNDING SYSTEMS

Ground cables at each termination point or as indicated.

3.7 DIRECT BURIAL SYSTEM INSTALLATION

Installation shall be in accordance with TIA-590-A. Under railroad tracks, paved areas, and roadways install cable in conduit encased in concrete. Slope ducts to drain. Excavate trenches by hand or mechanical trenching equipment. Provide a minimum cable cover of 24 inches below finished grade. Trenches shall be not less than 6 inches wide and in straight lines between cable markers. Do not use cable plows. Bends in trenches shall have a radius of not less than 36 inches. Where two or more cables are laid parallel in the same trench, space laterally at least 3 inches apart. When rock is encountered, remove it to a depth of at least 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 1/4 inch. Do not unreel and pull cables into the trench from one end. Cable may be unreeled on grade and lifted into position. Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK.

3.7.1 Media Placement

a. Separate FO media crossing other cables or metal piping from the other cables or pipe by not less than 3 inches of well tamped earth. Do not install FO media under or above traffic signal loops.

b. Media shall be in one continuous length without splices except where splices are shown on the drawings.

c. Do not allow bends in media which exceed the manufacturers minimum recommended radii. Do not bend media to a radius less than 10 times the outside diameter of the media.

d. Leave a horizontal slack of approximately 3 feet in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought above ground. Where cable is brought above ground, leave additional slack to make necessary connections.

3.7.2 Identification Slabs (Markers)

Provide a marker at each change of direction of the cable, over the ends of ducts or conduits which are installed under paved areas and roadways and over each splice. Identification markers shall be of concrete, approximately 20 inches square by 150 mm 6 inches thick and stake mounted warnings meeting the requirements of REA.

3.8 RECONDITIONING OF SURFACES INSTALLATION

3.8.1 Unpaved Surface Treatment

Restore unpaved surfaces disturbed during the installation of direct burial cable to their original elevation and condition. Carefully preserve existing sod and topsoil and replace after the back-filling is completed. Replace damaged sod with sod of quality equal to that removed. Where the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding.

3.9 CABLE PULLING

Test duct lines with a mandrel and swab out to remove foreign material before the pulling of FO media. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on media when entering or leaving the maintenance holes. Do not place media in ducts other than those shown without prior written approval of the Contracting Officer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up media reels on the same side of the maintenance hole as the pathway section in which the media is to be placed. Level the reel and bring into proper alignment with the pathway section so that the media pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the media be paid off from the bottom of the reel. Check the equipment set up prior to beginning the media cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between media reel and face of duct to protect media and guide cable into the duct as it is paid off the reel. As media is paid off the reel, lubricate and inspect media for sheath defects. When defects are noticed, stop pulling operations and notify the Contracting Officer to determine required corrective action. Stop media pulling if reel binds or does not pay off freely. Rectify cause of binding before resuming pulling operations. Provide media lubricants recommended by the cable manufacturer. Provide 3.3 feet of spare media in all manholes and enclosures for final termination and testing.

3.9.1 FO Media Tensions

Install FO media as shown on construction drawings. Provide devices to monitor media tension during installation. Do not exceed manufacturers recommended maximum FO tensions and bending radii during installation.

3.9.2 Pulling Eyes

Equip media 1-1/4 inches in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide media with diameter smaller than 1-1/4 inches with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Do not beat rings to prevent grip from slipping into the cable sheath. Use a swivel grip of 3/4 inch links between pulling-in eyes or grips and pulling strand.

3.9.3 Installation of Media in Maintenance Manholes, Handholes, and Vaults

Do not install media utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support media on brackets and cable insulators at a maximum of 4 feet. In existing maintenance manholes, handholes, and vaults where new ducts are to be terminated, or where new media are to be installed, modify the existing installation of media, cable supports, and grounding as required with cables arranged and supported as specified for new media.

3.10 GROUNDING

Ground exposed non current carrying metallic parts of telephone equipment, media sheaths, media splices, and terminals.

3.11 HOUSEKEEPING

The Contractor shall be responsible for cleaning up work area and maintaining the work area in orderly condition.

3.12 CABLE DELIVERY

Deliver replacement cable reels to the Government as directed by the Contracting Officer.

3.13 TESTING

As a minimum, the Contractor shall test each fiber cable before and after installation for any faults or attenuations using an Optical Time Domain Reflectometer (OTDR). End-to-end attenuation tests shall also be conducted after complete installation.

All test equipment, test procedures, and testing techniques shall be specified in the quality assurance plan and will require approval prior to execution. Tests shall be conducted by the Contractor in accordance with the approved Quality Assurance Plan. Field tests shall be witnessed by the Contracting Officer. Contracting Officer shall be given at least 20 calendar days notice prior to performing each test.

Each test sheet shall have a sign-off blank for the Contractor as well as the Contracting Officer. Deliver copies of the completed test forms and test results as indicated.

Sequential cable markings along the cable, prior to and after each end of splice point, shall be recorded on the sequential cable form and submitted for approval.

Submit test results on all installed fiber cabling before and after each pre-connectorized cable assembly splice is completed.

Contractor shall maintain an accurate test record during all field tests.

3.13.1 Field Reel Tests

Perform the following tests on FO media at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, perform these tests at the factory and certified test results shall accompany the media. Perform OTDR tests with media on reels and compare factory and field test data.

3.13.1.1 Reel Test Results

Provide results of reel tests to the Contracting Officer at least 5 working days before installation is to commence. Results shall indicate reel number of the media, manufacturer, type and number of fiber tested, and recorded readings. When reel tests indicate that the media does not comply with factory reel test results remove the media from the job site and replace with compliant media.

3.13.2 Final Acceptance Tests

Perform end-to-end tests including power meter light source and OTDR tests. Perform OTDR measurements as required by TIA-568-C.1 and TIA-568-C.3. Test single-mode fiber in accordance with TIA-526-7 (Optical Power Loss).

Test multi-mode fiber in accordance with TIA-526-14-A(Optical Power Loss).

3.13.2.1 Test Results

Provide results of final acceptance tests (attenuation tests, OTDR traces, etc.), to the Contracting Officer at least 5 working days after completion of tests.

3.14 TEST REQUIREMENTS

Test equipment used for verifying installation testing shall be calibrated by a certified testing company within 3 weeks of use.

3.14.1 Single-mode and Multi-mode OTDR Test

The Optical Time Domain Reflectometer (OTDR) shall conform to the following minimum requirements:

Operating wavelengths: 1,300 plus or minus 20 nanometers

Attenuation Range (one way): minimum 15 dB at 1,300 nm

Attenuation Resolution: 0.01 dB

Accuracy: plus 0.5 dB.

OTDRs shall have digital readout capability and shall have a means of providing a permanent record in the form of a strip chart.

3.14.2 End-to-End Attenuation Tests

An attenuation measurement test set shall consist of an optical power meter and an optical power source. Attenuation measurement test set shall be in accordance with the applicable National Bureau of Standards (NBS) standards for a stable optical source. Meter may be analog or digital. Include end-to-end attenuation test reading on the test reference loss. Measurement test set shall conform to the following minimum requirements:

Operating wavelengths: 1,300 plus or minus 10 nanometers

Attenuation Range: at least 30 dB at 1,300 nm

Attenuation Resolution: 0.01 dB

Accuracy: The accuracy of the attenuation measurement test set shall be plus or minus 5 percent.

Optical source shall be capable of coupling sufficient power into the fiber so that the light received at the meter is within the meter delectability limits.

3.14.3 End-to-End Bandwidth Tests

Bandwidth test shall conform to the following minimum requirements:

Operating wavelengths: 1,300 plus or minus 10 nanometers

Bandwidth range: minimum 1000 megahertz

Bandwidth Resolution: 1 megahertz

Accuracy: plus or minus 0.5 megahertz

Measurement Method: Swept Frequency

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 31 - EARTHWORK

SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.1 REFERENCES
1.2 DEFINITIONS
1.2.1 Satisfactory Materials
1.2.2 Unsatisfactory Materials
1.2.3 Degree of Compaction
1.2.4 Unstable Material
1.3 DEWATERING WORK PLAN
1.4 QUALITY CONTROL TESTING DURING CONSTRUCTION
1.5 TEST REPORTS
1.6 DRAWINGS
1.7 SUBMITTALS

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS
2.2 BACKFILL AND FILL MATERIALS
2.3 COHESIONLESS MATERIALS
2.4 COHESIVE MATERIALS
2.5 SUBBASE MATERIAL
2.6 COMPOST
2.7 COMPACTION EQUIPMENT
2.8 STRUCTURAL MATERIALS
2.9 BURIED WARNING AND IDENTIFICATION TAPE
2.9.1 Warning Tape for Metallic Piping
2.9.2 Tracer Wire for All Piping Including Horizontal Directional Drilling
2.10 GROUT
2.11 PIPE CASING
2.11.1 Casing Pipe
2.11.2 Wood Supports

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS
3.2 UNAUTHORIZED EXCAVATION
3.3 SURFACE PREPARATION
3.3.1 Stripping Of Topsoil
3.3.2 Clearing
3.3.3 Tree Removal
3.3.4 Pruning
3.3.5 Grubbing Operations
3.3.6 Filling Depressions
3.3.7 Stability of Sides
3.3.8 Shoring and Bracing

3.4 GENERAL EXCAVATION
3.4.1 Ditches, Gutters, and Channels
3.4.2 Utility Structures
3.4.3 Drainage
3.4.4 Dewatering
3.4.4.1 Dewatering System
3.4.4.2 Observation Wells
3.4.4.3 Discharge
3.4.5 Trench Excavation Requirements
3.4.5.1 Removal of Unstable Material
3.4.5.2 Removal of Unsatisfactory Materials
3.4.5.3 Removal of Unsatisfactory Soil Materials
3.4.5.4 Excavation for Appurtenances
3.4.5.5 Excavation For Water Distribution System and Force Mains
3.4.5.6 Excavation For Electrical Utilities
3.4.5.7 Jacking, Boring, and Tunneling
3.4.6 Underground Utilities
3.5 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS
3.6 SHORING
3.6.1 General Requirements
3.7 GRADING AREAS
3.7.1 Grading Outside Building Lines
3.8 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE
3.9 GROUND SURFACE PREPARATION
3.9.1 General Requirements
3.9.2 Frozen Material
3.10 UTILIZATION OF EXCAVATED MATERIALS
3.11 BURIED TAPE AND TRACER WIRE
3.11.1 Buried Warning and Identification Tape
3.11.2 Buried Tracer Wire
3.12 FILLING AND BACKFILLING
3.12.1 Preparations Prior to Backfill Placement
3.12.2 Preparation of Ground Surface to Receive Fill
3.12.3 Placement and Compaction
3.12.4 Trench Backfill
3.12.4.1 Replacement of Unstable Material
3.13 COMPACTION
3.13.1 Percentage of Maximum Density Requirements
3.13.2 Moisture Control
3.14 SPECIAL REQUIREMENTS
3.14.1 Pipeline Casing
3.14.1.1 Bore Holes
3.14.1.2 Cleaning
3.14.1.3 End Seals
3.14.2 Grouting
3.15 EMBANKMENTS
3.15.1 Earth Embankments
3.16 SUBGRADE PREPARATION
3.16.1 Proof Rolling
3.16.2 Construction
3.16.3 Compaction
3.16.3.1 Subgrade for Pavements
3.17 FINISHING
3.17.1 Subgrade and Embankments
3.17.2 Capillary Water Barrier
3.17.3 Grading Around Structures
3.18 TESTING
3.18.1 Fill and Backfill Material Gradation
3.18.2 In-Place Densities

3.18.3 Check Tests on In-Place Densities
3.18.4 Moisture Contents
3.18.5 Optimum Moisture and Laboratory Maximum Density
3.18.6 Tolerance Tests for Subgrades
3.19 MAINTENANCE
3.19.1 Protection of Graded Areas
3.19.2 Reconditioning Compacted Areas

-- End of Section Table of Contents --

SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 145	(1991; R 2000) Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
AASHTO T 180	(2001; R 2004) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop
AASHTO T 2	(1991; R 2006) Standard Method of Test for Sampling of Aggregates (same as ASTM D 75)
AASHTO T 87	(1986; R 2004) Standard Method of Test for Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010) Structural Welding Code - Steel

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA P5	(2005) Standard for Waterborne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM A 139/A 139M	(2004) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A 252	(1998; R 2007) Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 2216	(2005) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2487	(2006e1) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 3740	(2004) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 4318	(2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	(2007a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT)

Index 600 Series	Traffic Control Thru Work Zones

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926	Safety and Health Regulations for Construction

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials shall mean ASTM D 2487, SP, SP-SM, SM, A-2-3, A-2-4, and A-3.

1.2.2 Unsatisfactory Materials

Unsatisfactory soil materials shall mean ASTM D 2487, GW, GP, GM, GP-GM, CW-GM, GC, GP-GC, GM-GC, SW, SW-SM, SC, SW-SC, SP-SC, CL, ML, CL-ML, CH, MH, and AASHTO M 145, Soil Classification Groups A-2-5, A-2-6, A-2-7, A-4, A-5, A-6, and A-7, peat, muck and other highly organic soil, and other highly organic material, buried vegetation, roots, and post consumer materials such as trash, refuse, or other debris and soil materials of any classification that have a moisture content at the time of compaction beyond the range of 1 percentage point below and 3 percentage points above the optimum moisture content of the soil material as determined by moisture-density relations test.

1.2.3 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557, Method B or D.

1.2.4 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.3 DEWATERING WORK PLAN

Submit procedures for accomplishing dewatering work in accordance with drawings.

1.4 QUALITY CONTROL TESTING DURING CONSTRUCTION

Soil survey for satisfactory soil materials and samples of soil materials shall be furnished by the Contractor. A certified soil-testing service approved by the Contracting Officer shall be provided by the Contractor. Testing shall include soil survey for satisfactory soil materials; sampling and testing soil materials proposed for use in the work, and field-testing facilities for quality control during construction period.

Testing agencies shall conform to the requirements of ASTM D 3740.

Soil materials shall be tested by the Contractor during construction as follows:

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Satisfactory soil materials	Sieve analysis of fine and coarse aggregates	ASTM C 136	One daily for each soil material from each source; additional test whenever there is any apparent change
	Preparation of samples	AASHTO T 87	
	Sieve analysis is of fine and coarse aggregates	ASTM C 136	
	Amount of	ASTM C 117	

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
	material passing No. 200 sieve		
	Moisture content of subbase material	ASTM D 2216	
Soil materials prior to compaction	Moisture-density relations of soil	ASTM D 1557	One of each type of subgrade soil material except under backfill for structures; one for each backfill and fill material from each source
Soil material-in-place after compaction	Density of soil-in-place	ASTM D 1556 Sand Cone Method	At least three daily for each subgrade soil material except under backfill for structures, and for each layer and backfill and fill material; for each 400 linear feet of trench or fraction thereof, whichever is greater; and additional test whenever there is any change in moisture conditions

1.5 TEST REPORTS

No soil material shall be used until a written report of Soil Test results has been reviewed and approved by the Contracting Officer.

1.6 DRAWINGS

As-Built Drawings shall be submitted in accordance with Section 01 78 00 CLOSE-OUT SUBMITTALS.

1.7 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring; G

Dewatering Work Plan; G

Submit 15 days prior to starting work.

SD-06 Test Reports

Borrow Site Testing

Within 24 hours of conclusion of physical tests, 6 copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

Contractor shall submit written Test Reports of Soil Test results within 5 calendar days. Submit test reports in accordance with paragraph entitled, "Quality Control Testing During Construction," of this section.

SD-07 Certificates

Certificates for Proposed Soil Materials shall be submitted to the Contracting Officer in accordance with paragraph entitled, " Backfill and Fill Materials," of this section.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCLP test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Do not bring material onsite until tests have been approved by the Contracting Officer.

2.2 BACKFILL AND FILL MATERIALS

Backfill and fill material shall consist of sandy clay, sand, gravel, soft shale, or other satisfactory soil materials as defined in Subpart 1.2.1 Satisfactory Materials.

Materials for backfill and fill shall be satisfactory soil materials, free of clay clods, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials and other deleterious matter, and shall be satisfactory soil material as follows:

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Satisfactory soil materials	Sampling	AASHTO T 2	One for each source of material to determine conformance to definition of satisfactory soil materials; additional tests whenever there is any apparent change
	Preparation of samples	AASHTO T 87	
	Sieve analysis of fine and coarse aggregate	ASTM C 136	
	Mechanical analysis of soils	ASTM D 422	
	Liquid limit of soils	ASTM D 4318	
	Plastic limit and plasticity index of soils	ASTM D 4318	
	Moisture-density relations of soil	AASHTO T 180, Method B or D	

2.3 COHESIONLESS MATERIALS

Cohesionless soil materials include gravels, gravel-sand mixtures, sands, and gravelly-sands. Moisture-density relations of compacted cohesionless soils, when plotted on graphs, will show straight lines or reverse-shaped moisture density curves.

2.4 COHESIVE MATERIALS

Cohesive soil materials include clayey and silty gravels, sand-clay mixtures, gravel-silt mixtures, clayey and silty sands, sand-silt mixtures, clays, silts, and very fine sands. Moisture-density relations of compacted cohesive soils, when plotted on graphs, will show normal moisture-density curves.

2.5 SUBBASE MATERIAL

Subbase material shall be a naturally or artificially graded mixture of natural or crushed gravel, crushed stone, or sand.

2.6 COMPOST

Compost shall be yard trimmings or yard waste compost processed and graded according to state and local regulations.

2.7 COMPACTION EQUIPMENT

Compaction equipment shall consist of sheepsfoot rollers, pneumatic-tired rollers, tamper rollers, vibrating tampers, or other compaction equipment capable of obtaining the required density throughout the entire layer.

2.8 STRUCTURAL MATERIALS

Ensure that materials used for shoring and bracing, such as sheet piling, uprights, stringers, and crossbraces, are in good serviceable condition. Ensure that any timber used is sound and free from large or loose knots.

Use pressure-treated timber where wood sheeting or piling is specified or indicated to be cut and left in place.

Ensure that shoring and sheeting for excavations are designed by a Florida-registered Professional Engineer and are in accordance with 29 CFR 1926 OSHA Document 2226 "Safe Working Practices - Excavating and Trenching."

2.9 BURIED WARNING AND IDENTIFICATION TAPE

Provide polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes

Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air

2.9.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.9.2 Tracer Wire for All Piping Including Horizontal Directional Drilling

Provide a single conductor #6 gauge thick wire with Type TW insulation.

2.10 GROUT

Provide durable grout composed of cement, water, an air-entraining admixture, and sand mixed in proportions of one part portland cement to two parts of sand, sufficient water to produce a workable mixture, and an amount of admixture which will entrain sufficient air, as determined by the Contracting Officer. Mix grout in a concrete mixer.

2.11 PIPE CASING

2.11.1 Casing Pipe

ASTM A 139/A 139M, Grade B, or ASTM A 252, Grade 2, smooth wall pipe. Match casing size to the outside diameter and wall thickness as indicated on the drawings. Protective coating is to be fusion-bonded epoxy.

2.11.2 Wood Supports

Pressure-treated, locally available, rough, structural grade. Provide wood with nonleaching water-borne pressure preservative (ACA or CCA) and treatment conforming to AWPA P5 and AWPA C2, respectively. Secure wood supports to carrier pipe with stainless steel or zinc-coated steel bands.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Before starting earthwork, the location of underground utilities shall be carefully verified by hand methods. Utilities to be left in place shall be protected from damage.

Excavation, filling, backfilling, and grading shall be to subgrade elevations specified.

Excavated materials suitable for backfill shall be piled in an orderly manner sufficiently distant from excavations to prevent overloading, slides, and cave-ins.

Excavations shall be done in ways that will prevent surface water and subsurface water from flowing into excavations and will also prevent flooding of the site and surrounding area.

Protect excavation and trenching by shoring, bracing, sheet piling, underpinning, or other methods as required to prevent cave-ins or loose dirt from falling into excavations and trenches.

The Contractor shall maintain traffic in accordance with FDOT Standard Index 600 Series and the technical specifications. One traffic lane must be maintained at all times with use of flagger. All traffic lanes must be open for traffic at the close of workdays. All signing, barricades, lighting, flaggers, and other necessary materials shall be included in the lump-sum cost. For roadways with more than two lanes, the Contractor shall maintain one traffic lane in each direction.

3.2 UNAUTHORIZED EXCAVATION

Unauthorized excavation shall consist of removal of materials beyond indicated subgrade elevations or side dimensions specified without specific direction and shall be replaced as specified at no additional cost to the Government.

Unauthorized excavation under foundations or retaining walls shall be filled by lowering the bottom elevation of the footing or base to the excavation bottom without altering the approved top elevation.

Elsewhere unauthorized excavations shall be backfilled and compacted as specified for authorized excavations of the same classification.

3.3 SURFACE PREPARATION

Heavy growths of grass and other vegetation, roots, debris, stones, objects larger than 2 inches in any dimension, and other materials undesirable to the subsurface construction shall be removed by mowing, grubbing, raking, or other methods from the surface of areas to be stripped.

3.3.1 Stripping Of Topsoil

Where indicated or directed, strip topsoil to a depth of 4 inch. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inch in diameter, and other materials that would interfere with planting and maintenance operations. Excavated topsoil shall be transported to, and stockpiled in, designated topsoil storage areas.

3.3.2 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint. Apply herbicide in accordance with the manufacturer's label to the top surface of stumps designated not to be removed.

3.3.3 Tree Removal

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.3.4 Pruning

Trim trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1 1/4 inches in diameter with an approved tree wound paint.

3.3.5 Grubbing Operations

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a

depth of not less than 18 inches below the original surface level of the ground in areas indicated as areas to be paved and sodded. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 10 feet below the original surface level of the ground in areas indicated as areas for buildings, dry retention ponds and in a 10 foot wide perimeter around Buildings.

3.3.6 Filling Depressions

Depressions resulting from grubbing operations shall be completely filled with acceptable backfilling material, unless further excavation or earthwork is required.

Prior to filling, subgrade surfaces of depressions shall be free of standing water, frost, or frozen material. Unsatisfactory soil materials shall be removed.

Any structural backfill or fill required for site development should be placed in loose lifts not exceeding 12 inches in thickness and compacted by the use of a vibratory drum roller. If hand-held or track-mounted compaction equipment is used, the lift thickness should be reduced to 6 and 8 inches, respectively. Each layer shall be compacted at the optimum moisture content to a density equal to the original adjacent ground. Surface of filled depressions shall be graded to meet adjacent contours and to provide surface water drainage.

3.3.7 Stability of Sides

Sides of excavations over 5 feet in depth shall be sloped not steeper than 34 degrees from the horizontal (slope 1/1.5) of the material excavated or shall be shored and braced where sloping is not possible because of space restrictions, stability of material excavated, or where excavations are subjected to vibrations from vehicular traffic, the operation of machinery, or any other source.

Sides and slopes of excavations shall be maintained in a safe condition by scaling, benching, shelving, or bracing until completion of backfill placement.

3.3.8 Shoring and Bracing

Where sheeting and bracing are required to support the side walls of the excavation, retain a Professional Engineer, registered in Florida, to design sheeting and bracing. Ensure that the design establishes requirements for sheeting and bracing and complies with all applicable codes, authorities having jurisdiction, and federal, state, and local regulations.

The sole responsibility for the design, methods of installation, and adequacy of sheeting and bracing shall be and shall remain that of the Contractor and the Contractor's Professional Engineer. Provide all necessary sheeting and bracing or other procedures as required to ensure safe working conditions and to protect the excavations.

Provide sheeting and bracing consisting of braced steel sheet piling, trench box, braced wood lagging, and soldier beams, or other approved methods.

Immediately fill and compact voids formed outside the sheeting. Where soil cannot be properly compacted to fill the void, use Class B concrete as backfill at no additional cost to the Government.

Install sheeting outside the required clearances and dimensions. Ensure that sheeting is plumb, securely braced, and tied in position. Ensure that sheeting is adequate to withstand all pressure to which is may be subjected. Correct any movement or bulging at no expense to the Government to provide the necessary clearances or dimensions.

Maintain sheeting and bracing in excavations and trenches for the entire time excavations are open.

Do not brace sheeting against pipe being laid. Brace sheeting so that no concentrated load of horizontal thrust is transmitted to the pipe.

Do not withdrawn sheeting if driven below the spring line of any pipe. Cut off tops as indicated on the drawings and leave bottoms permanently in place.

3.4 GENERAL EXCAVATION

3.4.1 Ditches, Gutters, and Channels

Excavation shall be accomplished by cutting accurately to the cross sections, grades, and elevations indicated. Excessive open-ditch or gutter excavation shall be backfilled with suitable materials to grade at no additional cost.

3.4.2 Utility Structures

Excavation for valve vaults, septic tanks, and similar structures shall be sufficient to leave at least 12 inches in the clear between the outer surfaces and the embankment or timber used to hold and protect the walls. Any overdepth excavation below such appurtenances that has not been directed will be considered unauthorized and shall be refilled with select bedding material or concrete, as directed by the Contracting Officer, at no additional cost to the Government.

Excavation shall be made accurately to the lines, grades, and elevations indicated. Dimensions and elevations of footings and foundation excavations are only approximate and may be changed if necessary to ensure adequate foundation support. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as indicated. Rock or other hard foundation materials shall be cleaned of loose debris and cut to a firm surface, either level, stepped, or serrated, as indicated. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before concrete or masonry is to be placed.

3.4.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site

development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.4.4 Dewatering

3.4.4.1 Dewatering System

The dewatering system shall be adequate to pre-drain the soils to be excavated to the extent that the piezometric water level in the construction area is a minimum of 2 feet below the bottom of the excavation, side slopes of excavations, or bottom of the footings at all times, or as otherwise required to obtain the specified compaction and installation conditions. Pipeline trenches must be dewatered at least 6 inches below the trench bottom.

In the event of layered soils, the hydrostatic head in the zone below the subgrade elevation shall be relieved to prevent uplift.

Unless otherwise noted and prior to any excavating below or within 2 feet above the groundwater level, a dewatering system shall be placed into operation to lower water levels to the extent specified previously, and then shall be operated continuously 24 hours per day, 7 days a week, until work has been completed to the satisfaction of the Contracting Officer.

Where used, well points shall be installed in an approved manner and in sufficient numbers to provide the necessary removal of water as stated previously. Well points and header piping shall be installed in such a manner that traffic on public thoroughfares and site access roads will not be impeded.

The Contractor shall be solely responsible for the arrangements, locations, and depths of the dewatering system necessary to accomplish the specified work.

To prevent excessive noise, exhaust from all pumps and engines shall be silenced and muffled.

Wellpoint pump discharge shall be controlled to prevent erosion, undermining, and all other damage, and be piped to approved locations.

The Contractor shall comply with any and all applicable regulations and permitting requirements concerning groundwater and discharge.

Excavations shall be kept free from water during the placing of concrete structures and utilities.

3.4.4.2 Observation Wells

The Contractor shall install observation wells as may be required to record accurate water levels.

The Contractor shall be responsible for maintaining wells and observing and recording the elevation of the piezometric water levels daily.

3.4.4.3 Discharge

Discharge of water from dewatering shall be in accordance with NASA KSC policy.

3.4.5 Trench Excavation Requirements

Trenches shall be of adequate width and depth for the specified purpose. Side slopes of the trenches shall be as nearly vertical as practicable. Care shall be taken not to overexcavate. Bottoms of the trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length except where it is necessary to excavate for bell holes and for proper sealing of pipe joints. Bell holes and depressions for joints shall be dug after the trench bottom has been graded to ensure that the pipe rests on the prepared bottom for as much of its full length as practicable. Bell holes and depressions shall be only of such length, depth, and width as required to make the joint. Stones shall be removed, as necessary, to avoid point bearing. Where rock excavation is required in trenches for pipe, the rock shall be excavated to a minimum overdepth of 6-inches below the trench depth specified. Except as specified for wet or otherwise unstable material, overdepths shall be backfilled with materials specified for backfilling the lower portion of trenches. Whenever wet or otherwise unstable material that is incapable of properly supporting the pipe, as determined by the Contracting Officer, is encountered in the bottom of the trench, it shall be removed and the trench shall be backfilled to the proper grade with coarse sand, fine gravel, or other suitable, approved material.

Trench excavations in surfaced areas shall be by open cut, unless otherwise shown. The pavement shall be cut by concrete saw or other approved method. Cuts shall be in straight lines parallel to the utility line location and shall be to a depth of at least one quarter of the pavement thickness. The remainder of the pavement shall be broken out. Pavement shall be removed a minimum of 12 inches on each side of the trench and 6 inches beyond where the base course is to be removed.

3.4.5.1 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.4.5.2 Removal of Unsatisfactory Materials

Remove unsatisfactory materials to a horizontal distance of 10 feet beyond the structural element plan and to a vertical depth of not less than 10 feet below the original surface level of the ground in areas designated as structural elements and dry retention ponds. A structural element is a building slab or a foundation.

3.4.5.3 Removal of Unsatisfactory Soil Materials

Unsatisfactory soil materials encountered that extend below the required elevations, as specified under Grubbing Operations shall be excavated to the depth directed by the Contracting Officer.

3.4.5.4 Excavation for Appurtenances

Provide excavation for valve vaults, septic tanks, or similar structures sufficient to leave at least 12 inch clear between the outer structure surfaces and the face of the excavation or support members. Clean rock or loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Remove loose disintegrated rock and thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.4.5.5 Excavation For Water Distribution System and Force Mains

Trenches shall be graded to avoid high points that necessitate placing vacuum and relief valves in the waterlines. If a profile of the pipes is not provided, trenches shall be of a depth to provide a minimum cover over the top of the pipe of 3 feet from the existing ground surface or the indicated finished grade (whichever is lower) unless it is necessary to avoid interference of the waterlines with other utilities. Ensure that utility separation requirements are as shown on the drawings and in paragraph entitled "Location" in Section 33 11 00 WATER DISTRIBUTION.

3.4.5.6 Excavation For Electrical Utilities

Excavation of trenches for electrical cables and duct lines shall provide vertical walls, unless otherwise approved by the Contracting Officer, and the trench shall be only as wide as necessary for workers to install the cables or ducts. Abrupt changes in grade of the trench bottom shall be avoided. Trenches shall be of a depth to provide a minimum cover over the top of the cables or ducts of 3 feet below finished grade, unless it is necessary to avoid interference of the electrical cables or ducts with other utilities. Ensure that utility separation requirements are as shown on the drawings and in paragraph entitled "Location" in Section 33 11 00 WATER DISTRIBUTION.

3.4.5.7 Jacking, Boring, and Tunneling

Unless otherwise indicated, provide excavation by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.4.6 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by the utility company. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the

indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.5 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Notify the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, excavate borrow pits and other excavation areas providing adequate drainage. Transport overburden and other spoil material to designated spoil areas or otherwise dispose of as directed. Provide neatly trimmed and drained borrow pits after the excavation is completed. Ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.6 SHORING

3.6.1 General Requirements

Where sheeting and bracing are required, ensure that the sheeting and bracing system meet the requirements in these specifications.

Submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving.

3.7 GRADING AREAS

Areas within the limits of grading under this section, including adjacent transition areas, shall be uniformly graded. Finished surface shall be smooth within the specified tolerances, compacted, and with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

3.7.1 Grading Outside Building Lines

Areas outside the building lines for each structure shall be graded to drain away from the structure and to prevent ponding of water after rains. Finished surface shall be within the tolerance specified below for each area classification, compacted as specified, and free from irregular surface changes.

Grassed or planted areas:

Finished surface of areas to receive topsoil blend shall be not more than 0.10 foot above or below the indicated finish elevations.

3.8 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. Protect all surfaces from erosion resulting from ponding or water flow.

3.9 GROUND SURFACE PREPARATION

3.9.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inch, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

3.9.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3.10 UTILIZATION OF EXCAVATED MATERIALS

Dispose of unsatisfactory materials removed from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed by the Contracting Officer. Clear and grub newly designated waste areas on Government-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.11 BURIED TAPE AND TRACER WIRE

3.11.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.11.2 Buried Tracer Wire

Install tracer wire on all piping in accordance with the Typical Trench Detail. Install tracer wire for horizontal directional drilling in accordance with the installer's recommendations.

3.12 FILLING AND BACKFILLING

3.12.1 Preparations Prior to Backfill Placement

Excavations shall be backfilled as promptly as the work permits but not until completion of the following:

Approval of construction below finish grade

Inspection, testing, approval, and recording location of underground utilities

Removal of concrete formwork

Removal of shoring and bracing; backfilling of voids with satisfactory soil material; temporary sheet piling driven below bottom of structures; and cutting off and removing of utilities in a manner that prevents settlement of the structure or utilities

Removal of trash and debris

Completion of concrete waterproofing

3.12.2 Preparation of Ground Surface to Receive Fill

Vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials shall be removed from ground surface prior to the placement of fills. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stripped, or broken up in such manner that fill material will bond with the existing material.

When the ground surface has a density less than that specified for the particular area classification, the ground surface shall be broken up, pulverized, moisture-conditioned to near optimum moisture content of the soil material, and compacted to the required depth and percentage of maximum density.

3.12.3 Placement and Compaction

Any structural backfill or fill required for site development should be placed in loose lifts not exceeding 12 inches in thickness and compacted by the use of a vibratory drum roller. If hand-held or track-mounted compaction equipment is used, the lift thickness should be reduced to 6 and 8 inches, respectively. Before compaction, each layer of backfill or fill material shall be moistened or aerated as necessary to provide the optimum moisture content of the soil material and shall then be compacted to the percentage of maximum density for each area classification as specified. Backfill or fill material shall not be placed on surfaces that are muddy, frozen, icy, or contain frost.

Backfill and fill materials adjacent to structures shall be brought up evenly around structures and shall be carried up to the indicated elevations.

Compaction adjacent to structures, within a horizontal distance from the face of the structure equal to the depth of backfill or fill material (measured from the bottom of footing or bottom of foundation or retaining wall) to final grade, shall be done with power-driven hand tampers.

3.12.4 Trench Backfill

3.12.4.1 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inch loose thickness.

3.13 COMPACTION

3.13.1 Percentage of Maximum Density Requirements

Actual density of each layer of soil material-in-place shall be not less than the following percentages of the maximum density of the same soil material determined by the moisture-density test.

AREA CLASSIFICATION	PERCENT MAXIMUM DENSITY
Grassed areas	95
Walks	95
Utility trenches	95
Structures	
Each layer of backfill material	98
Building slabs and steps	
Top 12 inches of subgrade and each layer of backfill material	98

3.13.2 Moisture Control

Moisture content in soil material at time of compaction shall be within specified limits.

Where the moisture content of a layer of soil material is below optimum before compaction, the required amount of water shall be uniformly applied to the surface of the layer of soil material and the layer of soil disked or otherwise mixed until a uniform moisture content is reached.

Where the moisture of a layer of soil material is above optimum, it shall be dried.

3.14 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.14.1 Pipeline Casing

Provide new smooth wall steel pipeline casing under existing railroad and pavement by the boring and jacking method of installation. Provide each new pipeline casing, where indicated and to the lengths and dimensions

shown, complete and suitable for use with the new piped utility as indicated. Install pipeline casing by dry boring and jacking method as follows:

3.14.1.1 Bore Holes

Mechanically bore holes and case through the soil with a cutting head on a continuous auger mounted inside the casing pipe. Weld lengths of pipe together in accordance with AWS D1.1/D1.1M. Do not use water or other fluids in connection with the boring operation.

3.14.1.2 Cleaning

Clean inside of the pipeline casing of dirt, weld splatters, and other foreign matter which would interfere with insertion of the piped utilities by attaching a pipe cleaning plug to the boring rig and passing it through the pipe.

3.14.1.3 End Seals

After installation of piped utilities in pipeline casing, provide watertight end seals at each end of pipeline casing between pipeline casing and piping utilities. Provide watertight end seals as indicated.

3.14.2 Grouting

Distribute grout to place of final deposit and work into place at end of pipe with spades or trowels.

3.15 EMBANKMENTS

3.15.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 8 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise brake up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.16 SUBGRADE PREPARATION

3.16.1 Proof Rolling

Finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade.

3.16.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of 6 inch below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, do not show deviations for the surface of the subgrade for roadways greater than 1.0 inch when tested with a 10-foot straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

3.16.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas, compact each layer of the embankment to at least 98 percent of laboratory maximum density.

3.16.3.1 Subgrade for Pavements

As indicated on the drawings.

3.17 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.17.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.17.2 Capillary Water Barrier

Place a capillary water barrier under concrete floor and area-way slabs grade directly on the subgrade and compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.17.3 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.18 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer. Determine field in-place density in accordance with ASTM D 1557. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.18.1 Fill and Backfill Material Gradation

One test per 75 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM C 136.

3.18.2 In-Place Densities

a. One test per 2,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 2,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

3.18.3 Check Tests on In-Place Densities

If ASTM D 6938 is used, check in-place densities by ASTM D 1556 as follows:

a. One check test per lift for each 2,000 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.

b. One check test per lift for each 2,000 square feet, of fill or backfill areas compacted by hand-operated machines.

3.18.4 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.

3.18.5 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 75 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.18.6 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.19 MAINTENANCE

3.19.1 Protection of Graded Areas

Newly graded areas shall be protected from traffic and erosion and shall be maintained free of trash and debris.

3.19.2 Reconditioning Compacted Areas

Where approved compacted areas are disturbed by subsequent construction operations or adverse weather, the surface shall be scarified, reshaped, and compacted as specified to the required density prior to further construction.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 ASSEMBLY AND INSTALLATION INSTRUCTIONS
1.4 DELIVERY, STORAGE, AND HANDLING
1.5 QUALITY ASSURANCE
1.5.1 Required Report Data

PART 2 PRODUCTS

2.1 GENERAL
2.2 ZINC COATING
2.3 FABRIC
2.4 TOP AND BOTTOM SELVAGES
2.5 LINE POSTS
2.6 END, CORNER, AND PULL POSTS
2.7 SLEEVES
2.8 TOP RAIL
2.9 TENSION WIRE
2.10 STRETCHER BARS
2.11 POST TOPS
2.12 STRETCHER BAR BANDS
2.13 GATE POSTS
2.14 GATES
2.15 GATE HARDWARE AND ACCESSORIES
2.16 MISCELLANEOUS HARDWARE
2.17 WIRE TIES
2.18 CONCRETE
2.19 GROUT
2.20 PADLOCKS

PART 3 EXECUTION

3.1 GENERAL
3.2 EXCAVATION
3.3 SETTING POSTS
3.3.1 Earth and Bedrock
3.3.2 Bracing
3.4 CONCRETE STRENGTH
3.5 TOP RAILS
3.6 BRACE ASSEMBLY
3.7 TENSION WIRE INSTALLATION
3.8 FABRIC INSTALLATION
3.9 STRETCHER BAR INSTALLATION
3.10 GATE INSTALLATION

3.11 TIE WIRES
3.12 FASTENERS
3.13 ZINC-COATING REPAIR
3.14 TOLERANCES
3.15 SITE PREPARATION
3.15.1 Clearing and Grading
3.16 FENCE INSTALLATION
3.16.1 Post Spacing
3.16.2 Bottom Tension Wire
3.17 ACCESSORIES INSTALLATION
3.17.1 Post Caps
3.17.2 Padlocks
3.18 GROUNDING
3.19 CLEANUP

-- End of Section Table of Contents --

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A116	(2005) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A702	(1989; R 2006) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A90/A90M	(2009) Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM C 94/C 94M	(2010a) Standard Specification for Ready-Mixed Concrete
ASTM F 1043	(2011) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(2010) Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
ASTM F 567	(2011) Standard Practice for Installation of Chain Link Fence
ASTM F 626	(2008) Standard Specification for Fence Fittings
ASTM F 883	(2009) Padlocks

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control

approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fence Assembly; G

Location of Gate, Corner, End, and Pull Posts; G

Gate Assembly; G

Gate Hardware and Accessories; G

Erection/Installation Drawings; G

SD-03 Product Data

Fence Assembly; G

Gate Assembly; G

Gate Hardware and Accessories; G

Recycled Material Content; G

Zinc Coating; G

Fabric; G

Stretcher Bars; G

Concrete; G

1.3 ASSEMBLY AND INSTALLATION INSTRUCTIONS

Submit manufacturer's erection/installation drawings and instructions that detail proper assembly and materials in the design for fence, gate, hardware and accessories.

Submit erection/installation drawings along with manufacturer's catalog data for complete fence assembly and gate assembly.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.5 QUALITY ASSURANCE

1.5.1 Required Report Data

Submit reports of listing of chain-link fencing and accessories regarding weight in ounces for zinc coating.

PART 2 PRODUCTS

2.1 GENERAL

Provide fencing materials conforming to the requirements of ASTM A116,

ASTM A702, ASTM F 626, and as specified.

Submit manufacturer's data indicating percentage of recycled material content in protective fence materials, including chain link fence, fabric, and gates to verify affirmative procurement compliance.

2.2 ZINC COATING

Provide hot-dip galvanized (after fabrication) ferrous-metal components and accessories, except as otherwise specified.

Provide zinc coating of weight not less than 1.94 ounces per square foot, as determined from the average result of two specimens, when tested in accordance with ASTM A90/A90M.

Provide zinc coating conforming to the requirements of the following:

a. Pipe: Grade A in accordance with ASTM F 1083 and Grade B in accordance with ASTM F 1043.

b. Hardware and accessories: ASTM A153/A153M, Table 1

c. Surface: ASTM F 1043

d. External: Type B-B surface zinc with organic coating, 0.97 ounce per square foot minimum thickness of acrylated polymer.

e. Internal: Surface zinc coating of 0.97 ounce per square foot minimum.

Provide galvanizing repair material that is cold-applied zinc-rich coating conforming to ASTM A780/A780M.

2.3 FABRIC

Fabric shall be as shown on the drawings and as referenced and other requirements as specified.

Provide one-piece fabric widths for fence heights up to 12 feet.

2.4 TOP AND BOTTOM SELVAGES

Provide knuckled selvages at top and bottom for fabric with 2 inch mesh.

2.5 LINE POSTS

Minimum acceptable line posts are as follows:

Up to 6-feet high:

Grade A: 1.900 inch O.D. pipe weighing 2.72 pounds per linear foot.

2.6 END, CORNER, AND PULL POSTS

Provide minimally acceptable end, corner, and pull posts as follows:

Up to 6 feet high:

Grade B: 2.375 inch O.D. pipe weighing 3.12 pounds per linear foot.

2.7 SLEEVES

Provide sleeves for setting into concrete construction of the same material as post sections, sized 1-inch greater than the diameter or dimension of the post. Weld flat plates to each sleeve base to provide anchorage and prevent intrusion of concrete.

2.8 TOP RAIL

Provide Grade B weighing 1.82 pounds per linear foot. Provide expansion couplings 6-inches long at each joint in top rails.

2.9 TENSION WIRE

Provide galvanized wire, No. 7-gage, coiled spring wire, provided at the bottom of the fabric only. Provide zinc coating that weighs not less than 1.2 ounces per square foot.

2.10 STRETCHER BARS

Provide bars that have one-piece lengths equal to the full height of the fabric with a minimum cross section of 3/16 by 3/4 inch, in accordance with ASTM A116, ASTM A702 and ASTM F 626.

2.11 POST TOPS

Provide tops that are malleable iron designed as a weathertight closure cap. Provide one cap for each post, unless equal protection is provided by a combination post-cap and barbed-wire supporting arm. Provide caps with an opening to permit through passage of the top rail.

2.12 STRETCHER BAR BANDS

Provide bar bands for securing stretcher bars to posts that are malleable iron spaced not over 15 inches on center. Bands may also be used in conjunction with special fittings for securing rails to posts. Provide bands with projecting edges chamfered or eased.

2.13 GATE POSTS

Provide a gate post for supporting each gate leaf as follows:

Up to 6-feet wide:

2.875 inch O.D. pipe Grade A weighing 5.79 pounds per linear foot.

2.14 GATES

For gate leaves up to 6-feet high or 6-feet wide, provide perimeter gate frames of 1.66 inch O.D. pipe Grade A weighing 2.27 pounds per linear foot.

Provide gate frame assembly that is welded or assembled with special malleable or pressed-steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges; stretcher bars may also be used at top and bottom edges. Attach stretcher bars and fabric to gate frames on all sides at intervals not exceeding 15 inches. Attach hardware with rivets or by other means which provides equal security against breakage or removal.

Provide diagonal cross-bracing, consisting of 3/8-inch diameter adjustable-length truss rods on welded gate frames, where necessary to obtain frame rigidity without sag or twist. Provide nonwelded gate frames with diagonal bracing.

2.15 GATE HARDWARE AND ACCESSORIES

Provide gate hardware and accessories that conforms to ASTM A116, ASTM A702, ASTM F 626, and be as specified:

Provide malleable iron hinges to suit gate size, non-lift-off type, offset to permit 180-degree opening.

Provide latch that permits operation from either side of the gate, with a padlock eye provided as an integral part of the latch.

Provide stops and holders of malleable iron for vehicular gates. Provide stops that automatically engage the gate and hold it in the open position until manually released.

Provide double gates with a cane bolt and ground-set keeper, with latch or locking device and padlock eye designed as an integral part.

2.16 MISCELLANEOUS HARDWARE

Provide miscellaneous hot-dip galvanized hardware as required.

2.17 WIRE TIES

Provide 16-gage galvanized steel wire for tying fabric to line posts,spaced 12 inches on center. For tying fabric to rails and braces, space wire ties 24 inches on center. For tying fabric to tension wire, space 0.105-inch hog rings 24 inches on center.

Manufacturer's standard procedure will be accepted if of equal strength and durability.

2.18 CONCRETE

Provide concrete conforming to ASTM C 94/C 94M, and obtaining a minimum 28-day compressive strength of 3,000 psi.

2.19 GROUT

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

2.20 PADLOCKS

Provide padlocks conforming to ASTM F 883, with chain.

PART 3 EXECUTION

Provide complete installation conforming to ASTM F 567.

3.1 GENERAL

Ensure final grading and established elevations are complete prior to commencing fence installation.

3.2 EXCAVATION

Provide excavations for post footings which are drilled holes in virgin or compacted soil, of minimum sizes as indicated.

Space footings for line posts 10 feet on center maximum and at closer intervals when indicated, with bottoms of the holes approximately 3-inches below the bottoms of the posts. Set bottom of each post not less than 36-inches below finished grade when in firm, undisturbed soil. Set posts deeper, as required, in soft and problem soils and for heavy, lateral loads.

Remove excavated soil from Government property as directed by the Contracting Officer.

When solid rock is encountered near the surface, drill into the rock at least 12 inches for line posts and at least 18 inches for end, pull, corner, and gate posts. Drill holes at least 1 inch greater in diameter than the largest dimension of the placed post.

If solid rock is below the soil overburden, drill to the full depth required except that penetration into rock need not exceed the minimum depths specified above.

3.3 SETTING POSTS

Remove loose and foreign materials from holes and the soil moistened prior to placing concrete.

Provide tops of footings that are trowel finished and sloped or domed to shed water away from posts. Set hold-open devices, sleeves, and other accessories in concrete.

Keep exposed concrete moist for at least 7 calendar days after placement or cured with a membrane curing material, as approved.

Grout all posts set into sleeved holes in concrete with an approved grouting material.

Maintain vertical alignment of posts set in concrete construction until concrete has set.

3.3.1 Earth and Bedrock

Provide concrete bases of dimensions indicated. Compact concrete to eliminate voids, and finish to a dome shape. Work grout into hole to eliminate voids, and finish to a dome shape.

3.3.2 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and a diagonal tension rod.

3.4 CONCRETE STRENGTH

Provide concrete that has attained at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 calendar days after placement, before rails, tension wire, or fabric are installed. Do

not stretch fabric and wires or hang gates until the concrete has attained its full design strength.

Take samples and test concrete to determine strength as specified.

3.5 TOP RAILS

Provide top rails that run continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by the fencing manufacturer.

3.6 BRACE ASSEMBLY

Provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at midheight of the fabric.

Install brace assemblies so posts are plumb when the diagonal rod is under proper tension.

Provide two complete brace assemblies at corner and pull posts where required for stiffness and as indicated.

3.7 TENSION WIRE INSTALLATION

Install tension wire by weaving them through the fabric and tying them to each post with not less than 7-gage galvanized wire or by securing the wire to the fabric with 10-gage ties or clips spaced 24 inches on center.

3.8 FABRIC INSTALLATION

Provide fabric in single lengths between stretch bars with bottom barbs placed approximately 1-1/2-inches above the ground line. Pull fabric taut and tied to posts, rails, and tension wire with wire ties and bands.

Install fabric on the security side of fence, unless otherwise directed.

Ensure fabric remains under tension after the pulling force is released.

3.9 STRETCHER BAR INSTALLATION

Thread stretcher bars through or clamped to fabric 4 inches on center and secured to posts with metal bands spaced 15 inches on center.

3.10 GATE INSTALLATION

Install gates plumb, level, and secure, with full opening without interference. Install ground set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricated where necessary.

3.11 TIE WIRES

Provide tie wires that are U-shaped to the pipe diameters to which attached. Twist ends of tie wires not less than two full turns and bent so as not to present a hazard.

3.12 FASTENERS

Install nuts for tension bands and hardware on the side of the fence opposite the fabric side. Peen ends of bolts to prevent removal of nuts.

3.13 ZINC-COATING REPAIR

Clean and repair galvanized surfaces damaged by welding or abrasion, and cut ends of fabric, or other cut sections with specified galvanizing repair material applied in strict conformance with the manufacturer's printed instructions.

3.14 TOLERANCES

Provide posts that are straight and plumb within a vertical tolerance of 1/4 inch after the fabric has been stretched. Provide fencing and gates that are true to line with no more than 1/2 inch deviation from the established centerline between line posts. Repair defects as directed.

3.15 SITE PREPARATION

3.15.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation.

3.16 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.16.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10 feeton center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed 500 feet on straight runs between braced posts. Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade. Provide drawings showing location of gate, corner, end, and pull posts.

3.16.2 Bottom Tension Wire

Install bottom tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within 8 inches of respective fabric line.

3.17 ACCESSORIES INSTALLATION

3.17.1 Post Caps

Install post caps as recommended by the manufacturer.

3.17.2 Padlocks

Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike, and provide two keys for each padlock.

3.18 GROUNDING

Ground fences on each side of all gates, at each corner, at the closest approach to each building located within 50 feet of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations can not exceed 650 feet. Bond each gate panel with a flexible bond strap to its gate post. Ground fences crossed by powerlines of 600 volts or more at or near the point of crossing and at distances not exceeding 150 feet on each side of crossing. Provide ground conductor consisting of No. 8 AWG solid copper wire. Provide copper-clad steel rod grounding electrodes 3/4 inch by 10 foot long. Drive electrodes into the earth so that the top of the electrode is at least 6 inches below the grade. Where driving is impracticable, bury electrodes a minimum of 12 inches deep and radially from the fence, with top of the electrode not less than 2 feet or more than 8 feet from the fence. Clamp ground conductor to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. Total resistance of the fence to ground cannot exceed 25 ohms

3.19 CLEANUP

Remove waste fencing materials and other debris from the work site.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 92 23

SODDING

PART 1 GENERAL

1.1 REFERENCES
1.2 DEFINITIONS
1.2.1 Stand of Turf
1.3 RELATED REQUIREMENTS
1.4 SUBMITTALS
1.5 DELIVERY, STORAGE, AND HANDLING
1.5.1 Delivery
1.5.1.1 Sod Protection
1.5.1.2 Fertilizer Delivery
1.5.2 Storage
1.5.2.1 Sod Storage
1.5.2.2 Topsoil
1.5.2.3 Handling
1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS
1.6.1 Restrictions
1.7 TIME LIMITATIONS
1.7.1 Sod

PART 2 PRODUCTS

2.1 SODS
2.1.1 Classification
2.1.2 Purity
2.2 TOPSOIL
2.3 SOIL CONDITIONERS
2.4 FERTILIZER
2.5 WATER

PART 3 EXECUTION

3.1 PREPARATION
3.1.1 Extent of Work
3.1.2 Soil Preparation
3.1.2.1 Fertilizer Application Rates
3.2 SODDING
3.2.1 Finished Grade and Topsoil
3.2.2 Placing
3.2.3 Sodding Slopes and Ditches
3.2.4 Finishing
3.2.5 Rolling
3.3 PROTECTION OF TURF AREAS
3.4 GRASS ESTABLISHMENT
3.4.1 General
3.4.2 Watering

3.4.3 Mowing
3.4.4 Weeding
3.4.5 Resodding
3.5 RESTORATION
3.6 ACCEPTANCE REQUIREMENTS
3.6.1 Acceptance Requirements
3.6.2 Repairs

-- End of Section Table of Contents --

SECTION 32 92 23

SODDING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT)

Section 162 (2010) Prepared Soil Layer

TURFGRASS PRODUCERS INTERNATIONAL (TPI)

TPI GSS (1995) Guideline Specifications to Turfgrass Sodding

1.2 DEFINITIONS

1.2.1 Stand of Turf

100 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

Not used.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Sod Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Sod Storage

Lightly sprinkle with water, cover with moist burlap, straw, or other approved covering; and protect from exposure to wind and direct sunlight until planted. Provide covering that will allow air to circulate so that internal heat will not develop. Do not store sod longer than 24 hours. Do not store directly on concrete or bituminous surfaces.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Sod

Place sod a maximum of thirty six hours after initial harvesting, in accordance with TPI GSS as modified herein.

PART 2 PRODUCTS

2.1 SODS

2.1.1 Classification

Argentine Bahia sod shall be well matted with live grass roots. Sod shall be sufficiently thick to hold together during handling operations and to obtain a satisfactory growth of grass. Sod shall be live, fresh, and uninjured at the time of planting and it shall be the Contractor's responsibility to ensure that it contains sufficient moisture at planting to produce growth. Before the sod is harvested, the grass shall be mowed to the average height normally maintained for that variety of grass and shall have all clippings removed. Presence of weeds or other material which might be detrimental to the proposed planting will be cause for rejection of sod.

2.1.2 Purity

Sod species shall be genetically pure, free of weeds, pests, and disease.

2.2 TOPSOIL

Supply and install topsoil in accordance with FDOT Standard Section 162.

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.4 FERTILIZER

Provide commercial fertilizer of neutral character, with some elements derived from organic sources, containing not less than 8 percent phosphoric acid, 8 percent potassium, and percentage of nitrogen required to provide less than 1 pound of actual nitrogen per 1,000 square feet of area. Provide nitrogen in form that will be available to the seeded and sodded area during initial period of growth. The chemical designation shall be 5-10-10.

Ensure that the fertilizer is delivered to the site in labeled bags or containers.

2.5 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation containing no element toxic to plant life.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Extent of Work

Provide soil preparation (including soil conditioners), fertilizing, and sodding of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.2 Soil Preparation

Provide 4 inches of off-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.2.1 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Organic Granular Fertilizer 10 to 15 pounds per 1000 square feet.

Synthetic Granular Fertilizer 10 to 15 pounds per 1000 square feet.

3.2 SODDING

3.2.1 Finished Grade and Topsoil

Prior to the commencement of the sodding operation, the Contractor shall verify that finished grades are as indicated on drawings; the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 31 00 00 EARTHWORK.

The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove from the surface debris and stones over a minimum 5/8 inch in any dimension.

3.2.2 Placing

Place sod a maximum of 36 hours after initial harvesting, in accordance with TPI GSS as modified herein.

3.2.3 Sodding Slopes and Ditches

For slopes 2:1 and greater, lay sod with long edge perpendicular to the contour. For V-ditches and flat bottomed ditches, lay sod with long edge perpendicular to flow of water. Anchor each piece of sod with wood pegs or wire staples maximum 2 feet on center. On slope areas, start sodding at bottom of the slope.

3.2.4 Finishing

After completing sodding, blend edges of sodded area smoothly into surrounding area. Air pockets shall be eliminated and a true and even surface shall be provided. Frayed edges shall be trimmed and holes and missing corners shall be patched with sod.

3.2.5 Rolling

Immediately after sodding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 GRASS ESTABLISHMENT

3.4.1 General

The period of grass establishment shall begin immediately after the completion of sodding in an area and shall continue for a period of 2 months after the completion of sodding on the entire project unless the desired grass cover is established in a shorter period of time and shortening of the grass-establishment is authorized.

3.4.2 Watering

Provide and maintain temporary piping and lawn-watering equipment required to convey water from the water source to uniformly water the grassed areas. Water shall be free from substances detrimental to the growth of vegetation. Water sources located on Government property will be subject

to approval prior to use. Temporary water equipment shall be removed after grass area acceptance.

Watering schedules shall be arranged and lawn-watering equipment laid out in a manner to avoid the necessity of walking over muddy and newly grassed areas.

After the initial watering, the grassed areas shall be watered as required to maintain the soil in a moist condition for the entire grass-establishment period.

3.4.3 Mowing

When the average height of grass reaches 2-1/4 inches, sodded lawn areas shall be mowed with approved mowing equipment to a grass height of 1-1/2 inches. When the amount of cut grass is heavy, the cuttings shall be removed to prevent smothering the grass.

When the average height of grass reaches 8 inches, areas shall be mowed with approved mowing equipment ot a grass height of 4 inches.

3.4.4 Weeding

Weeds or other undesirable vegetation that threaten to smother the grass shall be uprooted and removed from the area.

3.4.5 Resodding

The area on which an acceptable stand of grass is not present shall be sodded as specified for the original planting. An acceptable stand of living grass from at least 90 percent of the sod placed according to this specification. Areas on which there is not an acceptable stand of grass shall continue to be replanted throughout the following year until an acceptable stand of grass is present.

3.5 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

3.6 ACCEPTANCE REQUIREMENTS

3.6.1 Acceptance Requirements

Completed grass areas shall have been recently mowed and be covered with a uniform stand of the specified grass, be free of rank growths of weeds or other undesirable vegetation, and be free of irregular surface changes and other depressions where water will accumulate.

Scattered bare spots not larger than 6 inches in any dimension will be allowed, up to a maximum of 3 percent of any grass area.

Condition of grass areas at the time of inspection will be noted and a determination made whether the grass-establishment period shall be extended for any area.

3.6.2 Repairs

If, before completion and final acceptance of the facility, portions of the surface become gullied or otherwise damaged, the grass areas having been destroyed, the affected area shall be repaired to re-establish the condition and grade of the soil prior to sodding and then re-sodded, and the grass established as specified.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 05 24

DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 SCOPE OF WORK
1.2 RELATED WORK
1.3 REFERENCES
1.4 SUBMITTALS
1.5 GENERAL REQUIREMENTS
1.6 DELIVERY, STORAGE, AND HANDLING OF MATERIALS
1.6.1 Handling
1.7 QUALIFICATIONS
1.8 SAFETY
1.9 BORE PLAN

PART 2 PRODUCTS

2.1 DRILL ROD
2.2 DIRECTIONAL DRILLING EQUIPMENT REQUIREMENTS
2.2.1 Drilling Rig
2.2.2 Drill Head
2.2.3 Mud Motors (If Required)
2.3 LOCATING EQUIPMENT
2.4 PRODUCT PIPE
2.4.1 HDPE Piping for Potable Water
2.4.2 HDPE Piping for Electrical
2.4.2.1 Polyethylene, Flexible Conduit
2.4.2.2 Transitions, HDPE to PVC
2.5 DRILLING FLUIDS
2.6 WIRE TRACING
2.7 GUIDANCE SYSTEMS

PART 3 EXECUTION

3.1 DRILL SET-UP AREA
3.2 DRILL ENTRANCE AND EXIT PITS
3.3 DRILL ENTRANCE AND EXIT ANGLE
3.4 DRILLING FLUIDS
3.5 PILOT HOLE
3.6 REAMING
3.7 PULLBACK
3.8 GUIDANCE SYSTEMS
3.9 CLEANING CONDUIT PIPE
3.10 DOCUMENTATION
3.11 UTILITY LOCATES
3.12 TESTING
3.13 CLEANUP

-- End of Section Table of Contents --

SECTION 33 05 24

DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 SCOPE OF WORK

This Section includes furnishing all labor, materials, equipment, and incidentals necessary to complete each directional drill (or horizontal directional drilling, HDD) installation shown on the drawings.

Directional drilling at additional locations must receive prior approval from the Contracting Officer.

1.2 RELATED WORK

Section 01 33 00	SUBMITTAL PROCEDURES
Section 01 57 20.00 10	ENVIRONMENTAL PROTECTION
Section 31 00 00	EARTHWORK
Section 33 11 00	WATER DISTRIBUTION

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 13A	(2006; Errata 2008) Specification for Drilling-Fluid Materials

ASTM INTERNATIONAL (ASTM)

ASTM A 48/A 48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM D 1248	(2005) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 149	(2009) Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM D 3261	(2010a) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

ASTM D 3350	(2010) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 4976	(2006) Standard Specification for Polyethylene Plastics Molding and Extrusion Materials
ASTM F 714	(2008) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM D 790	(2007e1) Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bore Plan; G

Submit an electronic copy and three hard copies of the record drawings (G) to the Contracting Officer within 5 days after completing the pull back. The record drawings shall include a plan, profile, and all information recorded during the progress of the work. The record drawings shall be tied to the project's survey control.

SD-03 Product Data

Directional Drilling Equipment
Size, capacity, and arrangement of equipment
Location and size of drilling and receiving pits
Dewatering and methods of removing spoils material
Type, location, and method of installing locator station
Method of fusing pipe segment and type of equipment
Type of cutting head
Method of monitoring and controlling line and grade
Method of detecting surface movement

SD-07 Certificates

Contractor's State License Number; G

Submit statement of qualifications and records of previous similar jobs; G

1.5 GENERAL REQUIREMENTS

ASTM A 48/A 48M--(2003; R 2008) Standard Specification for Gray Iron Castings

ASTM A 307--(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM D 3261--(2003) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

ASTM D 3350--(2008) Polyethylene Plastics Pipe and Fittings Materials

ASTM D 4976--(2006) Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

ASTM F 714--(2008) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

1.6 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Store materials onsite in enclosures or under protective covering. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

All materials found during inspection or during the progress of work to have cracks, flaws, surface abrasions, or other defects shall be rejected and removed from the job site.

Disposal of fluids is the responsibility of the Contractor. Disposal of fluids shall be done in a manner that is in compliance with all permits and applicable federal, state, and local regulations. The Contractor may dispose of the drilling fluids on approved land owned by the Government. The drilling slurry shall be spread over the Government-approved disposal area and plowed into the soil.

1.6.1 Handling

Handle conduit, piping, fittings, and other accessories in a manner to ensure delivery to the excavation in sound, undamaged condition. Carry, do not drag, conduit/piping to the excavation. Store conduit, piping, and fittings that are not to be installed immediately, under cover out of direct sunlight.

1.7 QUALIFICATIONS

The Contractor to perform this work is to be a State Licensed Underground Utilities Contractor.

The Contractor and his field supervisor assigned to this project must be experienced in work of this nature and must have successfully completed similar projects of similar length, pipe type, pipe size, and soil type using directional drilling in the last 3 years. The Contractor shall submit a description of such project(s) which shall include, at a minimum, a listing of the location(s), date of project(s), owner, pipe type and size installed, length of installation, type and manufacturer of equipment used, and other information relevant to the successful completion of the project.

1.8 SAFETY

Directional drilling equipment machine safety requirements shall include common grounding system to prevent electrical shock in the event of underground electrical cable strike. The grounding system shall connect all pieces of interconnecting machinery; the drill, mud mixing system, drill power unit, drill rod trailer, operators booth, worker grounding

mats, and any other interconnected equipment to a common ground. The drill shall be equipped with an "electrical strike" audible and visual warning system that will notify the system operators of an electrical strike.

Provide equipment to guard against electrocution and an alarm system on drilling equipment capable of detecting electrical current as it approaches electric lines

1.9 BORE PLAN

Prior to beginning work, the Contractor must submit to the Contracting Officer a to-scale shop drawing of the pilot bore plan with vertical scale 1-inch equals 2 inches and horizontal scale 1-inch equals 20 feet. The plan shall show finished grade, deflection and radii of the pilot bore, and all existing utilities with minimum vertical and horizontal clearances. The proposed clearance shall exceed the guidance system accuracy tolerance by a minimum of 100 percent.

PART 2 PRODUCTS

2.1 DRILL ROD

The Contractor shall select the appropriate drill rod to be used. The drill rod shall be inspected and approved for use by the Contractor prior to arrival at the work site.

2.2 DIRECTIONAL DRILLING EQUIPMENT REQUIREMENTS

The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pull back of the pipe, drilling fluid mixing, delivery, and recovery system of sufficient capacity to successfully complete the installation, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be reused (if required), a magnetic guidance system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, and trained and competent personnel to operate the system. All equipment shall be in good, safe condition with sufficient supplies, materials, and spare parts on hand to maintain the system in good working order for the duration of this project.

2.2.1 Drilling Rig

The directional drilling machine shall consist of a hydraulically powered system to rotate and push hollow drilling pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing, and rotating pressure required to complete the installation. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. The hydraulic system shall be free of leaks. The rig shall have a system to monitor and record maximum pullback pressure during the pullback operations. There shall be a system to detect electrical current from the drill string and an audible alarm that automatically sounds when an electrical current is detected.

2.2.2 Drill Head

The drill head shall be seeable by changing its rotation, and shall provide necessary cutting surfaces and drilling fluid jets.

2.2.3 Mud Motors (If Required)

Mud motors shall be of adequate power to turn the required drilling tools.

2.3 LOCATING EQUIPMENT

Shall have manufacturer tolerances of plus/minus 0.25 foot or better. Equipment shall be calibrated prior to the beginning of the work. Rods and pipe shall be located during the drilling process, to the tolerance in the contract documents.

2.4 PRODUCT PIPE

2.4.1 HDPE Piping for Potable Water

The product pipe to be installed shall be HDPE as specified in Section 33 11 00 WATER DISTRIBUTION.

2.4.2 HDPE Piping for Electrical

2.4.2.1 Polyethylene, Flexible Conduit

ASTM D 1248. Provide conduit that is continuous, flexible, high-density polyethylene Type III, SDR 11, IPS pipe of the size indicated on the drawings.

2.4.2.2 Transitions, HDPE to PVC

Install transitions for bonding high-density polyethylene conduit Type III, SDR 11 pipe to Schedule 40 PVC conduit using a two-part resin conduit adhesive specifically designed for the purpose and consisting of the following minimum properties:

Hardness (Shore D Durometer) 70-80
Flexibility (ASTM D 790) >2 percent
Dielectric Strength (ASTM D 149) 450 Volts/Mil (Nonconductive)
Air-tight (no leakage) 120 psi
Typical Adhesive Shear Strength: Substrate (HDPE to PVC 275 lbs/in2)
Typical Impact Resistance: HDPE 24.8 in-lbs, PVC 37.2 in-lbs

Bevel the inner diameter of the HDPE to create a smooth passage for cable pulling. Terminate the HDPE conduit in the belled end of the PVC conduit. Apply adhesive in accordance with the approved manufacturer's installation instructions.

2.5 DRILLING FLUIDS

Refer to Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION and Volume 1, Drawing EN2 for requirements when working in sites with potential contamination and environmental issues. Put in place additional environmental protection necessary to contain any hydraulic or drilling fluid spills, including berms, liners, turbidity curtains, and other measures. Do not store fuel in bulk containers within 200 feet of any water body or wetland area.

Provide a self-contained, closed, drilling fluid mixing system of sufficient size to mix and deliver drilling fluid. The mixing system shall continually agitate the drilling fluid during operations.

Use a high quality bentonite drilling fluid to ensure hole stability, cuttings transport, bit and electronics cooling, and hole lubrication to reduce drag on the drill pipe and the product pipe. Ensure that the composition of the fluid complies with API Spec 13A.

Mix the bentonite drilling fluid with potable water (of proper pH) to ensure no contamination is introduced into the soil during the drilling, reaming, or pipe installation process. The Contractor is responsible for any required pH adjustments. Provide bentonite product that contains the proper additives according to the manufacturer for use in directional drilling in the soil conditions that are expected to be encountered on the project.

The delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe. Connections between the pump and drill pipe shall be relatively leak-free. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and conveyed to the drilling fluid recycling system. A berm at least 12 inches high shall be maintained around drill rigs, the drilling fluid mixing system, entry and exit pits, and the drilling fluid cycling system to prevent spills into the surrounding environment. Pumps and or vacuum truck(s) of sufficient size shall be in place to convey excess drilling fluid from containment areas to storage and recycling facilities. The Contractor shall be responsible for properly disposing of any waste product generated as part of this operation.

The drilling fluid recycling system shall separate sand, dirt, and other solids from the drilling fluid to render the drilling fluid re-usable. Spoils separated from the drilling fluid will be stockpiled for later use or disposal.

2.6 WIRE TRACING

For nonmetallic piping, provide tracing wire in accordance with Section 31 00 00 EARTHWORK. Attach wire to top of pipe in such a manner that will not be displaced during construction operations.

2.7 GUIDANCE SYSTEMS

A Magnetic Guidance System (MGS) probe or proven gyroscopic probe and interface shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance shall be capable of tracking at all depths up to 50 feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate and calibrated to the manufacturer's specifications of the vertical depth of the borehole at the sensing position at depths of up to 50 feet and accurate to 2 feet horizontally.

Components: The Contractor shall supply all components and materials to install, operate, and maintain the guidance system.

The guidance system shall be of proven type, and shall be set up and operated by personnel trained and experienced with the system. The operator shall be aware of any geo-magnetic anomalies and shall consider such influences in the operation of the guidance system.

PART 3 EXECUTION

3.1 DRILL SET-UP AREA

Contractor may not disturb existing fence, structure, walkways, drive isles, and business operations during directional drilling operations.

3.2 DRILL ENTRANCE AND EXIT PITS

Contractor shall be responsible for design and construction of the drill entrance and exit pits.

Drill entrance and exit pits are required and shall be maintained at a minimum size to allow only the minimum amount of drilling fluid storage prior to transfer to mud recycling or a processing system or removal from the site.

Drilling mud shall not be allowed to flow freely on the site or around the entrance or exit pits. Mud spilled shall be removed as soon as possible and the ground restored to original condition. Pits shall be shored to OSHA standards.

When drilling near wetlands or water courses, the Contractor shall provide secondary containment to prevent drilling fluids from entering the wetlands area or water course by using sandbags or other acceptable means as approved by the Contracting Officer.

3.3 DRILL ENTRANCE AND EXIT ANGLE

Entrance and exit angles can be whatever the Contractor desires such that the elevation profile maintains adequate cover to reduce the risk of drilling fluid breakouts and that ground exit occurs as specified herein.

Contractor shall be responsible for ensuring that entrance and exit angles ensure pullback forces do not exceed 5 percent strain on the polyethylene pipe.

3.4 DRILLING FLUIDS

Maintain drilling fluid in the bore hole to increase the stability of the surrounding soil and reduce drag on the pulled pipe.

Dispose of the drilling fluids in compliance with all relative environmental regulations, right-of-way and work space agreements, and permit requirements.

Drilling fluid returns can be collected in the entrance pit, exit pit, or spoils recovery pit. Immediately clean up any drilling fluid spills or overflows from these pits.

Provide drilling fluid relief holes as required to prevent heaving of earth, pavement, or roads. Properly seal the relief holes in a timely manner to prevent any damage or injury.

Minimize drilling fluid at locations other than entry and exit points. Immediately clean up any drilling fluids that inadvertently surface.

3.5 PILOT HOLE

The type and size of the pilot string cutting head and the diameter of the drill pipe shall be at the Contractor's discretion.

The pilot hole shall be drilled along the path shown on the plan and profile drawings. Pilot hole tolerances are as follows:

1. Horizontal tolerance: 1-1/2 feet from the centerline of the product pipe.

2. Entry Point Location: The pilot hole entry point shall be within plus or minus 3 feet of the location shown on the drawings or as directed by the Contracting Officer in the field.

3. Exit Point Location: The exit point location shall be within plus or minus 3 feet of the location shown on the drawings or as directed by the Contracting Officer in the field.

The installed pipeline cover requirements as shown on the drawings or as specified shall not be violated.

At completion of pilot hole drilling, furnish Contracting Officer with tabulations of horizontal and vertical alignment.

3.6 REAMING

Reaming operations shall be conducted at the Contractor's discretion. The type of back reamer to be utilized shall be determined by the type of subsurface soil conditions that are encountered during the pilot hole drilling operation. The reamer type shall be at the Contractor's discretion.

3.7 PULLBACK

The entire pipeline to be installed via directional drill shall be fully assembled prior to commencement of pullback operations.

The pipeline shall be supported during pullback operations in a manner to enable it to move freely and prevent damage. The pipeline shall be installed in one continuous pull.

Torsional stress shall be minimized by using a swivel to connect the pull section to the reaming assembly.

The maximum allowable tensile force imposed on the pull section shall not exceed 90 percent of the pipe manufacturer's safe pull (or tensile) strength. If the pull section is made up of multiple pipe sizes or materials, the lowest safe pull strength value shall govern and the maximum allowable tensile force shall not exceed 90 percent of this value.

External pressure shall be minimized during installation of the pullback section in the reamed hole. Damaged pipe resulting from external pressure shall be replaced at no cost to the Government. Buoyancy modification shall be at the discretion of the Contractor.

Pull detection wire along with HDPE pipe. Extend wire into closest valve box at each end of HDPE pipe.

3.8 GUIDANCE SYSTEMS

Use a magnetic survey tool located behind the pilot string cutting head.

3.9 CLEANING CONDUIT PIPE

Thoroughly clean out each conduit run as it is completed by drawing a stiff bristle brush, of the nominal conduit size, through until conduit is clear of particles of earth, sand, gravel, and water. Swab the conduits with a poly-pig of the nominal conduit size and test the conduit with a non-flexible testing mandrel no less than 7 inches in length with a diameter suitable for the conduit being cleaned. After cleaning immediately install conduit caps. Provide mule tape in each conduit with minimum 8900 newton pulling strength. Mandrel shall be approved by the Contracting Officer before use. A tag line is required on each end of the mandrel during the testing process. Provide a tag line of sufficient strength to withdraw the cleaning device.

3.10 DOCUMENTATION

The Contractor shall maintain drilling logs that accurately provide drill bit location (both horizontally and vertically) at least every 15 feet along the drill path. In addition, logs shall be kept that record, as a minimum, the following every 15 minutes throughout each drill pass, back ream pass, or pipe installation pass:

1. Drilling fluid pressure.
2. Drilling fluid flow rate.
3. Drill thrust pressure.
4. Drill pullback pressure.
5. Drill head torque.

The Contracting Officer or Contracting Officer's Representative shall have access to instrumentation, readings, and logs at all times during operation.

3.11 UTILITY LOCATES

Contractor shall locate all utilities prior to the start of excavation or drilling. The Contractor shall be responsible for damage to utilities and shall repair damaged utilities at no cost to the Government.

3.12 TESTING

See Section 33 11 00 WATER DISTRIBUTION for testing requirements.

3.13 CLEANUP

Immediately upon completion of work of this section all rubbish and debris shall be removed from the job site. All construction equipment and implements of service shall be removed and the entire area involved shall be left in a neat condition acceptable to the Contracting Officer.

"Blow holes" or "breakouts" of drilling fluid to the surface shall be cleaned up immediately and the surface area returned to its original condition. All drilling fluids, spoils, and separated materials shall be disposed of in compliance with federal, state, and local environmental regulations.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 11 00

WATER DISTRIBUTION

PART 1 GENERAL

1.1 REFERENCES
1.2 DESIGN REQUIREMENTS
1.2.1 Water Distribution Mains
1.2.2 Water Service Lines
1.3 SUBMITTALS
1.4 SHOP DRAWINGS
1.5 DELIVERY, STORAGE, AND HANDLING
1.5.1 Delivery and Storage
1.5.2 Handling

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS
2.1.1 Piping Materials
2.1.1.1 Ductile-Iron Piping
2.1.1.1.1 Ductile-Iron Joints
2.1.1.1.2 Ductile-Iron Fittings
2.1.1.1.3 Lining and Coating
2.1.1.1.4 Manufacturers
2.1.1.1.5 Gaskets
2.1.1.1.6 Retainer Glands
2.1.1.1.7 External Pipe Restraints
2.1.1.1.8 Internal Pipe Restraints
2.1.1.2 Pipe Connections
2.1.1.3 Polyvinyl Chloride (PVC) Pressure Pipe
2.1.1.3.1 4-Inch PVC Pressure Pipe
2.1.1.3.2 Gaskets for PVC Pipe
2.1.1.3.3 3-Inch and Smaller PVC Pipe
2.1.1.4 PVC Fittings
2.1.1.4.1 4-Inch PVC Pressure Pipe Joints
2.1.1.4.2 3-Inch and Smaller PVC Pipe Joints
2.1.1.4.3 4-Inch PVC Pressure Pipe Fittings
2.1.1.4.4 3-Inch and Smaller PVC Pipe Fittings
2.1.1.4.5 3-Inch and Smaller PVC Pipe Unions
2.1.1.5 HDPE Pipe and Fittings
2.1.1.5.1 Quality Assurance
2.1.1.5.2 Pipe and Fittings
2.1.1.6 Galvanized Steel Pipe
2.1.2 Valves, Hydrants, and Other Water Main Accessories
2.1.2.1 Gate Valves
2.1.2.1.1 Cast-Iron Resilient Wedge Gate Valves, 2 Inches through 3 Inches, Threaded End (AWWA C509)
2.1.2.1.2 Ductile-Iron Resilient Wedge Gate Valves, 3 Inches through 20 Inches, for Exposed and Buried Service (AWWA C515)

2.1.2.2 Backflow Preventer Assemblies
2.1.2.3 Combination Air Valve, Single Body
2.1.2.4 Ball Valves
2.1.2.5 Valve Actuators
2.1.2.6 Fire Hydrants
2.1.2.7 Indicator Posts
2.1.2.8 Valve Boxes
2.1.2.9 Valve Vaults
2.1.2.10 Unions
2.1.2.11 Warning Tape and Tracing Wire for Buried Piping
2.1.2.12 Water System Identification Tags
2.1.2.13 Sleeve-Type Mechanical Couplings
2.1.2.14 Transition Couplings
2.1.2.15 Retainer Glands
2.1.2.16 Restraining Harness
2.1.2.17 Hanger and Support Systems
2.1.2.17.1 General
2.1.2.17.2 Hanger and Support Systems
2.1.2.18 Tracer Wire for All Piping Including Horizontal Directional Drilling
2.1.2.19 Polyethylene Bagging
2.1.2.20 Polyethylene Bagging for DI HDD Applications
2.2 WATER SERVICE LINE MATERIALS
2.2.1 Water Service Line Appurtenances
2.2.1.1 Service Saddles
2.2.1.2 Corporation
2.2.1.3 Curb or Service Stops
2.2.1.4 Curb Boxes

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES
3.1.1 General Requirements for Installation of Pipelines
3.1.1.1 Cutting Of Pipe
3.1.1.2 Location
3.1.1.3 Earthwork
3.1.1.4 Placing, Laying And Pipe Connections
3.1.1.5 Rubber Gaskets
3.1.1.6 Couplings And Joints
3.1.1.7 Deflection
3.1.1.8 Installation of Tracer Wire
3.1.1.9 Anchoring and Restraining
3.1.1.10 Locating Devices
3.1.1.11 Connections to Existing Water Lines
3.1.1.12 Flanged Pipe
3.1.1.13 HDPE Pipe and Fittings
3.1.1.13.1 General
3.1.1.13.2 Laying Pipe
3.1.2 Installation of Valves and Hydrants
3.1.3 Installation of Water Service Piping
3.1.3.1 Service Line Connections to Water Mains
3.1.4 Location of Meters
3.2 TESTING -- NON-HDPE PIPE AND FITTINGS
3.2.1 Hydrostatic Test of Aboveground or Exposed Piping
3.2.2 Leakage Test for Buried Piping
3.2.3 Test Timing
3.2.4 Retesting
3.2.5 Sterilizing
3.3 TESTING -- HDPE PIPE AND FITTINGS

3.4 TEST OF BACKFLOW PREVENTION ASSEMBLIES
3.5 WATER MAIN TAPS/SADDLES
3.6 DISINFECTION CRITERIA FOR KSC POTABLE WATER SYSTEM INSTALLATION, REPAIR, OR MODIFICATION TO WATER MAINS
3.7 DISPOSING OF HEAVILY CHLORINATED WATER
3.8 CLEANUP

-- End of Section Table of Contents --

SECTION 33 11 00

WATER DISTRIBUTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI C1012	(2007; Errata 2009) Ductile Iron or Malleable Iron for 1/2-inch thru 1-1/2-inch

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A21.11	(2000) Rubber Gasket Joints Cast and Ductile Iron Press Pip
ANSI A21.53	(2006) AWWA Standard for Ductile-Iron Compact Fittings for Water Service

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1015	(2009) Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies - (ANSI approved 2010)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2008; Errata 2010) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(2008) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	(2008) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2007) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2005) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C150/A21.50	(2002; Errata 2003; 2008) Thickness Design of Ductile-Iron Pipe
AWWA C151/A21.51	(2009) Ductile-Iron Pipe, Centrifugally Cast, for Water

ANSI/AWWA C153/A21.53	(2006) Ductile-Iron Compact Fittings for Water Service
AWWA C207	(2007) Standard for Steel Pipe Flanges for Waterworks Service-Sizes 100 mm through 3600 mm 4 in. through 144 in.
AWWA C502	(2005) Dry-Barrel Fire Hydrants
AWWA C509	(2009) Resilient-Seated Gate Valves for Water Supply Service
AWWA C510	(2007) Standard for Double Check Valve Backflow Prevention Assembly
AWWA C511	(2007) Standard for Reduced-Pressure Principle Backflow Prevention Assembly
ANSI/AWWA C512	(2007) Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
ANSI/AWWA C515	(2009) Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
AWWA C550	(2005; Errata 2005) Protective Epoxy Interior Coatings for Valves and Hydrants
AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C605	(2005) Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA C800	(2005) Underground Service Line Valves and Fittings
AWWA C900	(2007; Errata 2008) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
AWWA C901	(2008) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13mm) Through 3 In. (76 mm), for Water Service
AWWA C906	(2007) Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) through 63 In., (1,575 mm) for Water Distribution and Transmission

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2001) Pipe Threads, General

	Purpose (Inch)
ASME B16.1	(2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.11	(2009) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2011) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B31.1	(2007) Power Piping and Process Piping
ASME B36.10	(2004; R 2010) Welded and Seamless Wrought Steel Pipe
ASME B18.2.1	(1996; R 2005) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 2005) Standard for Square and Hex Nuts
ASME B18.21.1	(2009) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.22.1	(1965; R 2008) Plain Washers
ASME B18.5.2.1M	(2006) Metric Round Head Short Square Neck Bolts
ASME B18.5.2.2M	(1982; R 2005) Metric Round Head Square Neck Bolts
ASME B18.6.1	(1981; R 2008) Wood Screws (Inch Series)
ASME B18.6.3	(2003; R 2008) Machine Screws and Machine Screw Nuts
ASME SA-36/SA-36M	(2007) Carbon Structural Steel
ASME SA-675/SA-675M	(2007) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties

ASTM INTERNATIONAL (ASTM)

ASTM A 105/A 105M	(2009) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A 126	(2004; R 2009) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 148/A 148M	(2008) Standard Specification for Steel Castings, High Strength, for Structural Purposes
ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 242/A 242M	(2004; R 2009) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A 27/A 27M	(2008) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 322	(2007) Standard Specification Steel Bars, Alloy, Standard Grades
ASTM A 325	(2009a) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 47/A 47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A 48/A 48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A 489	(2004e1) Standard Specification for Carbon Steel Lifting Eyes
ASTM A 513	(2008a) Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A 563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 575	(1996; R 2007) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 576	(1990b; R 2006) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A 635/A 635M	(2009b) Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for

ASTM A 90/A 90M	(2009) Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM B 427	(2009) Standard Specification for Gear Bronze Alloy Castings
ASTM B 584	(2009a) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B 62	(2009) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 633	(2007) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM D 1330	(2004; R 2010) Rubber Sheet Gaskets
ASTM D 1784	(2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2464	(2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2467	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 3261	(2010a) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3350	(2010) Polyethylene Plastics Pipe and Fittings Materials
ASTM E 488	(1996; R 2003) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F 1554	(2007a) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F 2206	(2002; R 2010) Standard Practice for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock
ASTM F 436	(2010) Standard Specification for Hardened

Steel Washers

ASTM F 477 (2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

ASTM F 593 (2002; R 2008) Stainless Steel Bolts, Hex Cap Screws, and Studs

ASTM F 594 (2009) Standard Specification for Stainless Steel Nuts

ASTM F 714 (2008) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

ASTM F 879 (2010) Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR Manual (1988e9) Manual of Cross-Connection Control

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION (FDEP)

FAC 62-555.335 (2003) Guidance Documents for Public Water Systems

FAC 62-555.340 (2003) Disinfection and Bacteriological Evaluation of Public Water System Components

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC (2009) International Plumbing Code

JOHN F. KENNEDY SPACE CENTER (KSC)

KNPR 8500.1 KSC Environmental Requirements

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58 (2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24 (2010) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NSF INTERNATIONAL (NSF)

NSF/ANSI 14 (2009) Plastics Piping System Components and Related Materials

NSF/ANSI 61	(2009) Drinking Water System Components - Health Effects

PLASTICS PIPE INSTITUTE (PPI)

PPI TR-4	(2010) PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe
PPI TR-33	(2006) Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe

UNDERWRITERS LABORATORIES (UL)

UL 789	(2004; R 2008) Standard for Indicator Posts for Fire-Protection Service

1.2 DESIGN REQUIREMENTS

1.2.1 Water Distribution Mains

Provide water main accessories, gate valves and backflow preventers/meter assemblies as specified and where indicated.

Provide water distribution mains indicated as 6 through 12 inch diameter pipe sizes of ductile-iron pipe. Provide water distribution mains indicated as 2- through 4-inch diameter pipe sizes of polyvinyl chloride (PVC) plastic pipe. Also provide water main accessories, gate valves, backflow preventers, and water meters as specified and where indicated.

1.2.2 Water Service Lines

Provide water service lines indicated as 1- and 2-inch lines from water distribution main to building service at the point indicated. Water service lines shall be polyvinyl chloride (PVC) plastic pipe. PVC plastic pipe appurtenances, and valves as specified for water mains may also be used for service lines. Provide water service line appurtenances as specified.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Water Line Connection Plan; G

As-Built Drawings; G

SD-03 Product Data

Pipe Connections; G

Ductile Iron Pipe; G

Gaskets; G

Water service line, piping, fittings, joints, valves, and coupling; G

Ductile Iron Fittings; G

Valves; G

HDPE Pipe and Fittings; G

Water Meters; G

Appurtenances; G

Polyvinyl Chloride (PVC) Pressure Pipe; G

PVC Fittings; G

Unions; G

Valve Boxes; G

Hydrants; G

Corporation; G

Backflow Preventer Assemblies; G

Service Saddles; G

Submit manufacturer's instructions or catalog cuts.

SD-06 Test Reports

Hydrostatic Test; G

Leakage Test; G

Bacteriological Disinfection; G

Test results from commercial laboratory verifying disinfection

HDPE Pipe and Fittings; G

Backflow Prevention Assemblies; G

SD-08 Manufacturer's Instructions

Backflow Preventer Assemblies

Ensure that manufacturer's instructions include special provisions required to install equipment, components, and systems packages. Special notices shall detail impedances, hazards, and safety precautions.

1.4 SHOP DRAWINGS

A Water Line Connection Plan shall be submitted by the Contractor for the complete water system prior to start of work. The plan shall describe connections to existing water main, including any necessary valve closures and temporary outages.

As-built drawings are required for all systems and will be prepared by a surveyor registered in the State of Florida. As-built drawing shall contain the following information:

Location of valves, fittings, hydrants, and meters.

Elevation of top of water line at all utility crossings.

Separation between other utilities within 10 feet horizontally.

Material used.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not exceed the manufacturer's recommended stacking height during storage. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves, hydrants, and meters free of dirt and debris.

1.5.2 Handling

Handle pipe and accessories to ensure delivery to the trench in an undamaged conditions. Take particular care not to injure the pipe coating. When the coating or lining of any pipe or fitting is damaged, the Contractor shall repair at his expense in an approved manner. Do not place other pipe or material inside of a pipe or fitting after the coating has been applied. Carry the pipe into position. Only use pinch bars and tongs for aligning or turning the pipe on the bare ends of the pipe. Clean the interiors of pipe and accessories before the pipe or accessories are lowered into the trench keep clean during laying operations by an approved method. Before installation, inspect the pipe for defects. Replace material found to be defective before or after laying with sound material without additional cost to the Government. Store rubber gaskets that are not to be installed immediately in a cool dark place out of the direct rays of the sun.

PART 2 PRODUCTS

Ensure that newly installed or constructed public water system (PWS) components that come into contact with drinking water or drinking water treatment chemicals conform to NSF/ANSI 61 or Section 6 of NSF/ANSI 14.

Ensure that any pipe and pipe fitting used in the construction, alteration, or repair of any PWS is lead free (contains not more than 8 percent lead). Ensure that any plumbing fitting or fixture that is intended to dispense water for human consumption and that is used in the construction, alteration, or repair of any PWS is lead free (in compliance with Section 9

of NSF/ANSI 61 as adopted in FAC 62-555.335).

Color code or mark all water main pipes, including fittings, using blue as a predominant color to differentiate drinking water from reclaimed or other water. Apply blue stripes to the pipe wall of underground metal pipe. Ensure that pipe striped during manufacturing of the pipe has continuous stripes that run parallel to the axis of the pipe, are located at no greater than 90-degree intervals around the pipe, and will remain intact during and after installation of the pipe.If tape or paint is used to stripe pipe during installation of the pipe, apply the tape or paint in a continuous line that runs parallel to the axis of the pipe and that is located along the top of the pipe; for pipes with an internal diameter of 24 inches or greater, apply tape or paint in continuous lines along each side of the pipe as well as along the top of the pipe.

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

Ensure that all materials in contact with potable water are NSF/ANSI 61 approved and are suitable for use with chloraminated water.

2.1.1.1 Ductile-Iron Piping

All ductile-iron piping shall be cement-lined with push-on joints, and designed and manufactured in accordance with AWWA C150/A21.50 and AWWA C151/A21.51 for the following minimum operating conditions:

The minimum internal design pressure shall be 150 psi with a 100-psi surge allowance, with a safety factor of 2, for a total internal design pressure of 500 psi.

The external loads design criteria shall be for the minimum cover indicated on the drawings at 120 pounds per cubic foot soil weight and live load based on one AASHTO H-20 truck load. The thickness design of ductile iron pipe shall be in accordance with AWWA C150/A21.50.

The horizontal deflection of cement-mortar-lined ductile-iron pipe resulting from external load conditions shall not exceed 3 percent of the pipe diameter based on the trench design shown on the drawings.

Pressure Class: All ductile iron piping shall meet the following minimum working pressure classes:

(a) 4-inch through 12-inch: 350 psi.
(b) Pipe greater than 12 inches: 250 psi.

Provide buried pipe and fittings that are petroleum asphalt coated according to the manufacturer's recommendations and encased in 8-mil high-density polyethylene tubes in accordance with AWWA C105/A21.5 Method A. Paint all flanged and above-grade or exposed pipe and fittings in accordance with Section 09 90 00.00 98 PAINTING AND COATING.

Where new flanged pipe is joined with existing and other new flanges, provide adaptor flange pipe sections if necessary.

Ensure that all bolts, nuts, and stud provided are corrosion-resistant alloy with hex heads or heavy hex heads conforming to AWWA C115/A21.15 and Appendix A of AWWA C115/A21.15, except where otherwise indicated on the

drawings.

2.1.1.1.1 Ductile-Iron Joints

Ductile-iron fittings, below grade/buried, shall be furnished with mechanical joints and ductile-iron fittings above grade/exposed, shall be furnished with flanged joint ends as shown on the drawings and specified in this Section:

Mechanical Joints: All buried ductile-iron fittings shall be furnished with mechanical joint ends unless noted otherwise. Mechanical joints shall conform to AWWA C111/A21.11. Glands shall be constructed of ductile-iron.

Flanged Joints: Pipe for threaded flange fabrication shall be Special Thickness Class 53 in accordance with AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C115/A21.15. Bolt circle and bolt holes shall match those of ASME B16.1 Class 125 flanges. The flanges shall be rated for a maximum working pressure of 250 psi. Threaded flanges shall be individually fitted and machine tightened on the pipe ends. Flange facing shall be smooth or with shallow serrations in accordance with AWWA C115/A21.15.

2.1.1.1.2 Ductile-Iron Fittings

General: Ductile-iron pipe fittings shall meet the requirements of AWWA C110/A21.10 and be cement lined and seal coated. Fittings shall be manufactured in accordance with AWWA C110/A21.10. Where taps are shown on fittings, tapping bosses shall be provided. At a minimum, fittings shall have the same pressure rating as the connecting pipe.

Flanged Joint: AWWA C110/A21.10 and ASME B16.1, faced and drilled 125-pound ANSI standard.

Mechanical Joint: AWWA C110/A21.10. Provide mechanical joint fittings for all buried fittings as shown in the drawings, unless noted otherwise. Provide specified gaskets.

2.1.1.1.3 Lining and Coating

Perform all field measurements confirming the accuracy of the piping sizes and lengths shown on the drawings. Notify the Contracting Officer immediately before deviating from or altering the lining of ductile-iron piping shown on the approved layout schedule.

Cement-Lined Ductile-Iron Pipe and Fittings: Interior surfaces of all cement-lined ductile-iron pipe, fittings, and specials shall be cleaned and lined in the shop with a standard thickness cement-mortar lining applied in conformity with AWWA C104/A21.4, Portland cement mortar. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the Contractor shall repair or replace damaged or unsatisfactory portions with lining conforming to these Specifications at no additional cost to the Government. Pipe linings for potable water lines shall be NSF/ANSI 61 approved.

All buried ductile-iron pipe and fittings cement-mortar linings shall be surface sealed with an asphaltic seal coating, 1 mil, in accordance with AWWA C104/A21.4.

Coat all parts of the joint restraint system with coal tar epoxy as in

Section 09 90 00.00 98 PAINTING AND COATING, Mega-Bond coating system by EBAA Iron, Inc. or Contracting Officer approved equal.

2.1.1.1.4 Manufacturers

Acceptable ductile-iron pipe manufacturers include US Pipe, American Ductile Pipe, Griffin Pipe, or approved equal.

2.1.1.1.5 Gaskets

Gaskets shall be EPDM, Viton, or an approved equal. Wherever contaminated groundwater or contaminated soils are present, gaskets shall be Viton, or an approved equal. Refer to drawings for locations.

Gaskets for mechanical joints shall be compatible with potable water pipe service and be in accordance with ANSI A21.11 and ASTM D 1330.

Flange gaskets shall be in accordance with AWWA C207, except as modified in this Section. Gaskets shall be ring type. All gasket material shall be suitable for potable water and shall be resistant to free chlorine concentrations up to 10 mg/L. All gasket material shall be rated to the surge pressures noted under the paragraph entitled "Ductile-Iron Piping" of this Section.

Gaskets for flanged joints shall be 1/8-inch-thick, cloth-inserted rubber conforming to applicable parts of ASME B16.21 and AWWA C207. Gasket material shall be free from corrosive alkali or acid ingredients. Gaskets shall be full-face type for 125-pound flanges.

2.1.1.1.6 Retainer Glands

Retainer glands shall be provided for all buried ductile-iron mechanical joints, fitting, and ductile-iron pipe connections to buried valves. Retainer glands shall be designed for joint retaining through the use of a follower gland and set screw-anchoring devices that impart multiple wedging action against the pipe. The mechanical joint-restraint device shall be UL listed and shall have a working pressure of at least 250 psi with a minimum safety factor of 2.

a. Gland: Manufactured of ductile iron conforming to ASTM A 536. Gland dimensions shall match ANSI A21.11 and ANSI A21.53.

b. Restraining Devices: Manufactured of ductile iron heat treated to a minimum hardness of 370 BHN. Restraining devices shall incorporate a set screw/twist-off nut bolt to ensure the proper actuating of the restraining device. The twist-off nut shall be designed to come off at the torque limit desired to anchor the restraining device in place on the pipe.

c. Joint Deflection: Retainer gland joint deflection shall be limited to manufacturer's recommended maximum deflection angle. Joint deflection shall be applied before the set screws are torqued.

d. Acceptable Manufacturers are EBAA Iron, Inc. - Megalug 1100 Series, or approved equal.

2.1.1.1.7 External Pipe Restraints

Ductile-iron pipe push-on (bell and spigot) joint restraint shall be

provided by a restraining harness consisting of a restraint ring, connecting tie-rods, and split-ring assembly installed at all push-on joints. The restraint ring shall consist of wedging components made from 60-42-12 ductile-iron conforming to ASTM A 536 and wedges heat treated to minimum 370 BHN. Torque limiting twist-off nuts shall be provided on each wedge to ensure proper applied installation torque. The split ring shall be made from 60-42-12 ductile-iron conforming to ASTM A 536. The connecting rods shall be made of steel conforming to AWWA C111/A21.11. Sizes 4- to 16-inch-diameter restraining harnesses shall have 350-psi maximum working pressure rating. All harnesses shall be designed with a 2-to-1 safety factor applied to the maximum working pressure rating.

Acceptable manufacturers are EBAA Iron, Inc. - Series 1700 or approved equal.

2.1.1.1.8 Internal Pipe Restraints

Acceptable manufacturers are:

American Ductile Iron Pipe:

Fast Grip® Gasket
Flex Ring® Joint

US Pipe:

Field Lok® Gasket
TR Flex Restrained Joint Pipe and Fittings

Or Contracting Officer-approved equal.

2.1.1.2 Pipe Connections

Provide fasteners in accordance with the following section unless otherwise noted.

1. General: For all exterior applications and where fastening aluminum, provide Type 304 stainless steel fasteners. Provide hot-dipped galvanized fasteners in all other applications in accordance with ASTM A 153/A 153M unless noted otherwise on the drawings. Select fasteners for type, grade, and class required.

2. High-Strength Bolts and Nuts: ASTM A 325 with heavy hex nuts ASTM A 563 and hardened carbon-steel washers ASTM F 436.

3. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A, with hex nuts, ASTM A 563, and, where indicated, flat washers.

4. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group A4.

5. Stainless Steel Socket Button and Flat Countersunk Head Cap Screws: ASTM F 879.

6. Anchor Bolts: ASTM F 1554, Grade 36.

7. Eyebolts: ASTM A 489.

8. Machine Screws: ASME B18.6.3.

9. Lag Bolts: ASME B18.2.1.

10. Wood Screws: Flat head, ASME B18.6.1.

11. Plain Washers: Round, ASME B18.22.1.

12. Lock Washers: Helical, spring type, ASME B18.21.1.

13. Cast-in Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing conducted by a qualified independent testing agency according to ASTM E 488.

a. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized in accordance with ASTM A 153/A 153M.

14. Expansion Anchors: Anchor bolt and sleeve assembly with the ability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing conducted by a qualified independent testing agency according to ASTM E 488.

a. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

b. Material for Anchors in Exterior Locations: Alloy Group (A4) stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

2.1.1.3 Polyvinyl Chloride (PVC) Pressure Pipe

2.1.1.3.1 4-Inch PVC Pressure Pipe

Unless otherwise noted, ensure that PVC pressure pipe for nominal diameters 4 inches conforms to the requirements of AWWA C900 DR 18 with gasketed integral bell ends. Ensure that pipe is designed for maximum working pressure of not less than 150 psi. Ensure that the pipe is made to ductile iron pipe ODs instead of IPS. Ensure that the PVC pipe is NSF approved for potable water use.

The following pipe joints and fittings restraint methods can be used to prevent pipe joints and fittings from separating under pressure. No additional financial compensation will be provided to the Contractor for providing the following methods of restraint:

a. Restrain mechanical joint fittings used with PVC pipe (4-inch-through 36-inch-diameter DR 18 pipe) with the EBAA Iron MEGALUG® Series 2000 PV Restrainer or an equal approved by the Contracting Officer. Ensure that the Series 2000 PV restrainers provide a minimum of 150-psi restraint with a 2 to 1 safety factor. Ensure that the restraining device and Tee head bolts are manufactured of high-strength ductile iron meeting ASTM A 536, Grade 65-42-10. Ensure that clamping bolts and nuts are manufactured of corrosion-resistant, high-strength, low-alloy CORTEN steel meeting the requirements of ASTM A 242/A 242M. Also restrain joints on either side of fittings in accordance with

Restrained Joint Table, Spec EBAA 1500, in drawings.

b. Coat all parts of the joint restraint system with coal tar epoxy as in Section 09 90 00.00 98 PAINTING AND COATING, Mega-Bond coating system by EBAA Iron, Inc. or Contracting Officer approved equal.

2.1.1.3.2 Gaskets for PVC Pipe

Gaskets for mechanical joints shall be compatible with potable water pipe service. Gaskets shall be EPR, Viton ETP, or an approved equal. Wherever contaminated groundwater or contaminated soils are present, gaskets shall be Viton ETP, or an approved equal. Refer to drawings for locations.

Gaskets for flanged joints shall be full faced, 1/8-inch thick, having a Brinell Hardness of 50 to 70 durometer A.

2.1.1.3.3 3-Inch and Smaller PVC Pipe

Provide pipe that is Schedule 80, Type I, Grade 1 (Class 12454-B), conforming to ASTM D 1784 and ASTM D 1785.

Provide pipe that bears the NSF logo for potable water use.

2.1.1.4 PVC Fittings

2.1.1.4.1 4-Inch PVC Pressure Pipe Joints

Ensure that pipe joints are made with integral bell and spigot pipe ends. Ensure that the bell consists of an integral thickened wall section designed to be at least as strong as the pipe wall. Supply the bell with a factory glued rubber ring gasket which conforms to the manufacturer's standard dimensions and tolerances. Ensure that the gasket meets the requirements of ASTM F 477. Ensure that the PVC joints are "Ring-Tite" as manufactured by J-M Manufacturing Company, Inc. or an equal approved by the Contracting Officer. Ensure that nontoxic gasket lubricant is as specified by the pipe manufacturer.

2.1.1.4.2 3-Inch and Smaller PVC Pipe Joints

Socket weld pipe and fitting joints except where threaded and flanged joints are required to connect to valves and equipment.

2.1.1.4.3 4-Inch PVC Pressure Pipe Fittings

Ensure that fittings for use with 4-inch PVC pipe are ductile-iron fittings conforming to the requirements of mechanical joint fittings as specified in Part 2.1.1.1 of this Section.

Ensure that exterior coating for fittings is as specified in Part 2.1.1.1 of this Section.

Lining:

a. Ensure that lining for fittings is as specified in Part 2.1.1.1 of this Section.

b. Repair any damaged lined areas in accordance with the manufacturer's recommendations so that the repaired area is equal to the undamaged lined areas.

2.1.1.4.4 3-Inch and Smaller PVC Pipe Fittings

Ensure that fittings are Schedule 80 and conform to ASTM D 2464 for threaded fittings and ASTM D 2467 for socket-type fittings.

2.1.1.4.5 3-Inch and Smaller PVC Pipe Unions

Ensure that unions have socket-type ends, Viton O-rings, and are Schedule 80. Ensure that material is Type I, Grade 1 PVC in accordance with ASTM D 1784.

2.1.1.5 HDPE Pipe and Fittings

Provide a statement in writing from the HDPE pipe manufacturer that the manufacturer is listed with the Plastic Pipe Institute as a qualified extruder for the polyethylene resin to be used in the manufacture of the pipe for this project. Ensure that the performance requirements of the pipe comply with the most current version of AWWA C901 or AWWA C906. Ensure that the manufacturer is listed with NSF/ANSI 61 certification and include the third party certification in the print line of the product.

All persons making heat fusion joints shall receive training in the manufacturer's recommended procedures. The Contractor shall maintain records of trained personnel and certify that training was received not more than 12 months before construction began. Additionally, the Contractor shall have worked on one or more projects involving combined installation of at least 10,000 feet of HDPE butt-fusion-welded pipe and shall provide the Contracting Officer with a written list of HDPE pipeline installation experience, including project location, date, Owner, and personnel assigned and installing on this project.

A representative of the pipe manufacturer shall be onsite to oversee all pipe joining. The Contractor shall pay all costs for the manufacturer's representative.

2.1.1.5.1 Quality Assurance

The pipe and fitting manufacturer(s) shall have an established quality-control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rated, and contamination.

2.1.1.5.2 Pipe and Fittings

General

All HDPE shall be Performance Pipe PE 3408 HDPE, PolyPipe PW PE 3408 HDPE, or approved equal and conform to ASTM D 3350 44576C cell classification.

All HDPE pipe 4 inches in diameter or greater shall have a ductile iron pipe outside diameter in accordance with ASTM F 714, and HDPE pipe 3 inches in diameter and smaller shall be IPS in accordance with ASTM F 714, unless otherwise specified or shown in the drawings.

HDPE Pipe

HDPE pipe 4 inches in diameter and larger shall conform to ASTM D 3350

445576 cell classification rated as PE 3408 by the Plastics Pipe Institute. Minimum pressure rating shall be as specified in this Section. Minimum pressure rating shall be 100 psi SDR 17 (standard dimension ratio) for pipe sizes greater than 4 inches in diameter. For pipe sizes 4 inches and smaller in diameter, the minimum pressure rating shall be 200 psi SDR 9.

The polyethylene compound shall be suitably protected against degradation by ultraviolet light.

The maximum allowable hoop stress shall be 1,000 psi at 73.4° F.

The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the requirements of the resin manufacturer to manufacture pipe from the resin used in accordance with PPI TR-4.

Fittings

HDPE pipe fitting shall conform to ASTM F 2206. The pipe manufacturer shall mold or fabricate the polyethylene fittings. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe.

Molded Fittings: Molded fittings shall be manufactured in accordance with ASTM D 3261 and shall be so marked. Each production lot of molded fittings shall be subjected to the test required under ASTM D 3261. The manufacturer shall submit samples from each molded fitting production lot to x-ray inspection for voids and shall certify that voids were not found.

Fabricated Fittings: Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full-service pressure rating of the mating pipe. Pressure de-rated fittings are not acceptable. Directional fittings 16 inches IPS and larger, such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion and flanged directional outlets. Ensure that fittings fabricated from thicker wall pipe have an ID taper bore to match the wall of the pipe to which it will be fused.

HDPE Pipe Jointing Method

HDPE pipe shall be jointed by butt fusion in accordance with PPI TR-33 and the pipe manufacturer's directions and only for pipe within one SDR ratio of each other.

For SDR ratios that are two or more apart (i.e., SDR 21 to an SDR 11), the joint shall be made using restrained joints. Same-diameter pipe may be joined by using HDPE flange adapters and backup rings bolted to each other. The thicker wall pipe may also have an ID taper bore to match the wall of the thinner wall pipe to which it will be fused.

All HDPE pipe joined by butt fusion shall be made from the same class and type of raw material made by the same raw material supplier.

Butt fusion means the butt joining of the pipe by heat fusion aligned faces of the pipe ends (butts) in a suitable apparatus and joining

under controlled pressure and alignment.

The external bead resulting from the butt-fusion process shall be visible and examined for complete butt-fusion 360 degrees around the pipe exterior.

Short spools of pipe between valves and fittings shall be ductile iron pipe, with all joints restrained for sizes 4 inches and larger. For 2-inch pipe, the spool shall be Schedule 40 Type 304 stainless steel piping or Schedule 80 PVC piping with IP threads stainless steel or PVC fittings and all joints restrained.

Where approved by the Contracting Officer, the HDPE pipe and fittings may be fused with Electrofusion Couplings, as manufactured by Central Plastics Company, or approved equal. Technical information must be provided to demonstrate that the fused coupling will not compromise the structural integrity of the HDPE pipe.

2.1.1.6 Galvanized Steel Pipe

Pipe: Steel piping shall conform to the requirements of ASTM A 53/A 53M, Type S, Grade B, and ASME B36.10, Schedule 40 as indicated on the drawings.

Fittings: Forged steel conforming to ASTM A 105/A 105M and ASME B16.11, Class 2000.

Joints: Threaded conforming to ASME B1.20.1.

Galvanizing: Conform to ASTM A 90/A 90M.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves

2.1.2.1.1 Cast-Iron Resilient Wedge Gate Valves, 2 Inches through 3 Inches, Threaded End (AWWA C509)

Provide valves 2 inches through 3 inches that are of cast-iron or ductile-iron body construction and conform to AWWA C509 for resilient seated gate valves. Provide the valve design that incorporates non-rising stems and triple "O" ring seal staff box. Provide valves that open counterclockwise. Ensure that the valve wedge is symmetrical and fully encapsulated with molded rubber with no exposed iron. Design valves for bubbletight shutoff to flow in either direction. Before shipment the valve manufacturer shall test each valve to 200-psi pressure differential in both directions and provide a certificate to the Contracting Officer stating each valve provided bubbletight shutoff during testing. Ensure that the valve interior and exterior is epoxy fusion coated.

Ensure the ends are threaded ends complying with ASME B1.20.1.

Gate valves shall be manufactured by Mueller, American Flow Control or Kennedy.

2.1.2.1.2 Ductile-Iron Resilient Wedge Gate Valves, 3 Inches through 20 Inches, for Exposed and Buried Service (AWWA C515)

Provide valves that are cast-iron or ductile-iron body valves and comply with ANSI/AWWA C515 and the following. Ensure that valves are of the

bolted-bonnet type with nonrising stems. Ensure that the valve gate is of ductile-iron with a resilient wedge. Ensure that valve stems are Type 304 or 316 stainless-steel or cast, forged, or rolled bronze. Ensure that stem nuts are made of solid bronze. Ensure that bronze conforms to ASTM B 62 or ASTM B 584. Ensure that body bolts are Type 316 stainless-steel. Ensure that end connections for exposed valves are flanged. Ensure that end connections for buried valves are mechanical joint type. Provide reduction-thrust bearings above the stem collar. Ensure that stuffing boxes are O-ring seal type with two rings located in the stem above the thrust collar. Ensure that each valve has a smooth unobstructed waterway free from any sediment pockets. Ensure that valves are lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Ensure that minimum epoxy thickness is 8 mil.

Manufacturers: Clow, AVK, American Flow Control, Kennedy, or approved equal.

2.1.2.2 Backflow Preventer Assemblies

Provide backflow preventers that are the double-check type conforming to AWWA C510 for fire services. Provide valves that are FEBCO 850 or approved equal for double-check. Ensure that the assembly includes pressure gauge test ports and OS&Y shutoff valves on the inlet and outlet, 2-positive-seating check valve for continuous pressure application, and four test cocks. Ensure that the assemblies are rated for a working pressure of 175 psi and that the maximum pressure loss is 6 psi at a flow rate equal to the sprinkler water demand for fire lines, at the location of the assembly. Provide a test port for a pressure gauge both upstream and downstream of the double-check backflow prevention assembly valves.

Use double-check type backflow devices or assemblies for low degree of hazard non-pollutants or contaminants. Ensure that this device conforms to AWWA C510, ASSE 1015, and FCCCHR Manual-9 Standard. Install this unit a minimum of 32 inches above the ground or flood level.

Design and install backflow prevention devices to meet the NFPA's Code requirement for testing backflow prevention devices. Ensure that design includes a method to forward flow (full flow) test downstream of the backflow prevention device and meets all design criteria as stated herein and as shown on the drawings. Ensure that test outlet connection is UL listed, FM approved for fire service. Ensure that each outlet is capable of supplying water flow with a minimum of 250 gpm. Ensure that the outlet connection meets all testing and material specifications as stated herein and as shown on the drawings.

Provide test outlet connections with cast-brass body or Contracting Officer-approved equal material, NPT inlets with 2-1/2-inch NST male outlets equipped with the listed manufacturers cap and chain. Ensure that the test outlet connection includes a brass plate with engraved letter for identification as specified and shown on the drawings.

Provide backflow preventers that are the reduced pressure type conforming to AWWA C511 for potable water services. Provide valves that are FEBCO 825YD for reduced pressure or approved equal. Ensure that the assemblies are rated for a working pressure of 175 psi and that the maximum pressure loss is 6 psi at a flow rate equal to the average day demand for domestic lines, at the location of the assembly. Provide a test port for a pressure gauge both upstream and downstream of the double-check backflow prevention assembly valves.

Ensure that the interior of the backflow preventers is epoxy-coated in accordance with AWWA C550. Provide backflow preventers equipped with a thermally activated valve set for freeze protection installed on the downstream side of the backflow preventer. Provide thermally activated valve manufactured by Crispin, Freezetron, or approved equal. Provide backflow preventers equipped with galvanized steel chain and security lock. Ensure that fire service backflow preventer and associated aboveground piping is red in color. Ensure that domestic service backflow and associated aboveground piping is blue in color.

Ensure that plumbing fixtures, equipment, and pipe connection do not cross connect or interconnect between a potable water supply and any source of non-potable water. Install backflow preventers where indicated and in according with ICC IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any non-potable substance. In addition, install backflow preventers at all locations where the potable water outlet is below the flood level of the equipment or where the potable water outlet is located below the level of the non-potable substance. Locate backflow preventers so that no part of the device will be submerged. Ensure that backflow preventers are of sufficient size to allow unrestricted flow of water to the equipment and preclude the backflow of any non-potable substance into the potable water system. Do not provide bypass piping around backflow preventers. Provide access for maintenance and testing. Ensure that each device is a standard commercial unit.

2.1.2.3 Combination Air Valve, Single Body

All valves shall meet or exceed all applicable provisions of the latest revision of ANSI/AWWA C512, Standard for Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service. All valves for drinking water services shall comply with NSF/ANSI 61. Design pressure is 150 psig.

All valves shall consist of a float or a float assembly. Valves shall be identified properly in plates attached permanently on the valve body. The body and cover shall be cast iron ASTM A 126, Class B; or ASTM A 48/A 48M, Class 35. Valves 3 inches and smaller shall have threaded ends. Valves 4 inches and larger shall have flanged ends. Threaded ends shall comply with ASME B1.20.1. Flanges shall comply with ASME B16.11, Class 125. All flanges shall be flat faced.

The float shall be Type 304 or 316 Stainless Steel. For valves with inlet sizes less than 4 inches, the float shall be capable of withstanding a collapse pressure of 1,000 psig. Trim shall be Type 304 or 316 Stainless Steel. The valve seat shall be of EPDM or other rubber materials that are applicable to water. The valve seat shall be easily removed and replaced in the field.

Drain/test ports on all valves with inlet size 1 inch or larger shall have two 1/2-inch NPT minimum plugged ports, one near the bottom of the valve body and the other near the top of the valve. The plug shall be of stainless-steel, ASTM B 584, Alloy C83600.

2.1.2.4 Ball Valves

Stainless steel ball valves, 2 inches and smaller, shall be rated at a minimum pressure of 1,500 psi WOG at a temperature of 100 degrees F. Valve body shall be 300 Series stainless steel, NSF/ANSI 61 approved. Ball shall be Type 316 stainless steel. Seat and seals shall be reinforced Teflon.

Valves shall have lever handle, plastic coated. Valves shall have screwed ends (ASME B1.20.1) and nonblowout stems. Valves shall be McCanna M402, Worcester Series 48, Stockham SD 2120-CS, Apollo 73-100 Series, or approved equal.

2.1.2.5 Valve Actuators

The valve actuator shall be an integral part of a valve. The valve actuator shall be provided, installed, and adjusted by the valve manufacturer. Actuator mounting arrangements shall facilitate operation and maintenance and shall be determined by the valve manufacturer unless indicated otherwise on the drawings or directed by the Contracting Officer.

All valves shall open counterclockwise as viewed from the top. Unless otherwise required by the Government, the direction of rotation of the wheel or wrench nut to open each valve shall be to the left (counterclockwise). Each valve body or actuator shall have the word "Open" cast on it and an arrow indicating the direction to open.

Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. All exposed nuts, bolts, and washers shall be AISI Type 304 stainless-steel. Unless noted otherwise, equip valves with the following manual actuators:

a. Exposed valves 6 inches and smaller: removable lever or handwheel actuators.

b. Exposed valves 8 inches and larger: geared actuators with handwheels.

c. Buried or submerged valves 6 inches and smaller: 2-inch-square operating nuts (with valve bonnets, valve boxes, and extension stems as required) and T-handle wrench.

d. Buried or submerged valves 8 inches or larger: Geared actuators with 2-inch-square operating nuts (with valve bonnets, valve boxes, and extension stems as required) and wrench.

Provide levers or handwheels to actuate the valves where the valves are within 6 feet and 7 inches from finished grade or the operating floor. Construct handwheels of ductile-iron. Coat levers and handwheels in accordance with Section 09 90 00.00 98 PAINTING AND COATING. Handwheel diameters for traveling nut actuators shall not exceed 8 inches for valves 12 inches and smaller and shall not exceed 12 inches for valves 20 inches and smaller.

Provide chainwheel and guide actuators for all exposed valves installed with their centerlines more than 6 feet and 9 inches above finished grade. Chainwheels shall be cast-iron with stainless-steel stem, clip, and pins. The actuating chain shall be AISI Type 304 SS. Provide stainless-steel chain baskets with these units. Coat chainwheels in accordance with Section 09 90 00.00 98 PAINTING AND COATING.

Chainwheels and guides shall be Clow Figure F-5680, DeZurik Series W or LWG, Stockham, or approved equal.

Gear actuators for vales 8 inches through 20 inches shall be of the worm-and-gear or of the traveling-nut type. Gear actuators for valves 24 inches and larger shall be of the worm-and-gear type. Gear actuators for

motorized valves shall be of the worm-and-gear type, regardless of size.

a. Gear actuators should be designed assuming that the differential pressure across the valves is equal to the test pressure of the connecting piping and assuming a line fluid temperature range of 33 degrees F to 125 degrees F, unless otherwise required in the detailed valve specifications.

b. Enclose and oil lubricate gear actuators with seals provided on shafts to prevent entry of dirt and water into the actuator. Gear actuators for valves aboveground or in vaults and structures shall have handwheels. The actuators for valves in exposed service shall contain a dial indicating the position of the valve disc or plug.

c. Traveling nut and worm-and-gear actuators shall be of the totally enclosed design and proportioned to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 80 pounds on the handwheel or crank. Provide stop-limiting devices in the actuators in the open and closed positions. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Design actuator components between the input and the stop-limiting devices to withstand without damage a pull of 200 pounds for handwheel or chainwheel actuators and an input torque of 300 foot-pounds for operating nuts when operating against the stops.

d. The self-locking worm gear shall be a one-piece design of gear bronze material (ASTM B 427 or ASTM B 584, Alloy C86200) that is accurately machine cut. Actuators for eccentric and lubricated plug valves may use ductile-iron gears provided the gearing is totally enclosed with spring-loaded rubber lip seals on the shafts. The worm shall be hardened alloy steel (ASTM A 322, Grade G41500 or G41400, or ASTM A 148/A 148M, Grade 105-85) with thread ground and polished. Support worm-gear shafts at each end by ball or tapered roller bearings. Valves in aboveground locations or in vaults and structures shall have handwheels. The actuators for valves in exposed service shall contain a dial indicating the position of the valve disc or plug.

e. Traveling nut and worm-and-gear actuators shall be of the totally enclosed design and proportioned to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 80 pounds on the handwheel or crank. Provide stop-limiting devices in the actuators in the open and closed positions. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Design actuator components between the input and the stop-limiting devices to withstand without damage a pull of 200 pounds for handwheel or chainwheel actuators and an input torque of 300 foot-pounds for operating nuts when operating against the stops.

f. The self-locking worm gear shall be a one-piece design of gear bronze material (ASTM B 427 or ASTM B 584, Alloy C86200) that is accurately machine cut. Actuators for eccentric and lubricated plug valves may use ductile-iron gears provided the gearing is totally enclosed with spring-loaded rubber lip seals on the shafts. The worm shall be hardened alloy steel (ASTM A 322, Grade G41500 or G41400, or ASTM A 148/A 148M, Grade 105-85) with thread ground and polished. Support worm-gear shafts at each end by ball or tapered roller bearings. The reduction gearing shall run in a proper lubricant. The handwheel diameter shall be no more than twice the radius of the gear sector in contact with the worm. Worm-gear actuators shall be

Limitorque Model HBC, EIM Series W, or approved equal.

For buried or submerged service, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.

All buried valves shall have non-rising stems. Furnish all buried valves 3 feet below grade or deeper as measured at the valve centerline with an operator stem extension to extend the operating nut within 6 inches from the top of the valve box cover.

2.1.2.6 Fire Hydrants

Fire hydrants shall be in accordance with AWWA C502, for dry barrel-type fire hydrants. Fire hydrants shall meet the following requirements:

Catalogue and maintenance data	Required.
Type of shutoff	Compression or gate
Size of hydrant (valve opening)	5.25-inch
Inlet connection	6-inch, verify with drawings.
Outlet nozzles	Two 2.5-inch hose and one 4.5-inch pumper.
Outlet nozzle threads	See Note 1.
Direction to open	Counterclockwise.
Stem seals	O-ring.
Outlet nozzle cap chains	Required.
Drain outlet, non-corrodible	Required.
Traffic breakaway body and valve rod	Required.
Working pressure rating	200 psi (minimum).
Fire hydrant wrenches	Provide five wrenches as spare parts.
Nozzle wrenches	Provide five wrenches as spare parts for each size nozzle provided.
Breakaway repair kit	Provide five kits as spare parts.

Notes: Outlet nozzle threads shall be the Government's standard fire hydrant thread. The Contractor shall verify thread type before submittal.

Hydrants shall have Underwriter's Laboratory (UL) and Factory Mutual (FM) approvals. Hydrant exteriors shall be painted with one coat of zinc-chromate alkyd primer and two finish coats of approved paint of the color required by the Government. Hydrant is to be painted Red 11105. Hydrant interiors shall be painted with a paint system approved by NSF for use in potable water. Working parts shall be bronze. All internal parts shall be removable through the top of the hydrant. Hydrants shall conform

to NFPA 24.

Fire hydrant extensions shall be provided at no additional cost to the Government to meet final grade requirements. All hydrants shall stand plumb. No portion of the fire hydrant shall be within 6 inches of a sidewalk. After installation, all hydrants shall be inspected, cleaned, and opened and closed as many times as required to verify that all aspects of the hydrant work properly.

Fire hydrants shall be M&H, Kennedy, Mueller, American Darling or approved equal.

2.1.2.7 Indicator Posts

UL 789. Provide for gate valves where indicated.

2.1.2.8 Valve Boxes

Valve boxes shall be cast iron, complete with lock-type covers requiring a special wrench for removal. Cast-iron boxes shall be the extension type with slide adjustments and with flared bases. Concrete boxes shall be constructed in accordance with details indicated. The word "WATER" or "WASTEWATER" shall be cast in the cover. Boxes shall be installed over each gate valve. Boxes shall be of such a length as can be adapted, without full extension, to the depth of cover required over the pipe at the valve location. Concrete boxes may be installed only in locations not subjected to traffic.

2.1.2.9 Valve Vaults

For valve vault manufacturing, please refer to drawings and Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION.

2.1.2.10 Unions

No attempt has been made to show all unions required for the project. The Contractor shall provide unions at all connections of threaded pipe to installed equipment unless deleted by the Contracting Officer, in writing, at certain locations. The unions shall meet or exceed the quality of materials, pressure rating, service, and painting requirements of connected piping.

2.1.2.11 Warning Tape and Tracing Wire for Buried Piping

Warning tape and tracing wire for buried pipe is specified under Section 31 00 00 EARTHWORK.

2.1.2.12 Water System Identification Tags

Provide a coordinated system of piping and equipment identification which includes metal-tag-identified major valves, piping-system components, and equipment.

Install identification tags made of stainless steel and indicating function of valve or similar component on such system devices. Tags shall be not less than 2 inches in diameter and the marking shall be stamped.

Provide equipment with metal identification tags bearing an equipment designation number provided by the Government and matching the drawing

designations.

Secure tags to valve or equipment items with 12-gage galvanized wire.

2.1.2.13 Sleeve-Type Mechanical Couplings

Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. For ductile iron pipe, the middle ring shall be of cast-iron or steel; and the follower rings shall be of malleable or ductile iron. Malleable and ductile iron shall, conform to ASTM A 47/A 47M and ASTM A 536, respectively. Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111/A21.11. Bolts shall be track-head type, ASTM A 307, Grade A, with nuts, ASTM A 563, Grade A; or round-head square-neck type bolts, ASME B18.5.2.1M and ASME B18.5.2.2M with hex nuts, ASME B18.2.2. Bolts shall be a minimum of 5/8 inch in diameter.

2.1.2.14 Transition Couplings

Transition Coupling shall consist of a high-strength steel body, two steel or malleable iron flange or follower rings, a wedge shaped resilient gasket and sufficient number of follower bolts.

Adapter: Steel construction, ASTM A 513, ASTM A 635/A 635M or ASME SA-675/SA-675M GR60, free of surface defect.
Followers: AISI C1012 or ASME SA-36/SA-36M
Bolts: AWWA C111/A21.11
Gasket: Grade 27 BUNA-S.
Shop Paint: Fusion bonded epoxy coating.
Acceptable Manufacturers:
Dresser Manufacturing Division of Dresser Industries, Inc.; Dresser Styles 62 and 162 or approved equal.

2.1.2.15 Retainer Glands

Provide retainer glands for all buried ductile-iron mechanical joints, fitting, and ductile-iron pipe connections to buried valves. Design retainer glands for joint retaining through the use of a follower gland and set screw-anchoring devices which impart multiple wedging action against the pipe. The mechanical joint restraint device shall be UL listed and shall have a working pressure of at least 250 psi with a minimum safety factor of 2.

1. Gland: Manufactured of ductile iron conforming to ASTM A 536. Gland dimensions shall match AWWA C111/A21.11 and ANSI/AWWA C153/A21.53.

2. Restraining Devices: Manufactured of ductile iron heat treated to a minimum hardness of 370 BHN. Incorporate a set screw/twist-off nut bolt into restraining devices to ensure the proper actuating of the restraining device. Design the twist-off nut to come off at the torque limit desired to anchor the restraining device in place on the pipe.

3. Joint Deflection: Limit retainer gland joint deflection to manufacturer's recommended maximum deflection angle. Apply joint deflection before the set screws are torqued.

4. Acceptable manufacturers:

a. EBAA Iron, Inc.; Megalug 1100 Series or approved equal.

2.1.2.16 Restraining Harness

Provide ductile iron pipe push-on (bell and spigot) joint restraint by a restraining harness consisting of a restraint ring, connecting tie-rods, and split-ring assembly installed at all push-on joints. The restraint ring shall consist of wedging components made from 60-42-12 ductile iron conforming to ASTM A 536 and wedges heat treated to minimum 370 BHN. Provide torque limiting twist-off nuts on each wedge to ensure proper applied installation torque. Make the split ring from 60-42-12 ductile iron conforming to ASTM A 536. Make steel connecting rods conforming to AWWA C111/A21.11. Sizes 4- to 16-inch-diameter restraining harnesses shall have a 350-psi maximum working pressure rating and a 18- to 36-inch diameter restraining harnesses shall have 250-psi maximum working pressure rating. Design all harnesses with a 20-to-1 safety factor applied to the maximum working pressure rating.

Acceptable manufacturers:

EBAA Iron, Inc.; Series 1700 or approved equal.

2.1.2.17 Hanger and Support Systems

2.1.2.17.1 General

Not all pipe supports or hangers required are shown on the drawings. Provide pipe supports for every piping system installed. Support piping by pipe support where it connects to pumps or other mechanical equipment.

Ensure that pipe support and hanger components shall withstand the dead loads imposed by the weight of the pipes, fittings, and valves (all filled with water) plus valve actuators and any insulation and shall have a minimum safety factor of 5 based on the material's ultimate strength.

All of the equipment specified in this Section is intended to support the various types of pipe and piping systems. The details shown on the drawings are intended to indicate the generally desired methods of support under normal conditions. Develop final details and any details associated with special conditions not already covered to meet the system conditions specified in the respective Division 22 Pipe Sections.

Support all pipe and tubing as required to prevent significant stresses in the pipe or tubing material, valves, fittings, and other pipe appurtenances and to support and secure the pipe in the intended position and alignment. Design all supports to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact. Any structural steel members required to brace any piping from excessive dislocation shall conform to the applicable requirements of Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS and shall be furnished and installed under this Section.

Space hangers and supports in accordance with ASME B31.1 except that the maximum unsupported span shall not exceed 10 feet unless otherwise specified in this Section.

Where flexible couplings are required at equipment, tanks, etc., the end opposite to the piece of equipment, tank, etc. shall be rigidly supported.

Support all pipe and appurtenances connected to the equipment so as to prevent any strain from being imposed on the equipment or piping system.

Furnish all rods, clamps, hangers, inserts, anchor bolts, brackets, and components for interior pipe supports with galvanized finish, hot-dipped, or electro-galvanized coated, except where field welding is required. Plastic coat interior clamps on plastic pipe. Provide copper-plated supports for copper pipe or shall have a 1/16-inch plastic coating. All rods, clamps, hangers, inserts, anchor bolts, brackets, and components for exterior pipe and pipe within outdoor structures shall be of Type 316 stainless-steel.

Supports shall be sufficiently close together so that the sag of the pipe is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads between supports.

Protect all uninsulated nonmetallic piping such as PVC, CPVC, etc., from local stress concentrations at each support point. Provide protection by galvanized steel protection shields or other method as approved by the Contracting Officer. Where pipes are bottom supported 180 degrees, furnish arc shields. Where 360-degree support is required, such as U bolts, provide protection shields for the entire pipe circumference. Protection shields shall have an 18-gauge minimum thickness, not be less than 12 inches in length, and be securely fastened to pipe with stainless-steel or galvanized metal straps not less than 1/2-inch wide.

Furnish all insulated pipe with a rigid foam insulating saddle at each pipe support location as specified under respective pipe insulation. Provide galvanized protection shields as specified in this Section at each location.

Where pipe hangers and supports come in contact with copper piping, provide protection from galvanic corrosion by wrapping pipe with 1/16-inch-thick neoprene sheet material and galvanized protection shield or copper-plated or PVC-coated hangers and supports.

Provide pipe supports as follows:

1. Support cast-iron and ductile-iron piping at a maximum support spacing of 10 feet with a minimum of one support per pipe section at the joints.

2. Support steel and stainless-steel piping 2-1/2 inches or larger diameter at a maximum support spacing of 10 feet with a minimum of one support per pipe section at the joints.

3. Support spacing for steel and stainless-steel piping 2 inches and smaller diameter and copper tubing shall not exceed 5 feet.

4. Supports for multiple PVC plastic piping shall be continuous wherever possible. Support individually supported PVC pipes as recommended by the manufacturer except that support-spacing shall not exceed 3 feet. Where possible, support multiple, suspended, horizontal

plastic PVC pipe runs by ladder-type cable trays such as the Electray Ladder by Husky-Burndy; Cable Tray by Enduro Composite Systems; the Globetray by the Metal Products Division of United States Gypsum or approved equal. Ladder shall be of FRP construction. Run spacing shall be 12 inches. Tray width shall be approximately 6 inches for single runs and 12 inches for double runs. Furnish ladder-type cable trays complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc., required for a complete support system. Secure individual plastic pipes to the rungs of the cable tray by strap clamps, or fasteners similar to Globe, Model M-CAC; Husky-Burndy, Model SCR; or approved equal. Spacing between clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe. Individual clamps, hangers, and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

5. Support all vertical pipes at each floor or at intervals of not more than 12 feet by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to ensure rigid construction.

6. Pipe supports shall not induce point loadings, but shall distribute pipe loads evenly along the pipe circumference.

7. Provide supports at changes in direction and elsewhere as shown on the drawings or as specified in this Section. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless specifically directed or authorized by the Contracting Officer.

8. Provide pipe supports to minimize lateral forces through valves, both sides of split-type couplings, and sleeve-type couplings and to minimize all pipe forces on pump housings. Pump housings shall not be used to support connecting pipes.

9. Account for effects of thermal expansion and contraction of the pipe in the pipe support selection and installation.

Fabricate or construct any required pipe support for which the supports specified in this Section are not applicable from standard structural steel shapes and concrete and anchor hardware similar to items previously specified in this Section and shall be subject to the approval of the Contracting Officer.

2.1.2.17.2 Hanger and Support Systems

Pipe hangers and supports shall be as manufactured by Anvil, Unistrut, Cooper B-Line, Aikinstrut, Superstrut, or approved equal.

Pipe hangers and supports shall comply with MSS SP-58 for the standard types references on the drawings. Construct special hangers and supports if detailed in the drawings. Type numbers for standard hangers and supports shall be in accordance with MSS SP-58 as listed below:

Type Number	Description	Manufacturer and Model (or Equal)
1	Adjustable steel clevis	Anvil Fig. 590 or 260, B-Line B3100 or B3102

Type Number	Description	Manufacturer and Model (or Equal)
3	Steel double-bolt pipe clamp	Anvil Fig. 295A or 295H, B-Line B3144 or B3144A
4	Steel pipe clamp(pipes smaller than 3 inches)	Anvil Fig. 212, B-Line B3140
4	Steel pipe clamp (pipes 3 inches and larger)	Anvil Fig. 216, B-Line 3142
5	Pipe hanger	B-Line B6690
6	Adjustable swivel pipe ring	Anvil Superstrut 714, Anvil Fig. 104
7	Adjustable steel band hanger	B-Line B3172
8	Extension pipe or riser clamp	Anvil Fig. 261, B-Line B5573
9	Adjustable band hanger	Anvil Fig. 97
10	Adjustable swivel ring band hanger	Anvil Fig. 70, B-Line B3170 NF
11	Split pipe ring with adjustable turnbuckle	Anvil Fig. 108, B-Line B3173
13	Steel turnbuckle	Anvil Fig. 230, B-Line B3202
14	Steel clevis	Anvil Fig. 299, B-Line B3201
15	Swivel turnbuckle	Anvil Fig. 114, B-Line B3224
16	Malleable iron socket	Anvil Fig. 110R, B-Line B3222
17	Steel weldless eye nut	B-Line B3200
18	Steel or malleable iron concrete insert	Anvil Fig. 281, Superstrut 452
19	Top beam C-clamp	Anvil Fig. 92, B-Line B3033
20	Side I-beam or channel clamp	Anvil Fig. 14 or 217
21	Center I-beam clamp	Anvil Figure 134
22	Welded attachment type	Anvil Fig. 66 B-Line B3083

Type Number	Description	Manufacturer and Model (or Equal)
23	C-clamp	Anvil Fig. 86, B-Line B3036L
24	U-bolt	Anvil Fig. 137, B-Line B3188
26	Clip	Anvil Fig. 262, B-Line B3180
28	Steel I-beam clamp with eye nut	Anvil Fig. 228
29	Steel wide flange	Anvil Fig. 228 clamp with eye nut
30	Malleable iron beam clamp with extension piece	Superstrut CM-754, B-Line B3054
31	Light welded steel bracket	Anvil Fig. 194, B-Line B3063
32	Medium welded steel bracket	Anvil Fig. 195, B-Line B3066
33	Heavy welded steel bracket	Anvil Fig. 199, B-Line B3067
34	Side beam bracket	Anvil Fig. 202, B-Line B3062
36	Pipe saddle support	Anvil Fig. 258, B-Line B3095
37	Pipe stanchion saddle	Anvil Fig. 259, B-Line B3090
38	Adjustable pipe saddle support	Anvil Fig. 264, B-Line B3093/B3089
39	Steel pipe covering	Anvil Fig. 160, 161, 162, 163, 164, or 165; Superstrut A 789; B-Line B3160/B3165
40	Insulation protection shield	Anvil Fig. 167, B-Line B3151
41	Single pipe roll	Anvil Fig. 171, B-Line B3114
43	Adjustable roller hanger with swivel	Anvil Fig. 181, B-Line B3110
44	Pipe roll, complete	Anvil Fig. 271, B-Line B3117SL

Pipe hangers and supports shall be hot-dipped galvanized according to ASTM A 153/A 153M carbon steel (ASTM A 36/A 36M, ASTM A 575, or ASTM A 576). Bases, rollers, and anchors shall be steel as described above or may be cast iron (ASTM A 48/A 48M). Pipe clamps shall be steel as described above or may be malleable iron (ASTM A 47/A 47M).

2.1.2.18 Tracer Wire for All Piping Including Horizontal Directional Drilling

Tracer wire for all piping is specified under Section 31 00 00 EARTHWORK.

2.1.2.19 Polyethylene Bagging

Polyethylene bagging for buried ductile iron pipe, fittings, and valves shall be 8 mils thickness minimum polyethylene. The use of poylethylene bagging shall be in accordance with AWWA C105/A21.5

2.1.2.20 Polyethylene Bagging for DI HDD Applications

The initial piece of pipe will require that the polyethylene bagging be securely attached to the pipe barrel, approximately 1 foot from the end of the pipe, using several circumferential wraps of tape. To prevent drilling fluid or cuttings to get under the polyethylene, the tape should be applied directly to both the polyethylene and metal barrel of the pipe. To prevent drilling fluid and cuttings from being forced under the polyethylene bagging during the pull-back, when applying the polyethylene bagging to the assembled joint, the polyethylene overlap should always have the forward pipe's polyethylene bagging overlap the next pipe's polyethylene. To secure the polyethylene at the joint area, a plastic tie strap or tape should be snugly installed/circumferentially wrapped on each side of the joint.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Water Service Line Appurtenances

2.2.1.1 Service Saddles

Service saddles shall be epoxy coated ductile iron bodied suitable for use with PVC water main and corporation cocks specified. Saddles shall be double strap design complete with cemented-in-place O-Ring gaskets and full length threaded boss. Saddles shall have stainless-steel type straps; Clamping arrangement which is not fully contoured to the outside diameter of the pipe, or lugs which dig into the pipe or a saddle which distorts the pipe are not acceptable. Saddles shall be rated for leak free operation at a minimum of 200 psi and shall be as manufactured by Mueller Co, or approved equal.

2.2.1.2 Corporation

Corporation (through 2-1/2 inches in diameter) shall be manufactured from cast bronze with machined fitting surfaces and in accordance with AWWA C800. Corporation shall withstand a minimum working pressure of 200 psi. The inlet and outlet connections shall be coordinated to connect to the adjoining equipment, tubing, piping, couplings, unions, adapters, reducers, etc. by the Contractor. The inlet and outlet size shall be the same. The corporation outlet shall have the required all-bronze adapters, unions, reducers, bushings, or couplings to properly secure to the adjacent items and appurtenances. Corporation shall be Model FB series as manufactured by Ford Meter Box Company, Inc., or approved equal. Each corporation shall be furnished with a solid bronze square-head plug for plugging the corporation outlet. For stainless-steel insert stiffeners shall be used as required for connection to tubing, PVC pipe, HDPE pipe, or as required.

2.2.1.3 Curb or Service Stops

Curb stops shall be manufactured from cast bronze with machined fitting surfaces. Curb stops shall withstand a minimum working pressure of 150 psi. For curb stops (through 2 inches in diameter), the inlet and outlet connections shall be threaded or have 2-hole flanges to connect to the adjoining equipment, tubing, piping, couplings, unions, adapters, reducers, etc. as coordinated by the Contractor. The nuts and bolts for the flanges shall be cadmium-coated or zinc-plated. The inlet and outlet size shall be the same diameter, unless otherwise approved by the Contracting Officer. The curb stop inlet and outlet shall have the required all-bronze adapters, unions, bushings, or couplings to properly secure it to the adjacent items and appurtenances. Curb stops shall have padlock wings and be lockable with standard size padlocks. Curb stops shall be as manufactured by Ford Meter Box Company, Inc., or approved equal. Each curb stop shall be furnished with a solid bronze square-head plug for plugging the curb stop outlet. Ford stainless steel, insert stiffeners shall be used as required for connection to tubing, PVC pipe, HDPE pipe, or as required.

2.2.1.4 Curb Boxes

Provide a curb box for each curb or service stop. Curb boxes shall be of cast iron of a size suitable for the stop on which it is to be used. Provide a round head. Cast the word "WATER" on the lid. Each box shall have a heavy coat of bituminous paint.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

Any utilities damaged, both new and existing, as a result of this project shall be repaired per manufacturer's recommendations at no cost the Government.

3.1.1 General Requirements for Installation of Pipelines

3.1.1.1 Cutting Of Pipe

Cutting of pipe shall be done without damage to the pipe. Cutting shall be done with an approved mechanical cutter. Wheel cutters shall be used when practical.

3.1.1.2 Location

For the location and separation requirements of the water main with respect to other utilities, refer to the Typical Utility Conflict Detail in the drawings.

3.1.1.3 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.1.1.4 Placing, Laying And Pipe Connections

Pipe and accessories shall be carefully lowered into the trench by suitable equipment. Under no circumstances shall materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Poles used as levers for removing skids across trenches shall be made of wood and have broad flat faces to prevent damage to the pipe or

coating. Except where necessary in making connections with other lines or as authorized, pipe shall be laid with the bells facing upstream. Full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that foreign material will not enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor in an approved manner, at no additional expense to the Government.

Pipe ends left for future connections shall be valved, plugged, or capped and anchored. Where connections are made between new work and existing mains, the connections shall be made by using special sections and fittings to suit the actual conditions. Where made under pressure, connections shall be installed in accordance with the recommendations of the manufacturer of the pipe being tapped.

3.1.1.5 Rubber Gaskets

Rubber gaskets shall be handled, lubricated, and installed in accordance with the pipe manufacturer's recommendations.

3.1.1.6 Couplings And Joints

Installation of couplings, mechanical joints, and flanged joints shall be in accordance with the manufacturer's recommendations. Pipe Connections between different types of pipe and accessories shall be made with transition fittings as recommended by the manufacturer.

3.1.1.7 Deflection

Maximum allowable deflection for ductile iron bell-and-spigot pipe and mechanical-joint pipe, shall be as recommended by the manufacturer.

When the alignment requires deflections in excess of the manufacturer's recommendations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth, as approved. Slight deflections may be made by straight pipe, provided that the maximum joint opening caused by such deflections does not exceed the maximum recommended by the pipe manufacturer. Short-radius curves and closures shall be formed by shorter lengths of pipe, bevels, or fabricated special sections.

3.1.1.8 Installation of Tracer Wire

Tracer wire for all piping is specified under Section 31 00 00 EARTHWORK.

3.1.1.9 Anchoring and Restraining

Refer to drawings for thrust block requirements.

3.1.1.10 Locating Devices

Locating devices shall be loacted as indicated in the contract documents. For all subsurface fittings with thrust blocks, embed the device into the top surface on the thrust block such that half the device is exposed and the location is at the centroid of the thrust block top surface area. For

all subsurface elbows, tees, and valves without thrust blocks installed, install the device 6 inches above the fitting unless noted otherwise. The locating devices shall be Omni Marker Model 161 Water Marker or approved equal. Locating devices shall not be installed at vertical bends.

3.1.1.11 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped.

3.1.1.12 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.1.13 HDPE Pipe and Fittings

3.1.1.13.1 General

All polyethylene pipe shall be cut, fabricated, joined, and installed in strict conformance with the pipe manufacturer's recommendations. Joining, laying, and pulling of polyethylene pipe shall be accomplished by personnel experienced in working with HDPE pipe.

3.1.1.13.2 Laying Pipe

Joints

All HDPE to HDPE pipe joints shall be joined by heat fusion that produces homogeneous, sealed, leak-tight joints.

Restrained mechanical joint adaptors shall be provided at tie-ins with valves, ductile iron fittings, and other pipe materials.

Butt Fusion Testing

The Contractor shall test the first fusion of each day.

In testing, the fusion shall be allowed to cool completely and then fusion test straps shall be cut out. The test shall be a minimum of 12 inches or 30 times the wall thickness in length with the fusion in the center and a minimum of 1 inch or 1.5 times the wall thickness in width. Bend the test strap until the ends of the strap touch. The Contractor shall not begin until a fusion test has passed the bent strap test.

Pipe Deflection

When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane or where long radius curves are permitted, the amount of deflection shall not exceed 75% of that recommended by the manufacturer.

Pipe Cutting

Cutting HDPE butt fusion connections to HDPE pipe, valves, fittings, or closure pieces shall be done in a neat, workmanlike manner without

damaging the pipe. Ends shall be cut square and perpendicular to the pipe axis.

3.1.2 Installation of Valves and Hydrants

a. Installation of Valves: Installation of valves shall be in accordance with manufacturer's recommendations.

b. Installation of Hydrants: Installation of hydrants shall be in accordance with manufacturer's recommendations. Install hydrants with the 4 1/2 inch connections facing the adjacent paved surface. If there are two paved adjacent surfaces, contact the Contracting Officer for further instructions.

3.1.3 Installation of Water Service Piping

3.1.3.1 Service Line Connections to Water Mains

Connect service lines 2 inch size to the main by a corporation stop and gooseneck and install a service stop below the frostline as indicated. Connect service lines to ductile-iron water mains in accordance with AWWA C600 for service taps. Connect service lines to PVC water mains in accordance with AWWA C605 for service taps.

3.1.4 Location of Meters

The City of Cocoa shall install the water meter at the location shown on the drawings.

3.2 TESTING -- NON-HDPE PIPE AND FITTINGS

3.2.1 Hydrostatic Test of Aboveground or Exposed Piping

Open vents at high points of the piping system to purge air while the pipe is being filled with water. Venting during system filling may also be provided by temporarily loosening flanges.

Subject the piping system to the test pressure of 150 psi. Maintain the test pressure for a minimum of 2 hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show zero leakage or weeping. Correct leaks and retest until zero leakage is obtained.

3.2.2 Leakage Test for Buried Piping

Leakage tests shall be conducted concurrently with the pressure test. Duration of each leakage test shall be at least 2 hours. During the test, the main shall be subjected to a pressure of 150 psi. Leakage is defined as the additional quantity of water supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume is defined by the formula:

DUCTILE IRON PIPE		PVC PIPE	
$L = \frac{SD(P)^{1/2}}{C}$		$L = \frac{ND(P)^{1/2}}{C}$	
in which:		in which:	
L = allowable leakage (gallons)		L = allowable leakage (gallons)	
S = length of pipe tested (feet)		N = number of rubber-gasketed joints in the pipe tested	
D = diameter of the pipe (inches)		D = diameter of the pipe (inches)	
P = specified test pressure (psig)		P = specified test pressure (psig)	
C = 133,200		C = 7,400	

Allowable leakage in gallons per hour not exceed 5 percent of total system pressure.

Should any test of laid pipe disclose a leakage greater than that shown, the defective joints shall be located and repaired until the leakage is within the specified tolerance, at no additional cost to the Government.

3.2.3 Test Timing

Except where concrete-reaction backing necessitates a 72-hour delay, pipelines jointed with rubber gaskets, mechanical, or bolted joints may be subjected to hydrostatic pressure, inspected, and tested for leakage after partial completion of backfill.

3.2.4 Retesting

Before permanent paving is placed over the pipeline, a measured leakage test of the entire pipeline shall be required. Leakage loss shall be within approved tolerances.

3.2.5 Sterilizing

Water piping, including valves, fittings, and other devices, shall be sterilized and tested according to AWWA C651. After successful sterilization, the piping shall be flushed before placing into service. Water for sterilization will be furnished by the Government, but disposal shall be the responsibility of the Contractor.

3.3 TESTING -- HDPE PIPE AND FITTINGS

Hydrostatic Tests-General

All field tests shall be made in the presence of the Government or Contracting Officer. Except as otherwise directed, all pipelines shall be tested. All piping to operate under liquid pressure shall be tested in sections of approved length, typically from valve to valve and in no case longer than 1,000 feet.

Hydrostatic testing shall consist of a 150 psi combined pressure test and leakage test. The field test pressure shall be measured at the lowest point

of the section being tested. The pressure shall be applied by a pump connected to the pipe in a manner satisfactory to the Contracting Officer. The pump, pipe connection, and all necessary apparatus shall be furnished by the Contractor and shall be subject to the satisfaction of the Contracting Officer.

The maximum duration for any test, including initial pressurization, initial expansion, and time at test pressure, must not exceed 8 hours. If the test is not completed due to leakage, equipment failure, etc., depressurize the test section and allow it to "relax" for at least 8 hours before bringing the test section up to test pressure again.

Monitored Make-Up Water Test: The test procedure consists of initial expansion and test phases.

During the initial expansion phase, the test section is filled with water. Once the line is filled, make-up water is added at hourly intervals as required to maintain the test pressure for 3 hours.

At the end of the initial expansion period, the addition of make-up water will cease. During the test phase the pipe will not have any water added to it for the following 2 hours. The 2 hours will be the actual leakage test. At the end of the 2-hour period, measured make-up water will be added to the pipe to return it to the original test pressure.

If the amount of make-up water added is greater than calculated using the numbers listed below, the section being tested will be considered to have a leak. The leak shall be found and fixed at the Contractor's expense and that section of the line retested before continuing with subsequent leakage tests. Testing and repairs shall be repeated at the Contractor's expense until the amount of make-up water is less than the amount calculated using the numbers listed below.

ALLOWABLE FOR EXPANSION UNDER TEST PRESSURE*
POLYETHYLENE PIPE

Nominal Pipe Size (inches)	Allowances for Expansion		
	1-Hour Test	2-Hour Test	3-Hour Test
2	0.08	0.12	0.15
3	0.10	0.15	0.25
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.0	1.5
10	0.75	1.3	2.1
12	1.1	2.3	3.4
14	1.4	2.8	4.2
16	1.7	3.3	5.0

These allowances only apply to the test phase and not to the initial expansion phase.

3.4 TEST OF BACKFLOW PREVENTION ASSEMBLIES

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow preventer assemblies.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges shall be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.5 WATER MAIN TAPS/SADDLES

The existing distribution system shall be protected from backflow contamination during filling for pressure testing, flushing, disinfection, and final connections in accordance with AWWA C651. A 2 inch jumped connection bypassing the tie-in valve with an approved double-check valve or approved backflow prevention device shall be used for filling the new water main. The tie-in valve shall be closed and secured by a locking mechanism until flushing of the new water main occurs.

Prior to installing a service saddle, the KSC Pollution Control and Sanitation Officer (PCSO), or designated representative, must be contacted to monitor the installation. The exterior surface of the main to be tapped shall be thoroughly cleaned. Once the sleeve is securely attached to the main, the sleeve shall be filled with a hypochlorite solution and hydrostatically tested at 200 psi for a minimum of 15 minutes with no loss of pressure or sign of leakage. During the tapping process, the interior surface of the sleeve and the surface being tapped shall be in direct contact with the hypochlorite. After the tapping procedure is complete, flush the line to remove metal bits and debris.

All connections to existing work shall be in accordance with AWWA C651 for protection of existing main from contamination by the new line during filling, flushing and testing.

3.6 DISINFECTION CRITERIA FOR KSC POTABLE WATER SYSTEM INSTALLATION, REPAIR, OR MODIFICATION TO WATER MAINS

The KSC Pollution Control and Sanitation Officer (PCSO) or designated representative shall approve the disinfection procedure to be used and be present during the process. A minimum of 24 hours lead time is required to schedule attendance of disinfection by PCSO or representative. Contact should be made through the Construction Management Office. Ensure proper disinfection protocol/bacteriological sampling occurs if water line is broken, tapped, modified, or if loss of pressure occurs. All repaired, modified or newly installed water system components shall be disinfected after pressure and leak tests have been performed. All existing mains closed for outage shall be disinfected and tested prior to use. The system components to be disinfected shall be thoroughly flushed with potable water before introducing the chlorinating solution. This flushing is required to remove all debris from the systems components. The chlorinating solution shall provide a dosage of not less than 50 parts per million (ppm). The chlorine solution shall be introduced into the water line in an approved manner and be evenly distributed throughout the entire effected systems components long enough to destroy all non-spore forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and tests shall reveal not less than 25 ppm of chlorine residual after the 24 hour retention period. The line shall be flushed with potable water until the residual chlorine level is reduced to less than 1.0 ppm or to the normal background level in the area. Discharge of highly chlorinated water from disinfection shall be coordinated with URS Water and Wastewater. Samples will be collected by the Contractor or designated representative from several points in the water system for bacteriological examination. The system will remain closed and will not be accepted for use until two consecutive days of satisfactory bacteriological results have been obtained and approval has been given by the PCSO and regulatory agencies.

Taps, modification, repairs, or new lines added to the system shall be tested and disinfected following AWWA C651 and KNPR 8500.1. Successful disinfection shall be demonstrated by bacteriological testing following FAC 62-555.340(1) and FAC 62-555.340(2).

Bacteriological testing shall be provided by the Government. The Contractor shall coordinate the scheduling of tests with the Government and take corrective actions if results do not meet required standards.

3.7 DISPOSING OF HEAVILY CHLORINATED WATER

The environment to which chlorinated water may be discharged shall be inspected by the Contractor, and, if there is any question that the chlorinated discharge will cause damage to personnel or the environment, then a reducing agent shall be applied to the water (reference Appendix B of the current AWWA C651 for neutralizing chemicals). Such discharges should be coordinated with the KSC PCSO, or designated representative.

3.8 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 30 00

SANITARY SEWERS

PART 1 GENERAL

1.1 RELATED SECTIONS
1.2 REFERENCES
1.3 SYSTEM DESCRIPTION
1.3.1 Sanitary Sewer Gravity Pipeline
1.3.2 Sanitary Sewer Pressure Lines
1.4 SUBMITTALS
1.5 QUALITY ASSURANCE
1.5.1 Installer Qualifications
1.5.2 Drawings
1.6 DELIVERY, STORAGE, AND HANDLING
1.6.1 Delivery and Storage
1.6.1.1 Piping
1.6.1.2 Metal Items
1.6.1.3 Cement, Aggregate, and Reinforcement
1.6.2 Handling

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS
2.1.1 PVC Plastic Gravity Sewer Piping
2.1.1.1 PVC Plastic Gravity Pipe and Fittings
2.1.2 PVC Plastic Pressure Pipe and Fittings
2.1.2.1 Pipe
2.1.2.2 Fittings
2.1.2.3 Unions
2.1.2.4 Joints
2.1.2.5 Solvent Cement
2.1.3 HDPE Plastic Pressure Pipe and Fittings
2.1.3.1 General
2.1.3.2 HDPE Pipe
2.1.3.3 HDPE Pipe Fittings
2.1.3.4 HDPE Pipe Jointing Method
2.1.4 Ductile Iron Pipe
2.1.5 Pipeline Appurtenances
2.1.6 Transition Couplings
2.2 VALVES
2.2.1 Plug Valve
2.2.2 Air Release Valves
2.2.2.1 Combination Valve
2.3 MISCELLANEOUS MATERIALS
2.3.1 Precast Concrete Manholes
2.3.2 Manhole Ladders
2.3.3 Septic Tank Piping
2.3.4 Sewage Absorption Field Materials

2.3.5 Tracer Wire for All Piping Including Horizontal Directional Drilling
2.4 SEPTIC TANKS
2.5 EJECTOR PUMPS
2.6 DRAIN FIELD
2.6.1 Distribution Box
2.6.2 Mounded Drain Field
2.6.3 Header Pipe
2.7 REPORTS

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION
3.1.1 General Requirements for Installation of Pipelines
3.1.1.1 Location
3.1.1.2 Earthwork
3.1.1.3 Pipe Laying and Jointing
3.1.1.4 Connections to Existing Lines
3.1.1.5 Installation of Tracer Wire
3.1.2 Special Requirements
3.1.2.1 Installation of HDPE Piping
3.1.2.2 Solvent-Welded Joints
3.2 SEPTIC TANK AND MOUNDED DRAIN FIELD
3.3 INSPECTION AND TESTING
3.3.1 General
3.3.2 Gravity Piping
3.3.3 Infiltration
3.3.4 Exfiltration
3.3.5 Television Inspection
3.3.6 Alignment and Deflection
3.3.7 Repair of Piping
3.3.8 Tests of Pressure Lines
3.3.8.1 Hydrostatic Test of Aboveground or Exposed Piping
3.3.8.2 Buried DIP Leakage Test
3.3.8.3 HDPE Leakage Test
3.4 CLEANING
3.5 ACCEPTANCE

-- End of Section Table of Contents --

SECTION 33 30 00

SANITARY SEWERS

PART 1 GENERAL

1.1 RELATED SECTIONS

The provisions of other sections of the General and Supplementary Conditions are fully applicable to this Section as if incorporated herein.

Other related or referenced sections contained herein are as listed below:

Section 03 30 00	CAST-IN-PLACE CONCRETE
Section 03 40 00.00 10	PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION
Section 31 00 00	EARTHWORK
Section 33 30 00	SANITARY SEWERS

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI C1012	(2007; Errata 2009) Ductile Iron or Malleable Iron for 1/2-inch thru 1-1/2-inch

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C111/A21.11	(2007) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C504	(2010) Standard for Rubber-Seated Butterfly Valves
AWWA C606	(2006) Grooved and Shouldered Joints

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996; R 2005) Square and Hex Bolts and Screws (Inch Series)
ASME B18.21.1	(2009) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.22.1	(1965; R 2008) Plain Washers
ASME B18.6.1	(1981; R 2008) Wood Screws (Inch Series)
ASME B18.6.3	(2003; R 2008) Machine Screws and Machine Screw Nuts

ASME SA-36	(1998) Steel Designations
ASME SA-675	(1998) Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A126	(2004; R 2009) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 27/A 27M	(2008) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2009a) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 47/A 47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A 48/A 48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A 489	(2004e1) Standard Specification for Carbon Steel Lifting Eyes
ASTM A 513	(2008a) Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
ASTM A 563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 635/A 635M	(2009b) Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for
ASTM A743/A743M	(2006; R 2010) Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application

ASTM B 633	(2007) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 478	(2009) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM D 1784	(2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2464	(2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2467	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(2004; R 2009e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2680	(2001) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2855	(1996; R 2010) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3034	(2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3261	(2010a) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3350	(2010) Polyethylene Plastics Pipe and Fittings Materials
ASTM E 488	(1996; R 2003) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F 1554	(2007a) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F 405	(2005) Corrugated Polyethylene (PE) Tubing

	and Fittings
ASTM F 436	(2010) Standard Specification for Hardened Steel Washers
ASTM F 593	(2002; R 2008) Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F 594	(2009) Standard Specification for Stainless Steel Nuts
ASTM F 656	(2010) Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM F 714	(2008) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 879	(2010) Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws
ASTM F 1417	(1992; R 2005) Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air

FLORIDA ADMINISTRATIVE CODE (FAC)

FAC Chapter 64E-6	Standards for Onsite Sewage Treatment and Disposal Systems

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001	(2008; Corr 1 2009) Quality Management Systems- Requirements

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-70	(2006) Gray Iron Gate Valves, Flanged and Threaded Ends

1.3 SYSTEM DESCRIPTION

1.3.1 Sanitary Sewer Gravity Pipeline

Provide new exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 5 feet outside of building walls.

1.3.2 Sanitary Sewer Pressure Lines

Provide pressure lines of high density polyethylene (HDPE) pipe.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit method of testing in accordance with the paragraph entitled "Gravity Piping."

SD-03 Product Data

Pipeline materials; G
Pipeline Appurtenances; G

Submit manufacturer's standard drawings or catalog cuts.

SD-06 Test Reports

Air Test; G
Hydrostatic Test; G
Leakage Test; G

Reports for the following shall be submitted in accordance with paragraph entitled "Reports" of this section.

Reports; G

Test and inspection reports, as specified.

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualifications

Install specified materials by a licensed underground utility Contractor licensed for such work in the state where the work is to be performed. Installing Contractor's License shall be current and be state certified or state registered.

1.5.2 Drawings

a. Installation drawings shall be submitted showing complete detail, both plan and side view details with proper layout dimensions and elevations.

b. Record drawings for the complete sanitary sewer system shall be submitted showing complete detail with all dimensions, both above and below grade, including invert elevations.

c. Record drawings shall be signed and sealed by a Professional Surveyor. Include the following statement: "All potable water lines crossed by sanitary hazard mains are in accordance with the permitted utility separation requirements."

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery and Storage

1.6.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.6.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.6.1.3 Cement, Aggregate, and Reinforcement

As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

1.6.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 PVC Plastic Gravity Sewer Piping

2.1.1.1 PVC Plastic Gravity Pipe and Fittings

Polyvinyl chloride (PVC) pipe and fittings shall conform to ASTM D 3034, Cell Classification 12454-B DR 35 with push-on joints and shall be green.

2.1.2 PVC Plastic Pressure Pipe and Fittings

2.1.2.1 Pipe

Pipe shall be Schedule 80, Type I, Grade 1 (Class 12454-B), conforming to ASTM D 1784 and ASTM D 1785.

Pipe shall bear the NSF logo for potable water use.

2.1.2.2 Fittings

Fittings shall be Schedule 80 and shall conform to ASTM D 2464 for threaded fittings and ASTM D 2467 for socket-type fittings.

2.1.2.3 Unions

Unions shall have socket-type ends, Viton O-rings, and shall be Schedule 80. Material shall be Type I, Grade 1 PVC, conforming to ASTM D 1784.

2.1.2.4 Joints

Pipe and fitting joints shall be socket welded except where threaded and flanged joints are required to connect to valves and equipment.

2.1.2.5 Solvent Cement

Solvent cement for socket joints shall comply with ASTM D 2564 and ASTM F 656.

2.1.3 HDPE Plastic Pressure Pipe and Fittings

2.1.3.1 General

All HDPE shall be DriscoPlex PE 3408 HDPE or approved equal.

All HDPE pipe 4 inches in diameter or greater shall have a ductile iron pipe outside diameter, and HDPE pipe 3 inches in diameter and smaller shall be IPS unless otherwise specified or drawing in the drawings.

All HDPE piping system components shall be the products of one manufacturer.

Pipe and fittings shall be manufactured by an ISO 9001-certified manufacturer.

2.1.3.2 HDPE Pipe

HDPE pipe 4 inches in diameter and larger shall conform to material standard ASTM D 3350 345435 E cell classification rated as PE 3408 by the Plastic Pipe Institute. Minimum pressure rating shall be in accordance with Piping Schedule Drawing or as specified in this Section. Minimum pressure rating shall be 100 psi SDR 17 (Standard Dimension Ratio) for pipe sizes greater than 4 inches in diameter. For pipe sizes 3 inches and smaller in diameter, the minimum pressure rating shall be 200 psi SDR 9.

The polyethylene compound shall be suitably protected against degradation by ultraviolet light.

The maximum allowable hoop stress shall be 800 psi at 73.4 degrees F.

The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the requirements of the resin manufacturer to manufacture pipe from the resin used.

2.1.3.3 HDPE Pipe Fittings

Use ductile-iron fittings for HDPE pipe 4 inches and larger and as specified in paragraph "Ductile Iron Pipe" of this Section.

Provide polyethylene fittings that are molded or fabricated by the pipe manufacturer. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe.

a. Molded Fittings shall be manufactured in accordance with ASTM D 3261 and shall be so marked. Each production lot of molded fittings shall be subject to the test required under ASTM D 3261. The manufacturer shall submit samples from each molded fitting production lot to x-ray inspection for voids and shall certify that voids were not found.

b. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full-service pressure rating of the mating pipe. Pressure de-rated fittings are not acceptable.

The manufacturer of the HDPE pipe shall supply all DI/HDPE mechanical joint adapters and accessories required to connect plain-end HDPE piping to mechanical joint fittings, valves, and appurtenances.

The DI/HDPE mechanical joint adapter shall consist of:

a. A molded or fabricated HDPE mechanical joint transition fitting.

b. A gasket for a DI mechanical joint.

c. A ductile iron mechanical joint backup drive ring.

d. Mechanical joint tee bolts.

e. A stainless-steel sleeve stiffener molded or fabricated within the MJ end of the HDPE mechanical joint adapter fitting.

The DI/HDPE mechanical joint adapter shall be connected to the HDPE pipe by a heat-fused joint on one end and connected to a ductile iron pipe valve, fitting, or appurtenance with the internally stiffened mechanical joint end.

The tee bolts and backup drive ring shall act as a joint restraint for connections to mechanical joints.

The HDPE mechanical joint adapter fitting shall be molded or fabricated by the manufacturer of the HDPE pipe. All molded fittings shall be fully pressure rated to match the SDR pipe pressure rating. Fabricated fittings shall be rated for internal pressure service equivalent to the full pressure rating of the mated IPS pipe.

If rework compounds are required, only those generated in the manufacture's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.

Solvent epoxy cementing and mechanical joining with bolt on wrap-around clamps shall not be used.

2.1.3.4 HDPE Pipe Jointing Method

HDPE pipe shall be jointed by butt fusion in accordance with the pipe manufacturer's directions and only for pipe within one SDR ratio of each other.

For SDR ratios that are two or more apart (i.e. SDR 21 to an SDR 11), the joint shall be made using a restrained joint. Same-diameter pipe may be joined by using HDPE flange adapters and backup rings bolted to each other.

All HDPE pipe joined by butt fusion shall be made from the same class and type of raw material made by the same raw material supplier.

Butt fusion means the butt joining of the pipe by heat fusion aligned faces of the pipe ends (butts) in a suitable apparatus and joining under controlled pressure and alignment.

The external bead resulting from the butt fusion process shall be visible and examined for complete butt fusion 360 degrees around the pipe exterior.

Short spools of pipe between valves and fittings for 2-inch and smaller shall be Schedule 40 Type 304 stainless steel piping with IP threads stainless steel.

Where approved by the Contracting Officer, the HDPE pipe and fittings may be fused with Electrofusion Couplings, as manufactured by Central Plastics Company, or approved equal. Technical information must be provided to demonstrate that the fused coupling will not compromise the structural integrity of the HDPE pipe.

2.1.4 Ductile Iron Pipe

Ductile iron piping and appurtenances shall conform to the ductile iron piping section in Section 33 11 00 WATER DISTRIBUTION with protective 401 lining or approved equal instead of cement lining and shall be painted green.

2.1.5 Pipeline Appurtenances

Provide fasteners in accordance with the following section unless otherwise noted.

1. General: For all exterior applications and where fastening aluminum, provide Type 304 stainless-steel fasteners. Provide hot-dipped galvanized fasteners in all other applications in accordance with ASTM A 153/A 153M unless noted otherwise on the drawings. Select fasteners for type, grade, and class required.

2. High-Strength Bolts and Nuts: ASTM A 325 with heavy hex nuts ASTM A 563 and hardened carbon-steel washers ASTM F 436.

3. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A, with hex nuts, ASTM A 563, and, where indicated, flat washers.

4. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group A4.

5. Stainless Steel Socket Button and Flat Countersunk Head Cap Screws: ASTM F 879.

6. Anchor Bolts: ASTM F 1554, Grade 36.

7. Eyebolts: ASTM A 489.

8. Machine Screws: ASME B18.6.3.

9. Lag Bolts: ASME B18.2.1.

10. Wood Screws: Flat head, ASME B18.6.1.

11. Plain Washers: Round, ASME B18.22.1.

12. Lock Washers: Helical, spring type, ASME B18.21.1.

13. Cast-in Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing conducted by a qualified independent testing agency according to ASTM E 488.

a. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized in accordance with ASTM A 153/A 153M.

14. Expansion Anchors: Anchor bolt and sleeve assembly with the ability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing conducted by a qualified independent testing agency according to ASTM E 488.

a. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

b. Material for Anchors in Exterior Locations: Alloy Group (A4) stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

2.1.6 Transition Couplings

Transition Coupling shall consist of a high-strength steel body, two steel or malleable iron flange or follower rings, a wedge shaped resilient gasket and sufficient number of follower bolts.

Adapter: Steel construction, ASTM A 513, ASTM A 635/A 635M or ASME SA-675GR60, free of surface defect.
Followers: AISI C1012 or ASME SA-36
Bolts: AWWA C111/A21.11
Gasket: Grade 27 BUNA-S.
Shop Paint: Fusion bonded epoxy coating.
Acceptable Manufacturers:
Dresser Manufacturing Division of Dresser Industries, Inc.; Dresser Styles 62 and 162 or approved equal.

2.2 VALVES

2.2.1 Plug Valve

Conform plug valves to MSS SP-70.

Ensure that all plug valves are eccentric plug valves unless otherwise specified.

Plug valves shall be of the nonlubricated rectangular ported eccentric type with resilient faced plugs. Furnish valves in vaults or above-grade with flanged end connections. Furnish buried valves with mechanical joint end connections. Face and drill flanged valves to the ANSI 125/150-pound

standard. Mechanical joint ends shall conform with AWWA C111/A21.11, grooved ends shall conform with AWWA C606. Screwed ends shall conform to the NPT standard.

Valve bodies shall be made of Class B cast iron conforming to ASTM A126. Furnish bodies in 4-inch and larger valves with a 1/8 inch welded overlay seat of not less than 90 percent pure nickel. Seat area shall be raised with raised surface completely covered with weld to ensure that the plug face contacts only nickel. Screwed-in seats are not acceptable.

Plugs shall be cast iron conforming to ASTM A126 Class B. The plug shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft. The interference between the plug face and body seat with the plug in the closed position shall be externally adjustable in the field with the valve in the line under pressure. Plug shall be chloroprene (CR) or resilient facing suitable for application. VE option of round port valves is not acceptable.

Bearings shall have sleeve type metal bearings and shall be of sintered, soil impregnated permanently lubricated Type 316 ASTM A743/A743M Grade CF-8M. Non metallic bearings are not acceptable.

Valve shaft seals shall be of the multiple V-ring type and shall be externally adjustable and repackable without removing the actuator or bonnet from the valve under pressure. Valves using O-ring seals or non-adjustable packing are not acceptable. All exposed nuts, bolts, springs, washers, and other fasteners shall be 300-series stainless steel.

Pressure ratings shall be 175 psi. Test every valve with a hydrostatic and seat test and furnish certified copies of proof-of-design test reports as outlined in AWWA C504, Section 5.5.

Unless noted otherwise, equip manual valves with the following actuators:

Exposed valves 4 inches: removable lever actuators.

Equip all valves 6 inches and larger with worm-gear type actuators. Geared actuators shall be worm-gear type. Geared actuators and mounting brackets shall be designed for buried and submerged service and shall be totally enclosed in a cast iron housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. Support the actuator shaft and the quadrant on permanently lubricated bronze bearings.

Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque and to provide adjustment to compensate for change in pressure differential or flow direction change.

Ensure that valves and gear actuators for buried or submerged service have seals on all shaft and gaskets on the valve and actuator covers to prevent the entry of water. Totally enclose actuator mounting brackets for buried or submerged service and provide gasket seals.

All actuators shall be furnished by the valve manufacturer and shall be factory assembled, adjusted, and tested with the valve. Test reports shall be available upon request.

The exterior of valves and actuators shall be factory prepared and primed, and field finish coated in accordance with Section 09 90 00.00 98 PAINTING

AND COATING. Buried valves shall be polyethylene encased as specified herein for ductile iron pipe and fittings.

Plug valves shall be DeZURIK PEC or approved equal.

2.2.2 Air Release Valves

Use air release valves designed to permit release of air from an empty pipe during filling and capable of discharging accumulated air in the line while the line is in operation and under pressure. Attach valves with threaded pipe connections. Ensure that valves are vented to the atmosphere.

2.2.2.1 Combination Valve

Automatic combination valves shall be capable of withstanding operating pressures of 150 psi. The valves shall have a threaded outlet. The body and cover of the valve shall be made of iron with a stainless steel float. All internal parts shall be stainless steel or bronze. The valve shall be specifically adapted for use with sewage. Each valve shall be complete with hose and blow-off valves to permit backflushing without dismantling the valve. The valve shall be the Valmatic Combination Air Valve Series 800S or approved equal.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Precast Concrete Manholes

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C 478 and be manufactured in accordance with Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION; base and first riser shall be monolithic.

2.3.2 Manhole Ladders

A steel ladder shall be provided where the depth of a manhole exceeds 12 feet. The ladder shall not be less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.3.3 Septic Tank Piping

PVC or cast iron soil pipe and fittings.

2.3.4 Sewage Absorption Field Materials

Pipe shall be perforated perforated corrugated polyethylene tubing conforming to ASTM F 405.

2.3.5 Tracer Wire for All Piping Including Horizontal Directional Drilling

Tracer wire for all piping is specified under Section 31 00 00 EARTHWORK.

2.4 SEPTIC TANKS

Provide septic tanks with two compartments separated by a baffle. Inlet pipe invert elevation shall be 3 inches higher than outlets. Provide septic tanks made of precast concrete with a compressive strength of not less than 4,000 psi at 28 days. Each compartment shall have access through

a manhole with a minimum area of 225 inches extending to grade. Ensure that each opening has a secured cover. The septic tanks shall have minimum capacities as outlined below:

East Gun Club septic tank: 900 gallons.
West Gun Club septic tank: 900 gallons.

Ensure that construction is in accordance with FAC Chapter 64E-6.013.

2.5 EJECTOR PUMPS

Provide submersible sewage ejector pumps as manufactured by Hydromatic Pumps or approved equal. The pump volute, motor, and seal housing shall be high-quality gray cast iron in accordance with ASTM A 48/A 48M, Class 30. All fasteners exposed to the pumped liquids shall be 316 stainless steel.

Dosing Station #4 and #5 shall be included as part of the septic system package.

2.6 DRAIN FIELD

2.6.1 Distribution Box

Ensure that the distribution box is watertight and durable. The invert of the inlet shall be at least 1 inch above the invert of the outlets.

2.6.2 Mounded Drain Field

Provide mounded drain field in accordance with FAC Chapter 64E-6.009.

East Gun Club: Minimum drainfield area of 500 square feet.
West Gun Club: Minimum drainfield area of 334 square feet.

2.6.3 Header Pipe

Provide header pipe in accordance with paragraph entitled "Pipe" of this Section and FAC Chapter 64E-6.

2.7 REPORTS

Submit Test Reports. Compaction and density test shall be in accordance with Section 31 00 00 EARTHWORK. Submit Inspection Reports for daily activities during the installation of the sanitary system. Information in the report shall be detailed enough to describe location of work and amount of pipe laid in place, measured in linear feet.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

Any utilities damaged, both new and existing, as a result of this project shall be repaired per manufacturer's recommendations at no cost the Government.

3.1.1 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.1.1.1 Location

For the location and separation requirements of the water main with respect to other utilities, refer to the Typical Utility Conflict Detail in the drawings.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Bottom of trench shall be shaped to give uniform circumferential support to the lower fourth of each pipe. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid true to line and grade in a manner to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line. Interior of the sewer shall be cleared of superfluous materials at all times. Where cleaning after laying is difficult, a suitable swab or drag shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. When the maximum width of the trench at the top of the pipe is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, such bedding as may be required to satisfactorily support the added load of the backfill. Trenches shall be kept free from water until the pipe-joining material has set. Pipe shall not be laid when the condition of the trench or the weather is unsuitable for such work. When work is not in progress, open ends of pipe and fittings shall be closed to prevent intrusion of foreign materials.

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

3.1.1.4 Connections to Existing Lines

Obtain approval from the Contracting Officer before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.1.1.5 Installation of Tracer Wire

Tracer wire for all piping is specified under Section 31 00 00 EARTHWORK.

3.1.2 Special Requirements

3.1.2.1 Installation of HDPE Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with requirements of ASTM F 714.

3.1.2.2 Solvent-Welded Joints

Before solvent welding, remove fittings and couplings from their cartons

and expose them to the air at the same temperature conditions as the pipe for at least 1 hour.

Cut pipe ends square and remove all burrs, chips, and filings before joining pipe or fittings. Bevel solvent-welded pipe ends as recommended by the pipe manufacturer.

Wipe away loose dirt and moisture from the inside and outside of the pipe end and the inside of the fitting before applying solvent cement. Clean the surfaces of both pipes and fittings that are to be solvent welded with a clean cloth moistened with acetone or methylethyl ketone. Do not apply solvent cement to wet surfaces.

The pipe and fitting socket shall have an interference fit. The diametrical clearance between pipe and entrance of the fitting socket shall not exceed 0.04 inch. Check the fit at every joint before applying solvent cement.

Make up solvent-welded joints in accordance with ASTM D 2855. Application of cement to both surfaces to be joined and assembly of these surfaces shall produce a continuous bond between them with visual evidence of cement at least flush with the outer end of the fitting bore around the entire circumference.

Allow at least 8 hours of drying time before moving solvent-welded joints or subjecting the joints to any internal or external loads or pressures.

Acceptance criteria for solvent-welded joints shall be as follows:

Unfilled Areas in Joint: None permitted.

Unbonded Areas in Joint: None permitted.

Protrusion of Material into Pipe Bore, Percent of Pipe Wall Thickness: Cement, 50 percent.

3.2 SEPTIC TANK AND MOUNDED DRAIN FIELD

Ensure that septic tank contractor is a Florida State Certified Septic Tank Contractor.

Construction and installation shall be as indicated on the drawings and in accordance with FAC Chapter 64E-6.

Contractor shall apply for and obtain an Onsite Sewage Treatment and Disposal System Construction Permit before installation of the septic system with Brevard County Department of Health. Installation of the onsite sewage treatment system shall be by a registered septic system contractor in accordance with FAC Chapter 64E-6. Before covering with dirt and before placing the system in service, the registered septic system contractor shall notify the County Department of Health of the completion of the installation and shall have the system inspected by the Department for compliance with the requirements with FAC Chapter 64E-6. The Department of Health shall issue the Contractor a septic system "Construction Approval" notice once the system construction is approved.

3.3 INSPECTION AND TESTING

3.3.1 General

Inspect all work constructed for faults or defects and correct any deviation from these documents or omissions at once. Conduct all tests and provide necessary equipment and personnel for lamping the system in the presence of the Contracting Officer. The Contractor shall bear all costs for these tests and inspections.

Test sewers by a low-pressure air test.

Ensure that pipe testing closely follows pipe laying. No more than 1,000 feet of pipe shall remain untested at any time.

3.3.2 Gravity Piping

Submit the proposed method of testing to the Contracting Officer for approval. Perform air testing in accordance with the procedures described in ASTM F 1417. Ensure that the equipment is specifically designed and manufactured for testing pipelines with low-pressure air and is provided with an air regulator valve or air safety valve set to prevent the air pressure in the pipeline from exceeding 8 psig. If the results of the air test are unsatisfactory, perform the exfiltration test as outlined above.

The following low-pressure air testing procedures may be used. Ensure that the sewer line has an orifice through which to pass air into the pipe. Connect an air supply to the orifice at one end of the line. The air supply line will contain an on/off gas valve and a pressure gauge with a range of 0 to 5 psi. Ensure that the gauge has minimum divisions of 0.10 psi and has an accuracy of plus/minus 0.04 psi. Properly block the seals at each manhole to prevent displacement while the line is under pressure. Pressurize the pipe line under test to 4 psig. Allow the line to stabilize between 4 psig and 3.5 psig for no less than 5 minutes. If necessary, add air to the line to maintain the pressure above 3.5 psig. After the stabilization period, close the gas valve. When the line pressure drops to 3.5 psig, begin timing with a stop watch. Allow the stop watch to run until the line pressure drops to 2.5 psig. Then stop the watch and compare the time lapse to the allowable time lapse in these Specifications. If the time lapse is greater than that specified, the section undergoing the test shall have passed the low-pressure air test and the test will be discontinued at that time. If the time is less than that specified, the line has not passed the test (see Table 1 for test times).

TABLE 1 AIR TEST TABLE

Length (feet)	4	6	8	10	12	15	18	21	24
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34

TABLE 1 AIR TEST TABLE									
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30	--	--
175	0:31	1:09	2:03	3:13	4:37	5:05	--	--	--
200	0:35	1:19	2:21	3:40	5:17	--	--	--	12:06
225	0:40	1:29	2:38	4:08	5:40	--	--	10:25	13:36
250	0:44	1:39	2:56	4:35	--	--	8:31	11:35	15:07
275	0:48	1:49	3:14	4:43	--	--	9:21	12:44	16:38
300	0:53	1:59	3:31	--	--	--	10:12	13:53	18:09
350	1:02	2:19	3:47	--	--	8:16	11:54	16:12	21:10
400	1:10	2:38	--	--	6:03	9:27	13:36	18:31	24:12
450	1:19	2:50	--	--	6:48	10:38	15:19	20:50	27:13
500	1:28	--	--	5:14	7:34	11:49	17:01	23:09	30:14

3.3.3 Infiltration

After the work is complete, test the sewers or sections for infiltration. Any section in which the infiltration of water is detected will be rejected until corrective work has been performed. No infiltration will be allowed for any one trunk, main, lateral, or segment between manholes.

3.3.4 Exfiltration

The Contracting Officer may require tests for exfiltration. Ensure that exfiltration is in accordance with the requirements of ASTM requirements as modified by the Contracting Officer. Permit an allowance of 10 percent of exfiltration gallonage for each additional 10-foot head over the basic top-of-manhole head.

3.3.5 Television Inspection

Inspect all new sewer mains by internal television inspection, providing accurate distances to all service, with logs and video record of inspection. Provide all equipment and labor for such inspection. Any subcontractor must be approved by the Government before work. Acceptable procedures for televising and video recording are available from the Contracting Officer. Take digital video records of all inspection, including the manholes. Prepare the DVD and, after review by the Contracting Officer, deliver it to the Government. The Contracting Officer or Government's representative shall observe the television inspection.

3.3.6 Alignment and Deflection

Ensure that lines show full circle of light when lamped between manholes for line sections with complete pipe replacement.

Pass a nine-point mandrel through each new flexible pipe section installed after full backfill has been placed. Ensure that the maximum pipe diameter deflection does not exceed 5 percent.

3.3.7 Repair of Piping

At the option of the Contracting Officer, if piping is found to be defective during the warranty test period and if the Contracting Officer does not approve a method of pipe repair by the Contractor, the Contractor shall remove and replace the faulty pipe in an approved manner at no additional cost to the Government.

3.3.8 Tests of Pressure Lines

3.3.8.1 Hydrostatic Test of Aboveground or Exposed Piping

Open vents at high points of the piping system to purge air while the pipe is being filled with water. Venting during system filling may also be provided by temporarily loosening flanges.

Subject to piping system to the test pressure of 150 psi. Maintain the test pressure for a minimum of 2 hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show zero leakage or weeping. Correct leaks and retest until zero leakage is obtained.

3.3.8.2 Buried DIP Leakage Test

Leakage tests shall be conducted concurrently with the pressure test. The duration of each leakage test shall be at least 2 hours. During the test, the main shall be subjected to a pressure of 150 psi. Leakage is defined as the additional quantity of water supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume is defined by the formula:

$$L = \frac{SD(P)^{1/2}}{C}$$

in which:

L = allowable leakage (gallons)
S = length of pipe tested (feet)
D = diameter of the pipe (inches)
P = specified test pressure (psig)
C = 133,200

Should any test of laid pipe disclose a leakage greater than that shown, the defective joints shall be located and repaired until the leakage is within the specified tolerance, at no additional cost to the Government.

3.3.8.3 HDPE Leakage Test

The test procedure consists of initial expansion and test phases.

a. During the initial expansion phase, the test section is filled with water. Once the line is filled, make-up water is added at hourly intervals as required to maintain the test pressure for 3 hours.

b. At the end of the initial expansion period, the addition of make-up water will cease. During the test phase the pipe will not have any water added to it for the following 2 hours. The 2 hours will be the actual leakage test. At the end of the 2-hour period, measured make-up water will be added to the pipe to return it to the original test pressure.

c. If the amount of make-up water added is greater than calculated using the numbers listed below, the section being tested will be considered to have a leak. The leak shall be found and fixed at the Contractor's expense and that section of the line retested before continuing with subsequent leakage tests. Testing and repairs shall be repeated at the Contractor's expense until the amount of make-up water is less than the amount calculated using the numbers listed below.

ALLOWABLE FOR EXPANSION UNDER TEST PRESSURE* POLYETHYLENE PIPE

Nominal Pipe Size (inch	**Allowances for Expansion (US Gal/100 Feet of pipe)**		
	1 Hour Test	**2-Hour Test**	**3-Hour Test**
2	0.08	0.12	0.15
3	0.10	0.15	0.25
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.0	1.5

* These allowances only apply to the test phase and not to the initial expansion phase.

3.4 CLEANING

Thoroughly clean all precast structures of all silt, debris, and foreign matter of any kind before final inspections.

3.5 ACCEPTANCE

Sections of the sewer and manholes found defective in material, alignment, grade, or joints shall be corrected at no additional cost to the Government before acceptance.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 32 13.13

SEWAGE LIFT STATIONS

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 QUALITY ASSURANCE
1.3.1 Drawings
1.4 DESIGN REQUIREMENTS
1.5 NAMEPLATES
1.6 FIELD REPRESENTATIVE
1.7 GENERAL REQUIREMENTS

PART 2 PRODUCTS

2.1 PRECAST WET WELLS AND VALVE VAULTS -- LIFT STATIONS #1, #2, AND #3
2.2 ACCESS COVERS
2.3 SEWAGE PUMPS
2.3.1 Centrifugal Pumps
2.3.1.1 Pump and Motor Characteristics
2.3.1.1.1 Lift Station #1
2.3.2 Grinder Pumps
2.3.2.1 Pump and Motor Characteristics
2.3.2.1.1 Lift Station #2
2.3.2.1.2 Lift Station #3
2.4 PUMP CONSTRUCTION
2.5 IMPELLERS
2.6 SHAFT SLEEVES
2.7 STUFFING BOXES
2.8 BALANCE
2.9 SHAFTS
2.10 BEARINGS AND SHAFTS
2.11 LUBRICATION
2.12 SEALS
2.13 PIPING CONNECTIONS
2.14 VALVES
2.14.1 Check Valve
2.14.2 PVC Swing Check Valves, 3 Inches and Smaller
2.14.3 Plug Valve
2.14.4 Double-Union PVC Ball Valves, 3 Inches and Smaller, for Water and Light Chemical Service
2.15 QUICK DISCONNECT
2.16 DUST CAP
2.17 PIPING
2.18 ELECTRICAL POWER CORD
2.19 ELECTRIC MOTORS
2.19.1 Lift Station Controls
2.19.1.1 Scope

2.19.1.2 Enclosure(s)
2.19.1.3 Operator Interface
2.19.1.4 External Interfaces
2.19.1.5 Functional Requirements
2.19.1.6 Special Requirements
2.20 PAINT
2.21 GUIDE RAIL ASSEMBLY

PART 3 EXECUTION

3.1 GENERAL
3.2 PIPING
3.2.1 Flanged and Threaded Joints
3.2.1.1 Flanged Joints
3.2.1.2 Threaded Joints
3.2.2 Pipe Supports in Valve Vaults
3.3 VALVE VAULTS AND ACCESSORIES
3.3.1 Piping and Equipment in Valve Vaults
3.4 TESTS
3.5 OPERATION AND MAINTENANCE
3.6 FORMS

-- End of Section Table of Contents --

SECTION 33 32 13.13

SEWAGE LIFT STATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C207	(2007) Standard for Steel Pipe Flanges for Waterworks Service-Sizes 100 mm through 3600 mm 4 in. through 144 in.
AWWA C550	(2005; Errata 2005) Protective Epoxy Interior Coatings for Valves and Hydrants

ASME INTERNATIONAL (ASME)

ASME B16.1	(2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.5	(2009) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B31.3	(2008) Process Piping

ASTM INTERNATIONAL (ASTM)

ASTM A 126	(2004; R 2009) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 48/A 48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A 536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM B 584	(2009a) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM C 443	(2005a) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D 1784	(2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1940-1	(2003; Cor 2005) Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixtures List in accordance with paragraph entitled, "General Requirements," of this section.

Listing of Product Installations

SD-02 Shop Drawings

Submit the following in accordance with paragraph entitled, "Design Requirements," of this section.

Erection/Installation Drawings; G

SD-03 Product Data

Submit Spare Parts Data also for the following in accordance with paragraph entitled, "General Requirements," of this section.

Submit manufacturer's catalog data and equipment and performance data for the following items:

Package Lift Station; G
Access Covers; G
Sewage Pumps; G
Pump Controls; G
Impellers; G
Nameplate; G
Stuffing Boxes; G
Valves; G
Quick Disconnect; G
Piping; G
Valve Vault; G
Electric Motors; G
Lift Station Controls; G

Submit paint and manufacturer's recommendations for painting including material storage, mixing, and thinning surface preparation, number and thickness of coats, application drying between coats and final etc. shall be submitted.

SD-06 Test Reports

Pump Down Test; G

SD-07 Certificates

Manufacturer Certification

SD-10 Operation and Maintenance Data

Operation and Maintenance Manual in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA; G

1.3 QUALITY ASSURANCE

1.3.1 Drawings

a. Erection/installation drawings shall be submitted showing complete detail, both plan and side view details with proper layout dimensions and elevations.

b. Record drawings for the complete sanitary sewer system shall be submitted showing complete detail with all dimensions, both above and below grade, including invert elevation.

c. Record drawings shall be signed and sealed by a Professional Surveyor. Include the following statement: "All potable water lines crossed by sanitary hazard mains are in accordance with the permitted utility separation requirements."

1.4 DESIGN REQUIREMENTS

The lift stations shall have two submersible, centrifugal non-clog or grinder, pumps as specified herein with pump controls capable of operating the pumps either simultaneously or individually, depending on the load conditions.

The Contractor shall submit drawings covering necessary or recommended changes to accommodate the equipment offered. Drawings shall clearly show the wet well, with dimensions and elevation levels with reference to those elevations indicated.

The Contractor shall provide temporary sanitary facilities during the demolition of existing septic tank and installation of septic tank, dosing station, and drainfield at Gun Clubs.

1.5 NAMEPLATES

Provide the manufacturer's name or trademark on a corrosion-resistant identification plate or cast integrally, on each item of equipment, stamped, or otherwise permanently marked in a conspicuous place. Include on the pump identification plate the pump capacity in gpm, pump head in feet and speed of rotation. Cast on the body of the pump the direction of rotation. Indicate all necessary information to complete identification such as the manufacturer.

1.6 FIELD REPRESENTATIVE

A representative of the lift station pump manufacturer hired by the Contractor shall inspect the pump installation and direct the startup of the station and shall instruct representatives of the Government in startup

and operating procedures. The Contractor shall procure the services of the lift station pump manufacturer representative for the following:

1. A minimum of 1 full day on site to inspect, adjust, and test the lift station installation and provide certification as specified.

2. A minimum of 1 full day on site to place the station in operation to demonstrate compliance with the requirements of the Contract Documents.

3. A minimum of 1 full day onsite to train representatives of the Government in the operation, maintenance, and repair of station pumps, control panel, and related appurtenances.

The manufacturer's services specified represent an absolute minimum acceptable level of service, and are not intended to limit the responsibilities of the Contractor to comply with all requirements of the Contract Documents. At no additional cost to the Government, the Contractor shall procure all services required, including additional cost to the Government to the jobsite by the manufacturer's representative to comply with these requirements.

The Contractor shall submit written certification from the lift station pump manufacturer's representative that he has inspected, adjusted, tested, etc., the lift station installation and that all aspects of the installation meet requirements of the pump manufacturer for satisfactory performance and working life of the equipment. The written certification shall state that the system is installed and operating properly and is ready for acceptance by the Government.

1.7 GENERAL REQUIREMENTS

Submit Material, Equipment, and Fixtures List of all major components including manufacturer's catalog numbers, specification and drawing reference number, warranty information, and fabrication site.

Submit Listing of Product Installations similar to the package lift station the Contractor is installing.

Submit Spare Parts Data, including a complete list of parts and supplies with current unit prices and source of supply. List parts and supplies that are either normally furnished at no extra cost with the purchase of equipment, or specified to be furnished as a part of the contract, and list additional items recommended by the manufacturer to ensure an efficient operation for a period of one year.

Submit an Operation and Maintenance Manual for all components of the lift stations.

PART 2 PRODUCTS

Verify conformance of materials and equipment for package lift station to the referenced publications or as specified. Verify manufacturers are regularly engaged in the manufacture of such products.

Submit manufacturer's data indicating percentage of recycled material content in packaged sewage lift stations to verify affirmative procurement compliance.

2.1 PRECAST WET WELLS AND VALVE VAULTS -- LIFT STATIONS #1, #2, AND #3

The precast wet wells and valve vaults shall be sized as shown on the drawings and shall conform to the requirements of Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION.

The precast wet wells shall be lined with the protective liner specified in Section 09 97 24 CONCRETE REPAIR AND HYDROGEN SULFIDE PROTECTIVE COATING at the precast factory.

2.2 ACCESS COVERS

The access covers for wet wells shall be aluminum plate designed for 300 pounds per square foot live load. The covers shall be securely bolted to each concrete structure with stainless steel hinges and hardware. Covers shall have a diamond pattern non-skid surface and stainless steel recessed handles. Covers shall meet the requirements of Section 05 50 13 MISCELLANEOUS FABRICATIONS.

2.3 SEWAGE PUMPS

2.3.1 Centrifugal Pumps

Provide submersible sewage centrifugal pumps as manufactured by Hydromatic Pumps, or approved equal. The pump volute, motor, and seal housing shall be high-quality gray cast iron in accordance with ASTM A 48/A 48M, Class 30. All fasteners exposed to the pumped liquids shall be 316 stainless steel.

2.3.1.1 Pump and Motor Characteristics

2.3.1.1.1 Lift Station #1

Liquid Pumped:	Raw sewage
Pumping Temperature:	Ambient temperature
Shutoff Head:	73.9 feet double check valves
Design Condition:	See drawings
Rated Pump Speed:	See drawings
Motor Power:	See drawings
Discharge Elbow Outlet Diameter:	See drawings
Model:	See drawings
Motors:	Oil cooled induction/insulation Class H/60 hz Service Factor 1.2 NEMA design, Type B

2.3.2 Grinder Pumps

Provide submersible sewage grinder pumps as manufactured by Hydromatic Pumps or approved equal. The pump volute, motor, and seal housing shall be high-quality gray cast iron in accordance with ASTM A 48/A 48M, Class 30. All fasteners exposed to the pumped liquids shall be 316 stainless steel.

2.3.2.1 Pump and Motor Characteristics

2.3.2.1.1 Lift Station #2

Liquid Pumped:	Raw sewage
Pumping Temperature:	Ambient temperature
Shutoff Head:	62.2 feet double check valves
Design Condition:	See drawings

Rated Pump Speed:	See drawings
Motor Power:	See drawings
Discharge Elbow Outlet Diameter:	See drawings
Model:	See drawings
Motors:	Oil cooled induction/insulation Class H/60 hz Service Factor 1.2 NEMA design, Type B

2.3.2.1.2 Lift Station #3

Liquid Pumped:	Raw sewage
Pumping Temperature:	Ambient temperature
Shutoff Head:	62.2 feet double check valves
Design Condition:	See drawings
Rated Pump Speed:	See drawings
Motor Power:	See drawings
Discharge Elbow Outlet Diameter:	See drawings
Model:	See drawings
Motors:	Oil cooled induction/insulation Class H/60 hz Service Factor 1.2 NEMA design, Type B

2.4 PUMP CONSTRUCTION

Fabricate castings from cast iron or steel free from injurious defects. Design castings to permit easy replacement of parts. Gasket all joints to prevent leakage under a test pressure equal to 50 percent more than the pump discharge pressure or total dynamic head, whichever is greater. Design and install passageways to permit the smooth flow of sewage and free from sharp turns and projections. Provide pump castings with cleanout plates in the suction line and drain plugs.

2.5 IMPELLERS

For centrifugal non-clog pumps, impeller shall be cast iron recessed non-clogging design. For grinder pumps, impeller shall be red brass ASTM B 584-836. Pump out vanes shall preclude material buildup around the shaft and seal.

Impellers shall be dynamically balanced. The tolerance values shall be according to the International Standard Organization grade 6.3 for rotors in rigid frames. The tolerance is to be split equally between the two balance planes, which are the two impeller shrouds.

2.6 SHAFT SLEEVES

For end-suction pumps, protect the shaft from the liquid being pumped, points in contact with the stuffing boxes, and other wearing parts with sleeves designed in bronze or a suitable alloy.

2.7 STUFFING BOXES

For end-suction pumps, grease-seal stuffing boxes with a seal ring, designed to ensure tight packing without excessive wear or friction on the shafts, and prevent the leakage of air or water. Provide split type glands which can be easily removed for repacking.

2.8 BALANCE

Balance rotating parts of the equipment mechanically and hydraulically to operate throughout the required range without excessive end thrust, vibration, and noise. Conform allowable vibration limits with ISO 1940-1, Table 1. Existence of defects that cannot be eliminated by adjustment will be sufficient cause for rejection of the equipment.

2.9 SHAFTS

For centrifugal and grinder pumps, provide high-grade 3300 series stainless steel shafts of a size and strength to perform the work required.

2.10 BEARINGS AND SHAFTS

An upper radial bearing and a lower thrust bearing shall be required. These shall be heavy-duty single-row ball bearings that are permanently lubricated by the dielectric oil that fills the motor housing. Double-row, sealed-grease packed bearings shall not be acceptable. Bearings which require lubrication according to a prescribed schedule shall not be acceptable. The upper radial housing shall have a minimum B-10 life at the specified condition of 40,000 hours and the lower thrust bearing shall have a minimum B-10 life at the specified condition of 40,000 hours.

The shaft shall be machined from a solid 300 series stainless steel forging and shall be designed with a large diameter, having a minimum overhang to reduce shaft deflection and prolong bearing life.

2.11 LUBRICATION

Provide self lubricating, permanently lubed bearings.

2.12 SEALS

The pump shall have two mechanical seals, mounted in tandem, with an oil chamber between the seals. Units that required the use of tungsten-carbide seals or foreign manufactured seals shall not be acceptable.

The pump shall be equipped with a seal leak detection probe and warning system. This shall be designed to alert maintenance personnel of lower seal failure without having to take the unit out of service for inspection or requiring access for checking the seal chamber oil level and consistency.

Install an electric probe or seal failure sensor in the seal chamber between the two tandem mechanical seals. If the lower seal fails, contaminants which enter the seal chamber shall be detected by the sensor and sent a signal to operate the specified warning device.

Units equipped with opposed mechanical seals shall not be acceptable.

2.13 PIPING CONNECTIONS

Provide pump discharge with flanged connections of the proper size for the pump type and capacity. Conform pipe flanges to ASTM A 536 for ductile iron or gray-iron threaded flanges and piping or AWWA C207. Piping is to conform to the requirements of ASME B31.3.

2.14 VALVES

2.14.1 Check Valve

1. Check valves shall be swing-check type with outside lever and weight and shall permit free flow of sewage forward and provide a positive check against backflow. Check valves shall be designed for a minimum working pressure of 150 psi. The manufacturer's name, initials, or trademark and also the size of the valve, working pressure, and direction of flow shall be directly cast on the body.

2. Swing check valves shall exceed the minimum requirements of AWWA C508 with a heavy-duty body of cast iron conforming to ASTM A 126 Class B with integral flanges, faced and drilled in accordance with ASME B16.1 Class 125. Bolts, nuts, washers, etc., shall be 316 stainless steel.

3. The valve body shall be the full waterway type, designed to provide a net flow, not less than the nominal inlet pipe size, when swung open no more than 25 degrees. The valve shall have a replaceable stainless steel body seat, a cast iron disc faced with a renewable resilient seat ring of rubber, and shall be held in place by stainless steel screws.

4. The disk arm shall be ductile iron or steel, suspended from and keyed to a stainless steel shaft, which is completely above the waterway and supported at each end by heavy bronze bushings. The shaft shall rotate freely without the need for external lubrication. Where it passes through the body, the shaft shall be sealed by means of a stuffing box and adjustable packing. Simple O-ring shaft seals are not acceptable.

5. The check valve shall be GA Industries, Inc. Figure 220-DS or an approved equal.

6. The valve interior shall be painted with epoxy coating by the valve manufacturer in accordance with AWWA C550. The valve exteriors shall be factory prepared and primed, and field finish painted in accordance with Section 09 90 00.00 98 PAINTING AND COATING.

2.14.2 PVC Swing Check Valves, 3 Inches and Smaller

Swing check valves 3 inches and smaller shall be constructed of PVC in accordance with ASTM D 1784, Type 1, Grade 1. Ends shall be flanged, ASME B16.5, Class 150. Seats and seals shall be EPDM. Provide bolted bonnet. Valves shall have a pressure rating of 150 psi at a temperature of 73°F. Valves shall be as manufactured by Asahi/America or approved equal.

2.14.3 Plug Valve

Plug valves are specified under Section 33 30 00 SANITARY SEWERS in the paragraph entitled "Plug Valves".

2.14.4 Double-Union PVC Ball Valves, 3 Inches and Smaller, for Water and Light Chemical Service

Unless noted otherwise, ball valves installed in PVC piping systems 3 inches and smaller shall be constructed from polyvinyl chloride (PVC) ASTM D 1784, rated to 150 psi minimum from 30 to 120 degrees F, double-union design with two-way blocking capability, socket end connection, double EPDM O-ring seals and EPDM backing cushions, PTFE seals, ABS handle. Valves shall be as manufactured by Asahi/America Inc., Quarter-Bloc Ball Valve Series, or

approved equal.

2.15 QUICK DISCONNECT

Quick disconnect shall be rated for a minimum pressure rating of 150 psi and shall be constructed of 316 stainless steel. The quick disconnect outlet shall be male American Standard Taper Pipe Thread. Size shall be as indicated on the drawings. The quick disconnect shall be product number 633-F by OPW or approved equal.

2.16 DUST CAP

The dust cap shall be compatible with the quick disconnect and shall be constructed of 316 stainless steel. The dust cap shall be product number 634-B by OPW or approved equal.

2.17 PIPING

Terminate discharge lines 5-feet outside the lift station in flanged connections. Include the pipe from the wet well manhole in the suction line. External connection joints for pipe using rubber gaskets are to comply with the standards of ASTM C 443.

Piping shall be in accordance with Section 33 30 00 SANITARY SEWERS, except that non-potable ductile iron piping shall have Protecto 401 interior lining or approved equal.

2.18 ELECTRICAL POWER CORD

Electrical power cord shall be water resistant 600 V, 140 degree F, UL and CSA approved and applied depending on amp draw for size.

The pump shall be triple protected with a compression fitting and two epoxy-potted areas at the power cord entry to the pump. A separation between the junction box area of the pump and motor by a stator lead sealing gland or terminal board shall not be acceptable.

The power cable entry into the cord cap assembly shall first be made with a compression fitting. Each individual lead shall be stripped down to bare wire at staggered intervals, and each strand shall be individually separated. This area of the cord cap shall then be fitted with an epoxy compound potting that will prevent water contamination from gaining entry if wicking or capillary attraction occurs.

The power cord leads shall then be connected to the motor leads with extra heavy connectors having brass inserts with a screwed wire-to-wire connection.

The connection box wiring shall be separated from the motor housing wiring by stripping each lead down to bare wire, at staggered intervals and separating each strand. This area shall be filled with an epoxy compound potting. Fiberglass terminal boards that are subject to heat fatigue and cracking, and which may lead to possible leaks, shall not be acceptable.

The cord cap assembly where bolted to the connection box assembly shall be sealed with a Buna N Rubber O-ring on a beveled edged to ensure proper sealing.

2.19 ELECTRIC MOTORS

The stator, rotor, and bearings shall be mounted in a sealed submersible type housing. The stator windings shall have Class F or Class H insulation, and a dielectric oil-filled motor, NEMA B design.

The pump and motor shall be specifically designed so that they may be operated partially or completely submerged in the liquid being pumped.

Stators shall be securely held in place with a removable end ring and threaded fasteners so they may be easily removed in the field and must be capable of being repaired or rewound by a local motor service station. No special tools shall be required for pump and motor disassembly.

The pump motor shall be equipped with heat sensors. The heat sensors shall be a low-resistance, bi-metal disc that is temperature sensitive. They shall be mounted directly in the stator, sized to open at 250 degrees F, and automatically reset at 90 to 95 degrees F differential. The sensor shall be connected in series with the motor starter coil so that the starter is tripped if a heat sensor opens. The motor starter shall be equipped with overload heaters so all normal overloads are protected by an external heater block.

Each pump motor shall have a sensor to monitor moisture in the stator cavity. Provide a conductivity-sensitive relay for installation in the control panel to alarm excessive moisture content, which may be indicative of an outer mechanical seal FAILURE.

2.19.1 Lift Station Controls

All instrumentation, control, and electrical components provided under this section shall be of an industrial quality equal to the components specified in Section 40 95 00, Process Control System and Division 26, ELECTRICAL, except as noted otherwise.

The instrumentation and controls system, specified herein, shall accept single-phase, 120V, 60-Hz AC electrical power, except were noted herein.

2.19.1.1 Scope

This paragraph (2.20.1 Lift Station Controls) pertains to all the lift stations.

2.19.1.2 Enclosure(s)

Control Panel - 304 SST, NEMA 3R rated, 3-point latch, complete with swing-out, dead-front panel. Provide a solar-shield for each panel as illustrated in the drawings.

2.19.1.3 Operator Interface

Provide the following interface devices:

a. Lift Station Pumps (one complete set for each pump).

1. HAND/OFF/AUTO selector switch.
2. 'RUN' status pilot light.
3. Elapsed time meter.

b. Alarm Annunciation.

1. Alarm horn 'SILENCE' pushbutton.
2. Alarm 'RESET' pushbutton.
3. Pump No. 1 'Seal Leak'.
4. Pump No. 1 'Motor Temp HIGH'.
5. Pump No. 2 'Seal Leak'.
6. Pump No. 2 'Motor Temp HIGH'.
7. Wet Well 'Level High'.

Mount all controls and indicators on the swing-out, dead-front panel. Do not mount any device on the enclosure door.

Mount the alarm beacon and horn on control panel enclosure as indicated on the drawings.

2.19.1.4 External Interfaces

Provide the following signal interface(s) each of which terminated at the terminal strip, clearly designated as external signal interface:

a. Discrete outputs:

1. Control Power ON
2. Pump No. 1 RUN Status
3. Pump No. 2 RUN Status
4. Common Pump FAIL
5. Wet Well Level HIGH

b. Discrete inputs:

The following signals interface with components located in a classified environment (see electrical drawings). Provide suitable safety barrier(s) as needed to comply with NEC.

1. Wet Well Level HIGH HIGH Alarm
2. Wet Well Level START LAG
3. Wet Well Level START LEAD
4. Wet Well Level STOP ALL
5. Wet Well Level LOW LOW Alarm
6. Pump No. 1 Seal Failure
7. Pump No. 1 Motor Temperature HIGH
8. Pump No. 2 Seal Failure
9. Pump No. 2 Motor Temperature HIGH

2.19.1.5 Functional Requirements

a. Provide electro-mechanical (i.e. hard-wired, relay-based logic, using electro-mechanical relays and solid-state logic circuits) controls. The operating functions shall be as specified under 'General Lift Station Sequence of Operation' provided in the drawings, and as provided below.

b. Indicate the ALARM condition, both visually and audibly whenever wet well level exceeds the HIGH HIGH level setpoint. Provide silence function for the audible alarm.

c. Maintain all ALARM conditions until the offending condition is removed and the alarm is manually RESET.

2.19.1.6 Special Requirements

a. Provide and install a Main Circuit Breaker (MCB) and Generator Circuit Breaker (GCB); the MCB for the power utility 240 VAC, 60 Hz power feed, the GCB for the generator 240 VAC, 60 Hz power feed. Inter-lock the two breakers to avoid having both simultaneously closed. Allow operation of the breaker with the swing-out, dead-front panel closed. Interlock the swing-out panel with the operation MCB/GCB to prohibit opening of the swing-out panel while the MCB/GCB is energized. Provide the generator receptacle as indicated on the drawings.

c. Provide and install motor feed with non-reversing, motor starters for each pump. Allow for operation of the motor feeder circuit breakers with the swing-out, dead-front panel closed. Starters shall be as specified in Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES and as shown on the drawings. Equip starters with Solid State Overload (SSOL) relays as specified in Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

d. Provide and install non-mercury float switches as noted on the drawings, complete with intrinsically safe relays. Float switches shall be of the suspended type with polypropylene or PVC body. Units shall have an integral electrical cable with two #19 AWG stranded conductors. Switches shall be pilot duty, normally open or normally closed, as required for application.

e. Provide and install elapsed time meters for each motor. The meters shall be non-resettable, having six-digit indication of run time, and resolution of 0.1 hours. Run the meters whenever the pump motor starter is energized.

f. Provide and install a phase-loss/unbalance/reversal and under-voltage protection assembly with adjustable nominal voltage setting. Configure the pump logic to automatically lockout pump operation if all phases drop below 90 percent or of one phase drops below 80-83 percent nominal voltage. The device dropout delay shall be 1/2 second, nominally. The phase failure relay shall be Diversified Electronics.

g. Provide an alarm horn. Mount the alarm horn on the side of the panel.

h. Provide an alarm beacon. Mount the alarm beacon on the top of the panel.

i. Provide and install one (1) convenience receptacle.

j. Lift Station #1 Phase Converter: Provide a means for converting from single-phase power for the two three-phase, 230V, 15 hp pumps at Lift Station #1. Provide as recommended by the control panel manufacturer one of the following:

1. A single-phase converter mounted on the line side of the lift station control panel. The phase converter shall be suitable to operate both three-phase loads and single-phase loads. Mount the phase converter in a weatherproof corrosion-resistant enclosure. The phase converter shall also be sized to provide control power for the control panel.

2. Separate phase converters within the control panel, one for each pump.

The phase converter shall be a rotary phase converter or a digital phase converter as recommended by the control panel manufacturer. The phase converter/control panel installation shall be such that it does not void the pump warranty.

k. Provide and install #18 TSP as necessary in 1 inch conduit to connect alarms from Lift Station #1 and Lift Station #2 to KCCS monitoring.

2.20 PAINT

Surfaces to be painted include the wet well interior and all piping, conduit, etc., within the wet wells, and aluminum surfaces in contact with concrete.

Provide painting and coatings requirements in accordance with 09 90 00.00 98 PAINTING AND COATING and 09 97 24 CONCRETE REPAIR AND HYDROGEN SULFIDE PROTECTIVE COATING.

2.21 GUIDE RAIL ASSEMBLY

If applicable, guide rails shall be mounted to the basin floor on stainless steel riser supports. Guide rails shall be 300 Series stainless steel and size shall be in accordance with the pump manufacturer's recommendation. Each pump shall be equipped with a stainless steel upper and lower guide assembly, stainless steel lifting bail, and stainless steel lifting cable.

PART 3 EXECUTION

3.1 GENERAL

Install lift station as indicated, in accordance with drawings and the manufacturer's instructions.

Preventative Maintenance and Inspection procedure is required for package lift stations sewage pumps. Include in procedures the frequency of preventative maintenance, inspection, adjustment, lubrication, and cleaning necessary to minimize corrective maintenance and repair.

3.2 PIPING

3.2.1 Flanged and Threaded Joints

3.2.1.1 Flanged Joints

Flanged joints shall be faced true, provided with gaskets, and made perfectly square and tight. Flanged joints shall be used in special cases where connected equipment is available with only flanged joints, or when specifically shown on the drawings.

3.2.1.2 Threaded Joints

Threaded joints shall have graphite or inert filler and oil, graphite compound, or polytetrafluoroethylene (PTFE) tape applied to the male threads only. Unions shall be provided at all screwed valves, strainers and connections to equipment 3/4 inch and smaller. Dielectric unions shall be used at connections of dissimilar metals in 3/4 inch and smaller piping.

3.2.2 Pipe Supports in Valve Vaults

Horizontal and vertical runs of pipe in valve vaults shall be securely supported.

3.3 VALVE VAULTS AND ACCESSORIES

3.3.1 Piping and Equipment in Valve Vaults

Piping and equipment in valve vaults shall be installed to provide easy access without stepping on piping or equipment, and to provide sufficient working room. Piping and equipment in valve vaults shall be installed and supported as shown on the drawings. All plug and check valves shall be installed with the stems horizontal or above.

3.4 TESTS

Commercial testing shall be required and include the following:

The pump shall be visually inspected to confirm that it is built in accordance with the specification as to HP, voltage, phase, and hertz.

The motor and seal housing chambers shall be meggered to test for moisture content and/or insulation defects.

Pump shall be allowed to run dry to check for proper rotation.

Discharge piping shall be attached, the pump submerged in water and amp readings shall be taken in each leg to check for an imbalanced stator winding. If there is a significant difference in readings, the stator windings shall be checked with a bridge to determine if an unbalanced resistance exists. If so, the stator will be replaced.

Perform a pump down test to verify that pumps are operating as expected.

For testing of the wetwell refer to Section 03 40 00.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION.

3.5 OPERATION AND MAINTENANCE

Refer to Section 01 78 23 OPERATION AND MAINTENANCE DATA.

3.6 FORMS

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER _____ EQPT SERIAL NO: _____

EQPT TAG NO: _____ EQPT/SYSTEM: _____

PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

_____ Installed in accordance with Manufacturer's recommendations.

_____ Inspected, checked, and adjusted.

_____ Serviced with proper initial lubricants.

_____ Electrical and mechanical connection meet quality and safety standards.

_____ All applicable safety equipment has been properly installed.

_____ System has been performance tested, and meets or exceeds specified performance requirements (when complete system of one manufacturer).

Comments: _____

_____

_____

_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment, and (iii) authorize the make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20___

Manufacturer: _____

By Manufacturer's Authorized Representative:

_____
(Authorized Signature)

EQUIPMENT MANUFACTURER'S CERTIFICATE OF INSTALLATION TESTING AND INSTRUCTION

OWNER

PROJECT

CONTRACT NO.

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

_____
(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial No.)

Installed for the subject project has have been installed in a satisfactory manner, has have been satisfactorily tested, is/are ready for operation, and that Owner assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the units on Date:

_____ Time: _____.

CERTIFIED BY: _____ DATE: _____
(Signature of Manufacturer's Representative)

OWNER'S ACKNOWLEDGEMENT OF MANUFACTURER'S INSTRUCTION

I/We the undersigned, authorized representatives of the _____ and/or Plant Operating Personnel have received classroom and hands on instruction on the operation, lubrication, and maintenance of the subject equipment and am are prepared to assume normal operational responsibility for the equipment:

_____ DATE: _____

_____ DATE: _____

_____ DATE: _____

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 35 00

ONSITE SEWAGE DISPOSAL SYSTEM ABANDONMENT

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 GENERAL REQUIREMENTS
1.4 WORK INCLUDED
1.8 RELATED WORK
1.5 DEFINITIONS

PART 2 PRODUCTS

2.1 MATERIALS

PART 3 EXECUTION

3.1 GENERAL
3.2 SYSTEM ABANDONMENT
3.3 SEPTAGE DISPOSAL
3.4 COMPLETION AND CLEANUP

-- End of Section Table of Contents --

SECTION 33 35 00

ONSITE SEWAGE DISPOSAL SYSTEM ABANDONMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

FLORIDA ADMINISTRATIVE CODE (FAC)

Chapter 10D-6	Sewage Disposal Facilities
Chapter 64E-6	(2006) Standards for Onsite Sewage Treatment and Disposal Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Operating Plan

Permit to Abandon Onsite Sewage Treatment and Disposal System

SD-07 Certificates

Work Complete Logs

1.3 GENERAL REQUIREMENTS

Not more than 28 days after the contract is awarded, submit a proposed Operating Plan for the abandonment of 11 of the onsite sewage disposal systems and for the decommission and replacement of the two onsite sewage disposal systems located at East and West Gun Clubs. Ensure that the plan includes discussion of, but is not limited to, all items specified herein.

Maintain and submit upon completion of work complete logs of onsite sewage disposal system abandonment operations. Ensure that the logs include the following:

Date of system abandonment.
Name and local address of property owners(s).
Mailing address of property owner(s) if different from local address.
Type of system abandoned.
Number of tanks abandoned.

Submit permit to abandon onsite sewage treatment and disposal system.

1.4 WORK INCLUDED

This section includes the work necessary to abandon 11 of the onsite sewage disposal systems and for the decommission and replacement of the two onsite sewage disposal systems located at East and West Gun Clubs. Abandonment includes disconnecting the onsite sewage disposal system, pumping out the tank, rupturing its bottom, filling it with suitable material, and disposing of the pumped septage. Abandon only those onsite sewage disposal systems which are being functionally replaced by the sewage collection system.

1.8 RELATED WORK

FAC Chapter 10D-6 and Chapter 64E-6 are a part of this section as if incorporated within.

1.5 DEFINITIONS

"Onsite sewage disposal system", also referred to as "system," is defined as a sewage treatment disposal facility, which may contain a standard drainfield system pump, an aerobic treatment unit, a graywater system tank, a laundry wastewater system tank, a septic tank, a grease interceptor, a dosing tank, a solids or effluent pump, alternative system, or experimental system.

"Graywater" is defined as all domestic waste excluding waste carried off by toilets, urinals, and kitchen drains. Graywater includes bath, lavatory, laundry, and sink waste except kitchen sink waste.

"Septage" is defined as a mixture of sludge, fatty materials, human feces, and wastewater removed during the pumping of an onsite sewage disposal system.

"Tank" is defined as any receptacle constructed to provide onsite treatment and/or disposal of wastewater into a soil absorption system. Tanks include, but are not limited to, septic tanks, graywater system tanks, laundry wastewater system tanks, and grease interceptors.

PART 2 PRODUCTS

2.1 MATERIALS

Not used.

PART 3 EXECUTION

3.1 GENERAL

Begin onsite sewage disposal system abandonment procedures upon approval by the Contracting Officer only after the sewage collection system or new onsite sewage treatment and disposal system has been constructed and certified ready for operation. Closely coordinate abandonment procedures with the Contracting Officer throughout the duration of the work so as not to adversely affect or disrupt the proper operation of the sewage collection systems.

Abandon onsite sewage disposal systems only after all facilities served by the onsite system have been connected to the sewage system. Minimize disruption of the park's sewer service.

One week before performing any work, including lift station installation, pipe installation, electric power connection, septic tank abandonment, etc., provide the Contracting Officer and Park Manager written and verbal notice of the type of work and the date the work will take place. If work is delayed, provide a new written notice stating the work has been delayed.

3.2 SYSTEM ABANDONMENT

Disconnect the onsite sewage disposal system from all facilities it serves. Abandon-in-place all disconnected service lines, tanks, and drain fields. Remove all mounded drainfields to surrounding grade and dispose of removed materials offsite at a certified landfill.

A qualified septage disposal service permitted in the State of Florida shall pump out all disconnected tanks. Ensure that the pumped tanks are clean and devoid of any septage.

After being pumped clean, open or rupture the bottom of all compartments/chambers of all tanks to prevent the abandoned tank from retaining water.

Fill ruptured tanks with suitable soil material as defined in Section 31 00 00 EARTHWORK and backfill and compact any associated excavation in lifts not exceeding 12 inches to match existing grade as specified. There shall be no voids remaining in the abandoned tank. In cases where suitable soil material connect be placed in an abandoned septic tank, use excavatable flowable fill as approved by the Contracting Officer.

3.3 SEPTAGE DISPOSAL

Dispose of pumped septage as required in FAC Chapter 10D-6 and Chapter 64E-6.

3.4 COMPLETION AND CLEANUP

Perform final grading and sodding of all disturbed areas as specified in Section 32 92 23 SODDING.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 71 01.00 40

OVERHEAD TRANSMISSION AND DISTRIBUTION

PART 1 GENERAL

1.1 REFERENCES
1.2 DEFINITIONS
1.3 SUBMITTALS
1.4 MATERIAL, EQUIPMENT, AND FIXTURE SCHEDULE
1.5 QUALITY ASSURANCE
1.5.1 Regulatory Requirements
1.5.2 Standard Products
1.5.2.1 Alternative Qualifications
1.5.2.2 Material and Equipment Manufacturing Date
1.5.3 Ground Resistance Test Reports
1.5.4 Wood Crossarm Inspection Report
1.5.4.1 Field Test Plan
1.6 MAINTENANCE
1.6.1 Additions to Operations and Maintenance Data
1.7 DELIVERY, STORAGE, AND HANDLING
1.8 WARRANTY

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT
2.2 POLES
2.2.1 Wood Poles
2.2.2 Preservative
2.2.3 Preservative Application
2.2.4 Storage
2.2.5 Handling
2.3 CROSSARMS AND BRACKETS
2.4 HARDWARE
2.4.1 Pins
2.4.2 Hot-Line Clamps
2.5 INSULATORS
2.6 ANCHORS AND ANCHOR RODS
2.6.1 Screw Anchors
2.7 TRANSFORMERS (OVERHEAD-TYPE DISTRIBUTION)
2.8 SOURCE QUALITY CONTROL
2.8.1 Transformer Test Schedule
2.8.2 Routine and Other Tests

PART 3 EXECUTION

3.1 INSTALLATION
3.1.1 Wood Pole Installation
3.1.1.1 Setting Depth of Pole
3.1.1.2 Setting in Soil, Sand, and Gravel

3.1.1.3 Setting in Solid Rock
3.1.1.4 Setting With Soil Over Solid Rock
3.1.1.5 Setting on Sloping Ground
3.1.1.6 Backfill
3.1.1.7 Setting Poles
3.1.1.8 Alignment of Poles
3.1.1.9 Pole Caps
3.1.1.10 Marking
3.1.2 Anchors and Guys
3.1.2.1 Setting Anchors
3.1.2.2 Screw Anchors
3.1.2.3 Guy Installation
3.1.3 Hardware
3.2 TRANSFORMER INSTALLATION
3.3 FIELD APPLIED PAINTING
3.4 FIELD FABRICATED NAMEPLATE MOUNTING
3.5 FIELD QUALITY CONTROL
3.5.1 General
3.5.2 Safety
3.5.3 Sag and Tension Test
3.5.4 Performance of Acceptance Checks and Tests
3.5.4.1 Overhead-Type Distribution Transformers
3.5.5 Devices Subject to Manual Operation
3.5.6 Follow-Up Verification

-- End of Section Table of Contents --

SECTION 33 71 01.00 40

OVERHEAD TRANSMISSION AND DISTRIBUTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS ANSI O5.1	(2008) Wood Poles -- Specifications & Dimensions

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C29.2	(1992; R 1999) American National Standard for Insulators - Wet-Process Porcelain and Toughened Glass - Suspension Type
ANSI C29.3	(1986; R 2002) American National Standard for Wet Process Porcelain Insulators - Spool Type
ANSI C29.4	(1989; R 2002) Standard for Wet-Process Porcelain Insulators - Strain Type
ANSI C29.6	(1994; R 2002) Wet-Process Porcelain Insulators - High Voltage Pin Type
ANSI C29.7	(1996; 2007) American National Standard for Wet Process Porcelain Insulators - High-Voltage Line Post Type
ANSI C57.12.20	(2005) Overhead-Type Distribution Transformers, 500 kVA and Smaller: High Voltage 34,500 Volts and Below; Low Voltage 7970/13 800Y V and Below

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA A3	(2005) Standard Method for Determining Penetration of Preservatives and Fire Retardants
AWPA T1	(2009) Use Category System: Processing and Treatment Standard

ASME INTERNATIONAL (ASME)

ASME B16.11	(2009) Forged Fittings, Socket-Welding and Threaded

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM B 117	(2009) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM D 1625	(1971; R 2000) Standard Specifications for Chromated Copper Arsenate
ASTM D 1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C135.1	(1999) Standard for Zinc-Coated Steel Bolts and Nuts for Overhead Line Construction
IEEE C2	(2007; TIA 2007-1; TIA 2007-2; TIA 2007-3; TIA 2007-4; TIA 2007-5; Errata 2006-1; Errata 2007-2; Errata 2009-3) National Electrical Safety Code
IEEE C57.12.00	(2006) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.90	(2006; INT 1-2009) Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011) National Electrical Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 202-1	(2004) List of Materials Acceptable for

	Use on Systems of RUS Electrification Borrowers
RUS Bull 345-67	(1998) REA Specification for Filled Telephone Cables, PE-39

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE 100.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

As an exception to this paragraph, transformers manufactured by ABB in Athens, GA; by Cooper Power Systems in Lumberton, MS; by ERMCO in Dyersburg, TN; or by Howard Industries in Laurel, MS need not meet the submittal requirements of this contract. Instead, submit the following.

a. A certification, from the manufacturer, that the technical requirements of this specification are met.

b. Provide routine and other tests (paragraph entitled "Routine and Other Tests), that are conducted by the manufacturer and witnessed by the Government (paragraph entitled "Source Quality Control"). Provide certified copies of the tests.

c. Provide field test reports (paragraph entitled "Field Quality Control").

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Schedule

SD-02 Shop Drawings

Installation Drawings; G

Transformers; G

SD-03 Product Data

Transformers; G

Anchors

SD-06 Test Reports

Field Test Plan; G

Field Quality Control

Ground resistance test reports

Transformer Test Schedule; G

Submit report of the acceptance test results as specified by paragraph entitled "Field Quality Control"

1.4 MATERIAL, EQUIPMENT, AND FIXTURE SCHEDULE

Submit material, equipment, and fixture schedule for overhead pole line assemblies including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

1.5 QUALITY ASSURANCE

1.5.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of NFPA 70 and IEEE C2 unless more stringent requirements are specified or indicated.

1.5.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Provide products that have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period includes applications of equipment and materials under similar circumstances and of similar size. Provide a product that has been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, provide items that are products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.2.1 Alternative Qualifications

Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.2.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than 3 years prior to date of delivery to site, unless specified otherwise.

1.5.3 Ground Resistance Test Reports

Submit the measured ground resistance of grounding system. When testing grounding electrodes and grounding systems, identify each grounding electrode and each grounding system for testing. Include the test method and test setup (i.e. pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

1.5.4 Wood Crossarm Inspection Report

The RUS approved Quality Mark "WQC" on each crossarm is acceptable, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.5.4.1 Field Test Plan

Provide a proposed field test plan 30 days prior to testing the installed system. Do not perform field test until the test plan is approved. Provide a test plan that consists of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

1.6 MAINTENANCE

1.6.1 Additions to Operations and Maintenance Data

In addition to requirements of Data Package 5, include the following in the operation and maintenance manuals provided:

a. Assembly and installation drawings

b. Prices for spare parts and supply list

c. Date of purchase

1.7 DELIVERY, STORAGE, AND HANDLING

Visually inspect devices and equipment when received and prior to acceptance from conveyance. Protect stored items from the environment in accordance with the manufacturer's published instructions. Replace damaged items. Store oil filled transformers and switches in accordance with the manufacturer's requirements. Store wood poles held in storage for more than 2 weeks in accordance with ATIS ANSI 05.1. Handle wood poles in accordance with ATIS ANSI 05.1, except do not use pointed tools capable of producing indentations more than an inch in depth. Nails and holes are not permitted in top of poles. Handle and store metal poles in accordance with the manufacturer's instructions.

1.8 WARRANTY

Support the equipment items by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Consider materials specified herein or shown on contract drawings which are identical to materials listed in RUS 202-1 as conforming to requirements. Provide equipment and component items, not hot-dip galvanized or porcelain enamel finished, with corrosion-resistant finishes which withstand 480 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. Provide the described test mark and test evaluation in accordance with ASTM D 1654 with a rating

of not less than 7 in accordance with TABLE 1, (procedure A). Coat cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel with a zinc rich paint conforming to the manufacturer's standard.

2.2 POLES

Provide poles of lengths and classes indicated.

2.2.1 Wood Poles

Wood poles machine trimmed by turning, Southern Yellow Pine conforming to ATIS ANSI O5.1 and RUS Bull 345-67. Gain, bore and roof poles before treatment. If additional gains are required subsequent to treatment, provide metal gain plates. Pressure treat poles with chromated copper arsenate (CCA). Ensure the quality of each pole with "WQC" (wood quality control) brand on each piece, or by an approved inspection agency report.

2.2.2 Preservative

For preservative used for humid, harsh environment, provide Chromated Copper Arsenate type (A)(B)(C) conforming to AWPA T1 and ASTM D 1625.

Treat wood poles with waterborne preservatives conforming to AWPA T1.

2.2.3 Preservative Application

Apply preservative treatment using a pressure process conforming to and AWPA T1 for Southern Pine. Determine penetration of preservatives as specified in AWPA A3 and obtain complete sapwood penetration.

Before treatment, roof, gain and bore poles that are to be given a full-length preservative treatment. Plug unused holes in poles with treated wood-dowel pins. Treat field-cut gains or field-bored holes in poles with an approved preservative compound.

2.2.4 Storage

For poles stored for any reason more than 2 weeks, stack them on pressure treated or decay-resistant skids of such dimensions and so arranged as to support the poles without producing noticeable distortion. Stack poles in a manner that permits free circulation of air; with the bottom poles of the stacks at least 1-foot above ground level or any vegetation growing thereon. No decayed or decaying wood is permitted to remain underneath stored poles.

2.2.5 Handling

Do not drag treated poles along the ground. Do not use pole tongs, cant hooks, and other pointed tools capable of producing indentations more than 1 inch in depth, in handling the poles. Do not apply tools to the groundline section of any pole. Groundline section is that portion between 1 foot above and 2 feet below the ground line.

2.3 CROSSARMS AND BRACKETS

2.4 HARDWARE

Provide hot-dip galvanized hardware in accordance with ASTM A 153/A 153M

and ASTM A 123/A 123M.

Install washers under boltheads and nuts on wood surfaces and elsewhere as required. Provide washers used on through-bolts and double-arming bolts that are approximately 2-1/4 inches square and 3/16 inch thick. Make the diameter of holes in washers the correct standard size for the bolt on which a washer is used. Provide washers for use under heads of carriage-bolts, of the proper size to fit over square shanks of bolts. Use eye bolts, bolt eyes, eyenuts, strain-load plates, lag screws, guy clamps, fasteners, hooks, shims, and clevises wherever required to support and to protect poles, brackets, crossarms, guy wires, and insulators. Pole line hardware shall meet the requirements of IEEE C135.1 for steel bolts and nuts.

2.4.1 Pins

Provide pins that are zinc-coated forged steel with lead-thread height to suit the insulator to be installed, but not less than 4-1/2-inches high by 5/8-inch diameter. Provide shoulder that is not less than 2-inch diameter and that is designed to distribute the load uniformly to the crossarm. Provide shank that is not less than 5/8-inch diameter by 5-3/4-inch length, equipped with a 2-inch square washer, nut, and locknut, and that projects not less than 1/8 inch nor more than 2 inches beyond the locknut. Use broad-based corner pins of drop-forged welded steel or malleable iron for turning small angles, as indicated.

2.4.2 Hot-Line Clamps

Make connections to overhead primary conductors with hot-line clamps of the screw type with concealed threads. Fill thread chamber with corrosion-resistant compound. Provide hot-line clamp tap conductor of bare soft-drawn seven-strand No. 4 copper, except that for the hot-line clamp tap conductor for lateral lines No. 2 and larger, provide bare soft-drawn copper of the same size and stranding as the lateral line.

Provide stirrups for hot-line clamp connections that are 4 by 4 inches, and are constructed of bare hard-drawn copper the same size as the tap line but not less than No. 4.

2.5 INSULATORS

Insulators for use on primary open-wire construction shall conform to ANSI C29.2, ANSI C29.3, ANSI C29.4, ANSI C29.6, and ANSI C29.7.

Insulators shall have a minimum wet flashover rating of 80 kV.

Use suspension insulators on the primary system at corners, angles greater than 5 degrees, suspended buses, dead ends, and wherever pin insulators do not provide adequate strength.

Mechanical strength of suspension and strain insulators shall exceed the ultimate tensile strength of the conductor or guy attached thereto.

Pin insulators used on voltages in excess of 5,000 volts phase-to-phase shall be radio-noise free.

Insulators for various uses shall have ratings not lower than the classes indicated as follows:

SERVICE	PIN	LINE POST	SUSPENSION
5,001- to 15,000-volt	56-3	27-21 or 2s	3 X 52-2*

*With a 12-inch extension link in the center phase.

Spool insulators used on secondaries shall be not smaller than Class 52-2. For conductors No. 4/0 and larger, use Class 52-4 spool insulators.

Insulator testing shall be in accordance with ANSI C29.2.

2.6 ANCHORS AND ANCHOR RODS

Provide anchors that present holding area indicated on drawings as a minimum. Provide anchor rods that are triple thimble-eye, 1-1/2 inch diameter by 8 feet long. Provide anchors and anchor rods that are hot dip galvanized.

2.6.1 Screw Anchors

Screw type anchors having a manufacturer's rating of not less than 10,000 pounds in loose to medium sand/clay soil, Class 6 and extra heavy pipe rods conforming to ASTM A 53/A 53M, Schedule 80, and couplings conforming to ASME B16.11.

2.7 TRANSFORMERS (OVERHEAD-TYPE DISTRIBUTION)

Transformers shall comply with IEEE C135.1 for general requirements and ANSI C57.12.20 for specific requirements for overhead transformers. Overhead distribution transformers shall be of outdoor type, salt spray mineral-oil-insulated single-phase as indicated and have two separate windings per phase. Transformers shall be provided with necessary auxiliary mounting devices suitable for the indicated installation. Transformer installations shall include one primary fuse cutout and one surge arrester for each ungrounded phase conductor. Self-protected transformers are not acceptable. Transformer tanks shall have a standard gray finish.

2.8 SOURCE QUALITY CONTROL

2.8.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

(1) Provide a manufacturer that has a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

(2) Provide an accuracy that is directly traceable to the National Institute of Standards and Technology.

(3) Provide instrument calibration frequency schedule that does not exceed 12 months for both test floor instruments and leased specialty equipment.

(4) Provide visible dated calibration labels on all test equipment.

(5) Provide calibrating standard of higher accuracy than that of the instrument tested.

(6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

(a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.8.2 Routine and Other Tests

IEEE C57.12.00 and IEEE C57.12.90. Perform routine and other tests by the manufacturer on the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Provide required tests as follows:

a. Polarity

b. Ratio

c. No-load losses (NLL) and excitation current

d. Load losses (LL) and impedance voltage

e. Dielectric

(1) Impulse

(2) Applied voltage

(3) Induced voltage

f. Leak

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wood Pole Installation

Provide pole holes at least as large at the top as at the bottom and large enough to provide 4 inch clearance between the pole and side of the hole.

3.1.1.1 Setting Depth of Pole

Provide pole setting depths as follows:

Length of Pole (feet)	Setting in Soil (feet)	Setting in Solid Rock (feet)
20	5.0	3.0
25	5.5	3.5
30	5.5	3.5
35	6.0	4.0
40	6.0	4.0
45	6.5	4.5
50	7.0	4.5
55	7.5	5.0
60	8.0	5.0
65	8.5	5.5
70	9.0	5.5
75	9.5	6.0
80	10.0	6.0
85	10.5	6.5
90	11.0	6.5
95	11.5	7.0
100	12.5	7.5

3.1.1.2 Setting in Soil, Sand, and Gravel

"Setting in Soil" depths, as specified in paragraph entitled "Setting Depth of Pole," apply where the following occurs:

a. Where pole holes are in soil, sand, or gravel or any combination of these;

b. Where soil layer over solid rock is more than 2 feet deep;

c. Where hole in solid rock is not substantially vertical; or

d. Where diameter of hole at surface of rock exceeds twice the diameter of pole at same level. At corners, dead ends and other points of extra strain, set poles that are 40 feet or more long 6 inches deeper.

3.1.1.3 Setting in Solid Rock

"Setting in Solid Rock," as specified in paragraph entitled "Setting Depth of Pole," applies where poles are to be set in solid rock and where hole is substantially vertical, approximately uniform in diameter and large enough to permit use of tamping bars the full depth of hole.

3.1.1.4 Setting With Soil Over Solid Rock

Where a layer of soil 2 feet or less in depth over solid rock exists, make depth of hole the depth of soil in addition to depth specified under "Setting in Solid Rock" in paragraph entitled "Setting Depth of Pole," provided, however, that such depth does not exceed depth specified under "Setting in Soil."

3.1.1.5 Setting on Sloping Ground

On sloping ground, always measure hole depth from low side of hole.

3.1.1.6 Backfill

Thoroughly tamp pole backfill for full depth of the hole and mound excess fill around the pole.

3.1.1.7 Setting Poles

Set poles so that alternate crossarm gains face in opposite directions, except at terminals and dead ends where gains of last two poles are on side facing terminal or dead end. On unusually long spans, set poles so that crossarm comes on side of pole away from long span. Where pole top pins are used, place on opposite side of pole from gain, with flat side against pole.

3.1.1.8 Alignment of Poles

Set poles in alignment and plumb except at corners, terminals, angles, junctions, or other points of strain, set and rake them against the strain. Set not less than 2 inches for each 10 feet of pole length above grade, nor more than 4 inches for each 10 feet of pole length after conductors are installed at required tension. When average ground run is level, vary consecutive poles by not more than 5 feet in height. When ground is uneven, keep poles differing in length to a minimum by locating poles to avoid the highest and lowest ground points. If it becomes necessary to shorten a pole, saw a piece off the top. Dig holes large enough to permit the proper use of tampers to full depth of hole.

3.1.1.9 Pole Caps

Provide plastic pole caps with 1/4 inch sealing rings and four nailing tabs. Fill sealing area with either a bituminous, elastigum roof cement or an acceptable preservative paste to level of sealing ring to eliminate possibility of condensation. Place on pole top and nail each tab down with a 1 1/4 inch nail.

3.1.1.10 Marking

Mark each pole in accordance with the requirements of ATIS ANSI 05.1. Locate marking on the face of the pole approximately 10 feet from the butt on the pole. Mark on the face of the pole at other locations standard with the pole manufacturer, where approved by the Contracting Officer.

Number poles as indicated. Number poles not having numbers indicated as directed by the Contracting Officer. Provide pole numbers that consist of aluminum numerals and characters not less than 2-1/2-inches high fastened to the pole with aluminum nails. Locate numerals to provide maximum visibility from the road or patrol route.

3.1.2 Anchors and Guys

Place anchors in line with strain. Provide indicated length of the guy lead (distance from base of pole to the top of the anchor rod).

3.1.2.1 Setting Anchors

Set anchors in place with anchor rod aligned with, and pointing directly at, guy attachment on the pole with the anchor rod projecting 6 to 9 inches out of ground to prevent burial of rod eye.

3.1.2.2 Screw Anchors

Install screw anchors by torquing with boring machine.

3.1.2.3 Guy Installation

Provide guys where indicated, with loads and strengths as indicated, and wherever conductor tensions are not balanced, such as at angles, corners and dead-ends. Where single guy do not provide the required strength, provide two or more guys. Where guys are wrapped around poles, provide at least two guy hooks. Provide pole shims where guy tension exceeds 6000 pounds. Provide guy clamps 6 inches in length with three 5/8 inch bolts, or offset-type guy clamps, or approved guy grips at each guy terminal. Securely clamp plastic guy marker to the guy or anchor at the bottom and top of marker.Complete anchor and guy installation, dead end to dead end, and tighten guy before wire stringing and sagging is begun on that line section.

3.1.3 Hardware

Provide hardware with washer against wood and with nuts and lock nuts applied wrench tight. Provide locknuts on threaded hardware connections. Provide M-F style locknuts and not palnut style.

3.2 TRANSFORMER INSTALLATION

Carefully install transformers so as not to scratch finishes or damage bushings. Install transformers in accordance with the manufacturer's instructions. After installation, inspect surfaces and touch up scratches with a finish provided by the transformer manufacturer for this purpose.

3.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Provide painting as specified in Section 09 90 00.00 98 PAINTING AND COATING.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 FIELD QUALITY CONTROL

3.5.1 General

Perform field testing in the presence of the Contracting Officer. Notify the Contracting Officer 30 days prior to conducting tests. Furnish materials, labor, and equipment necessary to conduct field tests. Perform tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. Maintain a written record of tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Sign and date field reports.

3.5.2 Safety

Provide and use safety devices such as rubber gloves, protective barriers,

and danger signs to protect and warn personnel in the test vicinity. Replace any devices or equipment which are damaged due to improper test procedures or handling.

3.5.3 Sag and Tension Test

Give the Contracting Officer prior notice of the time schedule for stringing conductors or cables serving overhead medium-voltage circuits. The Contracting Officer reserves the right to witness the procedures used for ascertaining that initial stringing sags and tensions are in compliance with requirements for the applicable loading district and cable weight.

3.5.4 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.5.4.1 Overhead-Type Distribution Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate information with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey is not required.

(4) Perform specific inspections and mechanical tests as recommended by manufacturer.

(5) Verify correct equipment grounding.

b. Electrical tests

(1) Perform insulation-resistance tests.

(2) Perform continuity test.

(3) Set tap changer to provide a secondary voltage of 120/240.

3.5.5 Devices Subject to Manual Operation

Operate each device subject to manual operation at least three times, demonstrating satisfactory operation each time.

3.5.6 Follow-Up Verification

Upon completion of acceptance checks and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, give the Contracting Officer 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 71 02.00 20

UNDERGROUND ELECTRICAL DISTRIBUTION

PART 1 GENERAL

1.1 REFERENCES
1.2 DEFINITIONS
1.3 SUBMITTALS
1.4 QUALITY ASSURANCE
1.4.1 Precast Underground Structures
1.4.2 Certificate of Competency for Cable Splicer/Terminator
1.4.3 Cable Installer Qualifications
1.4.4 Regulatory Requirements
1.4.5 Standard Products
1.4.5.1 Alternative Qualifications
1.4.5.2 Material and Equipment Manufacturing Date
1.5 GENERAL REQUIREMENTS

PART 2 PRODUCTS

2.1 CONDUIT, DUCTS, AND FITTINGS
2.1.1 Rigid Metal Conduit
2.1.1.1 Rigid Metallic Conduit
2.1.2 Plastic Conduit for Direct Burial
2.1.3 Plastic Duct for Concrete Encasement
2.1.4 Conduit Sealing Compound
2.1.5 Fittings
2.1.5.1 Metal Fittings
2.1.5.2 PVC Conduit Fittings
2.1.5.3 PVC Duct Fittings
2.1.5.4 Outlet Boxes for Steel Conduit
2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES
2.2.1 Conductor Types
2.2.2 Conductor Material
2.2.3 Jackets
2.2.4 In Duct
2.2.5 Cable Marking
2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS
2.4 LOW VOLTAGE SPLICES
2.4.1 Heat Shrinkable Splice
2.4.2 Cold Shrink Rubber Splice
2.5 TAPE
2.5.1 Insulating Tape
2.5.2 Buried Warning and Identification Tape
2.5.3 Fireproofing Tape
2.6 PULL ROPE
2.7 GROUNDING AND BONDING
2.7.1 Driven Ground Rods
2.7.2 Grounding Conductors

2.8 CAST-IN-PLACE CONCRETE
2.9 UNDERGROUND STRUCTURES
2.9.1 Cast-In-Place Concrete Structures
2.9.2 Precast Concrete Structures, Risers and Tops
2.9.2.1 General
2.9.2.2 Design for Precast Structures
2.9.2.3 Construction
2.9.2.4 Joints
2.9.3 Manhole Frames and Covers
2.9.4 Handhole Frames and Covers
2.9.5 Brick for Manhole Collar
2.9.6 Composite/Fiberglass Handholes and Covers
2.10 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)
2.10.1 Cable Racks
2.10.2 Rack Arms
2.10.3 Insulators
2.11 CABLE TAGS IN MANHOLES
2.11.1 Polyethylene Cable Tags

PART 3 EXECUTION

3.1 INSTALLATION
3.2 CABLE INSPECTION
3.3 CABLE INSTALLATION PLAN AND PROCEDURE
3.4 UNDERGROUND FEEDERS SUPPLYING BUILDINGS
3.5 UNDERGROUND STRUCTURE CONSTRUCTION
3.5.1 Cast-In-Place Concrete Structures
3.5.2 Precast Concrete Construction
3.5.3 Pulling-In Irons
3.5.4 Cable Racks, Arms and Insulators
3.5.5 Field Painting
3.6 UNDERGROUND CONDUIT AND DUCT SYSTEMS
3.6.1 Requirements
3.6.2 Treatment
3.6.3 Conduit Cleaning
3.6.4 Jacking and Drilling Under Roads and Structures
3.6.5 Galvanized Conduit Concrete Penetrations
3.6.6 Multiple Conduits
3.6.7 Conduit Plugs and Pull Rope
3.6.8 Conduit and Duct Without Concrete Encasement
3.6.8.1 Encasement Under Roads and Structures
3.6.9 Duct Encased in Concrete
3.6.9.1 Connections to Manholes
3.6.9.2 Connections to Existing Underground Structures
3.6.9.3 Connections to Existing Concrete Pads
3.6.9.4 Connections to Existing Ducts
3.6.9.5 Partially Completed Duct Banks
3.6.9.6 Removal of Ducts
3.7 CABLE PULLING
3.7.1 Cable Lubricants
3.8 CABLES IN UNDERGROUND STRUCTURES
3.8.1 Cable Tag Installation
3.9 CONDUCTORS INSTALLED IN PARALLEL
3.10 LOW VOLTAGE CABLE SPLICING AND TERMINATING
3.11 FIREPROOFING OF CABLES IN UNDERGROUND STRUCTURES
3.11.1 Fireproofing Tape
3.12 GROUNDING SYSTEMS
3.12.1 Grounding Electrodes
3.12.2 Grounding Connections

3.12.3 Grounding Conductors
3.12.4 Ground Cable Crossing Expansion Joints
3.12.5 Manhole Grounding
3.13 EXCAVATING, BACKFILLING, AND COMPACTING
3.13.1 Reconditioning of Surfaces
3.13.1.1 Unpaved Surfaces
3.13.1.2 Paving Repairs
3.14 CAST-IN-PLACE CONCRETE
3.14.1 Concrete Slabs for Equipment
3.14.2 Sealing
3.15 FIELD QUALITY CONTROL
3.15.1 Performance of Field Acceptance Checks and Tests
3.15.1.1 Grounding System
3.15.2 Follow-Up Verification

-- End of Section Table of Contents --

SECTION 33 71 02.00 20

UNDERGROUND ELECTRICAL DISTRIBUTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318M	(2005) Metric Building Code Requirements for Structural Concrete and Commentary
ACI SP-66	(2004) ACI Detailing Manual

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005) Standard Specifications for Highway Bridges
AASHTO M 198	(2005) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants

ASTM INTERNATIONAL (ASTM)

ASTM B 1	(2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
ASTM B 3	(2001; R 2007) Standard Specification for Soft or Annealed Copper Wire
ASTM B 8	(2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 32	(2005) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 478	(2009) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 857	(2007) Standard Practice for Minimum Structural Design Loading for Underground

	Precast Concrete Utility Structures
ASTM F 512	(2006) Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2007; TIA 2007-1; TIA 2007-2; TIA 2007-3; TIA 2007-4; TIA 2007-5; Errata 2006-1; Errata 2007-2; Errata 2009-3) National Electrical Safety Code
IEEE Std 100	(2000) The Authoritative Dictionary of IEEE Standards Terms
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)Normal Measurements

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2009) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C119.1	(2006) Sealed Insulated Underground Connector Systems Rated 600 Volts
NEMA RN 1	(2005) Standard for Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 3	(2004) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA TC 6 & 8	(2003) Standard for Polyvinyl Chloride PVC Plastic Utilities Duct for Underground Installations
NEMA TC 9	(2004) Standard for Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation
NEMA WC 70	(1999; Errata 2001) Standard for Non-Shielded Power Cable 2000 V or Less for the Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-758-A	(2004) Customer-Owned Outside Plant Telecommunications Cabling Standard

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 1751F-644	(2002) Underground Plant Construction

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60005	(Basic; Notice 1) Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole

UNDERWRITERS LABORATORIES (UL)

UL 467	(2007) Standard for Grounding and Bonding Equipment
UL 486A-486B	(2003; R 2010) Wire Connectors
UL 510	(2005; R 2008) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2004; Rev thru Aug 2007) Standard for Metallic Outlet Boxes
UL 514B	(2004; Rev thru Aug 2007) Standard for Conduit, Tubing and Cable Fittings
UL 6	(2007) Standard for Electrical Rigid Metal Conduit-Steel
UL 651	(2005; Rev thru May 2007) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 83	(20086) Standard for Thermoplastic-Insulated Wires and Cables
UL 854	(2004; Rev thru Oct 2007) Service-Entrance Cables

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

b. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

c. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Precast underground structures; G

SD-03 Product Data

Precast concrete structures; G

Manhole frames and covers; G

Handhole frames and covers; G

Composite/fiberglass handholes; G

Cable supports (racks, arms and insulators); G

SD-06 Test Reports

Field Acceptance Checks and Tests; G

Cable Installation Plan and Procedure

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

1.4 QUALITY ASSURANCE

1.4.1 Precast Underground Structures

Submittal required for each type used. Provide calculations and drawings for precast manholes and handholes bearing the seal of a registered professional engineer including:

a. Material description (i.e., f'c and Fy)

b. Manufacturer's printed assembly and installation instructions

c. Design calculations

d. Reinforcing shop drawings in accordance with ACI SP-66

e. Plans and elevations showing opening and pulling-in iron locations and details

1.4.2 Certificate of Competency for Cable Splicer/Terminator

Certification of the qualification of the cable splicer/terminator shall include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. The certification shall indicate that the individual has had three or more years recent experience splicing and terminating medium voltage cables. The certification shall also list a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice splice/termination in the presence of the Contracting Officer, before being approved as a qualified cable splicer. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice/termination kit, and detailed manufacturer's instructions for the cable to be spliced. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for certification of an alternate cable splicer.

1.4.3 Cable Installer Qualifications

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations.

1.4.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the

products of the same manufacturer unless stated in this section.

1.4.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

PART 2 PRODUCTS

2.1 CONDUIT, DUCTS, AND FITTINGS

2.1.1 Rigid Metal Conduit

UL 6.

2.1.1.1 Rigid Metallic Conduit

NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, and tensile strength shall be minimum 3500 psi.

2.1.2 Plastic Conduit for Direct Burial

UL 651, Schedule 40 or as indicated.

2.1.3 Plastic Duct for Concrete Encasement

NEMA TC 6 & 8 and ASTM F 512 as indicated.

2.1.4 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials. Inflatable bladders may be used as an option.

2.1.5 Fittings

2.1.5.1 Metal Fittings

UL 514B.

2.1.5.2 PVC Conduit Fittings

UL 514B, UL 651 and NEMA TC 3.

2.1.5.3 PVC Duct Fittings

NEMA TC 9.

2.1.5.4 Outlet Boxes for Steel Conduit

Outlet boxes for use with rigid or flexible steel conduit shall be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and shall conform to UL 514A.

2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES

Insulated conductors shall be rated 600 volts and conform to the requirements of NFPA 70, including listing requirements, or in accordance with NEMA WC 70. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be accepted. Service entrance conductors shall conform to UL 854, type USE.

2.2.1 Conductor Types

Cable and duct sizes indicated are for copper conductors and THHN/THWN unless otherwise noted. Conductors No. 10 AWG and smaller shall be solid copper. Conductors No. 8 AWG and larger shall be stranded copper. All conductors shall be copper.

2.2.2 Conductor Material

Unless specified or indicated otherwise or required by NFPA 70, wires in conduit, other than service entrance, shall be 600-volt, Type THWN/THHN conforming to UL 83. Copper conductors shall be annealed copper complying with ASTM B 3 and ASTM B 8.

2.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.2.4 In Duct

Cables shall be single-conductor cable.

2.2.5 Cable Marking

Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length.

Each cable shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

Conductors shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is

made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, heat shrink type sleeves,or colored electrical tape. Control circuit terminations shall be properly identified. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals shall be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems shall be as follows

a. 208/120 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, three-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

c. 120/240 volt, single phase: Black and red

2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS

Shall provide a uniform compression over the entire conductor contact surface. Use solderless terminal lugs on stranded conductors.

a. For use with copper conductors: UL 486A-486B.

b. For use with aluminum conductors: UL 486A-486B. For connecting aluminum to copper, connectors shall be the circumferentially compressed, metallurgically bonded type.

2.4 LOW VOLTAGE SPLICES

Provide splices in conductors with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply NEMA C119.1.

2.4.1 Heat Shrinkable Splice

Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which shall be applied in accordance with the manufacturer's written instructions.

2.4.2 Cold Shrink Rubber Splice

Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation shall not require heat or flame, or any additional materials such as covering or adhesive. It shall be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.5 TAPE

2.5.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.5.2 Buried Warning and Identification Tape

Provide detectable tape as indicated on the drawings.

2.5.3 Fireproofing Tape

Provide tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than .030 inch thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.6 PULL ROPE

Shall be plastic or flat pull line (bull line) having a minimum tensile strength of 200 pounds.

2.7 GROUNDING AND BONDING

2.7.1 Driven Ground Rods

Provide copper-clad steel ground rods conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used for rods 20 feet or longer.

2.7.2 Grounding Conductors

Stranded-bare copper conductors shall conform to ASTM B 8, Class B, soft-drawn unless otherwise indicated. Solid-bare copper conductors shall conform to ASTM B 1 for sizes No. 8 and smaller. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Aluminum is not acceptable.

2.8 CAST-IN-PLACE CONCRETE

Provide concrete for encasement of underground ducts with 3000 psi minimum 28-day compressive strength. Concrete associated with electrical work for other than encasement of underground ducts shall be 4000 psi minimum 28-day compressive strength unless specified otherwise.

2.9 UNDERGROUND STRUCTURES

Provide precast concrete underground structures or standard type cast-in-place manhole types as indicated, conforming to ASTM C 857 and ASTM C 478. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide

necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable.

2.9.1 Cast-In-Place Concrete Structures

Construct walls on a footing of cast-in-place concrete except that precast concrete base sections may be used for precast concrete manhole risers.

2.9.2 Precast Concrete Structures, Risers and Tops

In lieu of cast-in-place, Contractors, at their option, may provide precast concrete underground structures subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes.

2.9.2.1 General

Precast concrete structures shall have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures shall have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction shall be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work shall have a 28-day compressive strength of not less than 4000 psi. Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

2.9.2.2 Design for Precast Structures

ACI 318M. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:

a. Angle of Internal Friction (phi) = 30 degrees

b. Unit Weight of Soil (Dry) = 110 pcf, (Saturated) = 130 pcf

c. Coefficient of Lateral Earth Pressure (Ka) = 0.33

d. Ground Water Level = 3 feet below ground elevation

e. Vertical design loads shall include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads shall consider all types and magnitudes of vehicular (automotive, industrial, or aircraft) traffic to be encountered. The minimum design vertical load shall be for H20 highway loading per AASHTO HB-17.

f. Horizontal design loads shall include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of installation to be encountered. Also, horizontal loads imposed by

adjacent structure foundations, and horizontal load components of vertical design loads, including impact, shall be considered, along with a pulling-in iron design load of 6000 pounds.

g. Each structural component shall be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.

h. Design shall also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.

2.9.2.3 Construction

Structure top, bottom, and wall shall be of a uniform thickness of not less than 6 inches. Thin-walled knock-out panels for designed or future duct bank entrances shall not be permitted. Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. Provide drain sumps a minimum of 12 inches in diameter and 4 inches deep for precast structures.

2.9.2.4 Joints

Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M 198, Type B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

2.9.3 Manhole Frames and Covers

Provide cast iron frames and covers for manholes conforming to CID A-A-60005. Cast the words "ELECTRIC" or "TELECOMMUNICATIONS" in the top face of power and telecommunications manhole covers, respectively.

2.9.4 Handhole Frames and Covers

Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled-steel floor plate having an approved antislip surface. Hinges shall be of stainless steel with bronze hinge pin, 5 by 5 inches by approximately 3/16 inch thick, without screw holes, and shall be for full surface application by fillet welding. Hinges shall have nonremovable pins and five knuckles. The surfaces of plates under hinges shall be true after the removal of raised antislip surface, by grinding or other approved method.

2.9.5 Brick for Manhole Collar

Brick shall be sewer and manhole brick conforming to ASTM C 32, Grade MS.

2.9.6 Composite/Fiberglass Handholes and Covers

Provide handholes and covers of polymer concrete, reinforced with heavy weave fiberglass.

2.10 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

The metal portion of racks and arms shall be zinc-coated after fabrication.

2.10.1 Cable Racks

The wall bracket shall be 4 inches by approximately 1-1/2 inch by 3/16 inch channel steel, 48 inches long (minimum) in manholes. Slots for mounting cable rack arms shall be spaced at 8 inch intervals.

2.10.2 Rack Arms

Cable rack arms shall be steel or malleable iron or glass reinforced nylon and shall be of the removable type. Rack arm length shall be a minimum of 8 inches and a maximum of 12 inches.

2.10.3 Insulators

Insulators for metal rack arms shall be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.11 CABLE TAGS IN MANHOLES

Provide tags for each power cable located in manholes. The tags shall be polyethylene. Do not provide handwritten letters. The first position on the power cable tag shall denote the voltage. The second through sixth positions on the tag shall identify the circuit. The next to last position shall denote the phase of the circuit and shall include the Greek "phi" symbol. The last position shall denote the cable size. As an example, a tag could have the following designation: "11.5 NAS 1-8(Phase A)500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 1-8, underground, Phase A, sized at 500 kcmil.

2.11.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment and devices in accordance with the manufacturer's published instructions and with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable. In addition to these requirements, install telecommunications in accordance with TIA-758-A and RUS Bull 1751F-644.

3.2 CABLE INSPECTION

Prior to installation, each cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable prior to installation in accordance with the cable manufacturer's recommendations.

3.3 CABLE INSTALLATION PLAN AND PROCEDURE

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature limits for installation, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, maximum allowable pulling tension, and maximum allowable sidewall bearing pressure. The Contractor shall then perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS. Cable shall be installed strictly in accordance with the cable manufacturer's recommendations and the approved installation plan.

Calculations and pulling plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall bearing pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.4 UNDERGROUND FEEDERS SUPPLYING BUILDINGS

Terminate underground feeders supplying building at a point 5 feet outside the building and projections thereof, except that conductors shall be continuous to the terminating point indicated. Coordinate connections of the feeders to the service entrance equipment. Conduit shall be as shown on the drawings from the supply equipment to a point 5 feet outside the building and projections thereof. Protect ends of underground conduit with plastic plugs until connections are made.

Encase the underground portion of the conduit in a concrete envelope and bury as specified for underground duct with concrete encasement.

3.5 UNDERGROUND STRUCTURE CONSTRUCTION

Provide standard type cast-in-place construction as specified herein and as indicated, or precast construction as specified herein. Horizontal concrete surfaces of floors shall have a smooth trowel finish. Cure concrete by applying two coats of white pigmented membrane forming-curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound shall conform to ASTM C 309. Locate duct entrances and windows in the center of end walls (shorter) and near the corners of sidewalls (longer) to facilitate cable racking and splicing. Covers for underground structures shall fit the frames without undue play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete.

3.5.1 Cast-In-Place Concrete Structures

Construct walls on a footing of cast-in-place concrete except that precast concrete base sections may be used for precast concrete manhole risers.

3.5.2 Precast Concrete Construction

Set commercial precast structures on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to 1 inch size, extending 12 inches beyond the structure on each side. Compact granular fill by a minimum of four passes with a plate type vibrator. Installation shall additionally conform to the manufacturer's instructions.

3.5.3 Pulling-In Irons

Provide steel bars bent as indicated, and cast in the walls and floors. Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other types of pulling-in devices possessing the strengths and clearances stated herein. The final installation of pulling-in devices shall be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor the irons shall be a minimum of 6 inches from the edge of the sump, and in the walls the irons shall be located within 6 inches of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron shall not be located within 6 inches of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron cannot be located directly opposite the corresponding duct bank or precast

window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast window the minimum distance required to preserve the 6 inch clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 3 foot length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner shall be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 3 inches from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons shall have a clear projection into the structure of approximately 4 inches and shall be designed to withstand a minimum pulling-in load of 6000 pounds. Irons shall be hot-dipped galvanized after fabrication.

3.5.4 Cable Racks, Arms and Insulators

Cable racks, arms and insulators shall be sufficient to accommodate the cables. Racks in power manholes shall be spaced not more than 3 feet apart, and each manhole wall shall be provided with a minimum of two racks. Racks in signal manholes shall be spaced not more than 16 1/2 inches apart with the end rack being no further than 12 inches from the adjacent wall. Methods of anchoring cable racks shall be as follows:

a. Provide a 5/8 inch diameter by 5 inch long anchor bolt with 3 inch foot cast in structure wall with 2 inch protrusion of threaded portion of bolt into structure. Provide 5/8 inch steel square head nut on each anchor bolt. Coat threads of anchor bolts with suitable coating immediately prior to installing nuts.

b. Provide concrete channel insert with a minimum load rating of 800 pounds per foot. Insert channel shall be steel of the same length as "vertical rack channel;" channel insert shall be cast flush in structure wall. Provide 5/8 inch steel nuts in channel insert to receive 5/8 inch diameter by 3 inch long steel, square head anchor bolts.

c. Provide concrete "spot insert" at each anchor bolt location, cast flush in structure wall. Each insert shall have minimum 800 pound load rating. Provide 5/8 inch diameter by 3 inch long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with suitable coating immediately prior to installing bolts.

3.5.5 Field Painting

Cast-iron frames and covers not buried in concrete or masonry shall be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint.

3.6 UNDERGROUND CONDUIT AND DUCT SYSTEMS

3.6.1 Requirements

Depths to top of the conduit shall be in accordance with NFPA 70. Run conduit in straight lines except where a change of direction is necessary. Numbers and sizes of ducts shall be as indicated. Ducts shall have a continuous slope downward toward underground structures and away from buildings, laid with a minimum slope of 3 inches per 100 feet. Depending

on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in structures.

3.6.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.6.3 Conduit Cleaning

As each conduit run is completed, for conduit sizes 3 inches and larger, draw a flexible testing mandrel approximately 12 inches long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs.

3.6.4 Jacking and Drilling Under Roads and Structures

Conduits to be installed under existing paved areas which are not to be disturbed, and under roads and railroad tracks, shall be zinc-coated, rigid steel, jacked into place.Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers.

3.6.5 Galvanized Conduit Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations shall be PVC coated and shall extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

3.6.6 Multiple Conduits

Separate multiple conduits by a minimum distance of 2 1/2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 12 inches. Stagger the joints of the conduits by rows (horizontally) and layers (vertically) to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, ties, and locking device on top to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.6.7 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weephole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

3.6.8 Conduit and Duct Without Concrete Encasement

Provide not less than 3 inches clearance from the conduit to each side of the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve. The first 6 inch layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in3 to 6 inch layers. Provide color, type and depth of warning tape as specified.

3.6.8.1 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts. Concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks.

3.6.9 Duct Encased in Concrete

Construct underground duct lines of individual conduits encased in concrete. Do not mix different kinds of conduit in any one duct bank. Concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 1/2 inches, except separate light and power conduits from control, signal, and telecommunications conduits by a minimum concrete thickness of 3 inches. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring shall be done by driving reinforcing rods adjacent to duct spacer assemblies and attaching the rods to the spacer assembly. Provide color, type and depth of warning tape as specified.

3.6.9.1 Connections to Manholes

Duct bank envelopes connecting to underground structures shall be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section shall be larger

than the corresponding manhole opening dimensions by no less than 12 inches in each direction. Perimeter of the duct bank opening in the underground structure shall be flared toward the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is poured to assure a seal between the envelope and the wall of the structure.

3.6.9.2 Connections to Existing Underground Structures

For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and bend out to tie into the reinforcing of the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

3.6.9.3 Connections to Existing Concrete Pads

For duct bank connections to concrete pads, break an opening in the pad out to the dimensions required and preserve steel in pad. Cut the steel and bend out to tie into the reinforcing of the duct bank envelope. Chip out the opening in the pad to form a key for the duct bank envelope.

3.6.9.4 Connections to Existing Ducts

Where connections to existing duct banks are indicated, excavate the banks to the maximum depth necessary. Cut off the banks and remove loose concrete from the conduits before new concrete-encased ducts are installed. Provide a reinforced concrete collar, poured monolithically with the new duct bank, to take the shear at the joint of the duct banks. Remove existing cables which constitute interference with the work.

3.6.9.5 Partially Completed Duct Banks

During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, and, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately one footapart. Restrain reinforcing assembly from moving during concrete pouring.

3.6.9.6 Removal of Ducts

Where duct lines are removed from existing underground structures, close the openings to waterproof the structure. Chip out the wall opening to provide a key for the new section of wall.

3.7 CABLE PULLING

Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with wire shield

shall have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.7.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.8 CABLES IN UNDERGROUND STRUCTURES

Do not install cables utilizing the shortest path between penetrations, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure.

3.8.1 Cable Tag Installation

Install cable tags in each manhole as specified, including each splice. Tag wire and cable provided by this contract. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes.

3.9 CONDUCTORS INSTALLED IN PARALLEL

Conductors shall be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and 1 neutral conductor.

3.10 LOW VOLTAGE CABLE SPLICING AND TERMINATING

Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set. Make splices in underground distribution systems only in accessible locations such as manholes,handholes, or aboveground termination cabinets.

3.11 FIREPROOFING OF CABLES IN UNDERGROUND STRUCTURES

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in underground structures.

3.11.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

3.12 GROUNDING SYSTEMS

Provide grounding system as indicated, in accordance with NFPA 70 and

IEEE C2, and as specified herein.

Noncurrent-carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding the following values:

Pad-mounted transformers without protective fences	5 ohms
Ground in manholes	5 ohms
Grounding other metal enclosures of primary voltage electrical and electrically-operated equipment	5 ohms

3.12.1 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus 12 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded.
If the specified ground resistance is not met, an additional ground rod shall be provided in accordance with the requirements of NFPA 70 (placed not less than 6 feet from the first rod). Should the resultant (combined) resistance exceed the specified resistance, measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.12.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.12.3 Grounding Conductors

Provide bare grounding conductors, except where installed in conduit with associated phase conductors. Ground cable sheaths, cable shields, conduit, and equipment with No. 6 AWG. Ground other noncurrent-carrying metal parts and equipment frames of metal-enclosed equipment. Ground metallic frames and covers of handholes and pull boxes with a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.12.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper

cable across such separations.

3.12.5 Manhole Grounding

Loop a 4/0 AWG grounding conductor around the interior perimeter, approximately 12 inches above finished floor. Secure the conductor to the manhole walls at intervals not exceeding 36 inches. Connect the conductor to the manhole grounding electrode with 4/0 AWG conductor. Connect all incoming 4/0 grounding conductors to the ground loop adjacent to the point of entry into the manhole. Bond the ground loop to all cable shields, metal cable racks, and other metal equipment with a minimum 6 AWG conductor.

3.13 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with NFPA 70 and Section 31 00 00 EARTHWORK.

3.13.1 Reconditioning of Surfaces

3.13.1.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct or direct burial cable. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding, and provide topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

3.13.1.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.14 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.14.1 Concrete Slabs for Equipment

Unless otherwise indicated, the slab shall be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Slab shall be placed on a 6 inch thick, well-compacted gravel base. Top of concrete slab shall be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade shall have 1/2 inch chamfer. Slab shall be of adequate size to project at least 8 inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.14.2 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing

compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.15 FIELD QUALITY CONTROL

3.15.1 Performance of Field Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.15.1.1 Grounding System

a. Visual and mechanical inspection

Inspect ground system for compliance with contract plans and specifications

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with IEEE Std 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable megohmmeter tester in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

3.15.2 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 40 - PROCESS INTEGRATION

SECTION 40 95 00

PROCESS CONTROL SYSTEM

PART 1 GENERAL

1.1 REFERENCES
1.2 SYSTEM DESCRIPTION
1.2.1 General Requirements
1.2.2 Operation
1.2.3 Points
1.2.4 Data Transmission Systems (DTS)
1.2.5 Process Control System Sub Contractor Responsibilities
1.3 DEFINITIONS
1.4 SUBMITTALS
1.5 SITE ENVIRONMENTAL CONDITIONS
1.6 DRAWINGS
1.7 QUALIFICATIONS

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT
2.1.1 Standard Products
2.2 GENERAL REQUIREMENTS
2.3 NAMEPLATES
2.4 SCHEDULES
2.4.1 Instrument List
2.4.2 RTU Input/Output List
2.4.3 Component Specifications
2.5 CONTROL PANELS
2.5.1 Panel Assembly
2.5.2 Components
2.5.2.1 Enclosures
2.5.2.2 Pilot Devices
2.5.2.3 Relays
2.5.2.4 Terminal Blocks
2.5.2.5 Alarm Horns
2.5.2.6 Hour Meter
2.5.3 Electrical Requirements
2.5.4 Grounding
2.5.5 Convenience Outlet
2.5.6 Panel Interior Light
2.5.7 Temperature Control

PART 3 EXECUTION

3.1 SCADA APPLICATION DEVELOPMENT
3.1.1 Pre-Development Meeting
3.1.2 50 Percent Development Coordination Meeting
3.1.3 90 Percent Development Coordination Meeting

3.1.4 Field Testing
3.1.5 Transfer of SCADA Application
3.2 EQUIPMENT INSTALLATION REQUIREMENTS
3.2.1 Installation
3.2.1.1 Isolation, Penetrations and Clearance from Equipment
3.2.1.2 Device Mounting
3.3 INSTALLATION OF EQUIPMENT
3.3.1 Control Panels
3.3.2 Electric Power Devices
3.3.2.1 Potential and Current Transformers
3.3.2.2 Hour Meters
3.3.2.3 Transducers
3.3.3 Output Devices
3.3.4 Enclosures
3.3.5 Transformers
3.4 WIRE, CABLE AND CONNECTING HARDWARE
3.4.1 Metering and Sensor Wiring
3.4.1.1 Power Line Surge Protection
3.4.1.2 Sensor and Control Wiring Surge Protection
3.5 CONTROL DRAWINGS
3.6 FIELD TESTING AND ADJUSTING EQUIPMENT
3.6.1 Testing, Adjusting and Commissioning
3.6.2 Performance Verification Test (PVT)
3.7 MANUFACTURERS' FIELD SERVICES
3.8 FIELD TRAINING
3.8.1 Preliminary Operator Training
3.8.2 Additional Operator Training
3.8.3 Maintenance Training
3.9 ATTACHMENTS
3.9.1 RTU and FIC Input/Output List
3.9.2 Component Specifications

-- End of Section Table of Contents --

SECTION 40 95 00

PROCESS CONTROL SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 587	(1980) Guide/Surge Voltages/Lo-Volt.AC.Power.Circuits
IEEE C37.90	(2005) Standard for Relays and Relay Systems Associated With Electric Power Apparatus
IEEE C62.41.1	(2002; R 2008) IEEE Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE Std 142	(2007) Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book (Color Book Series)
IEEE Std 802.3	(2009) Standard for Information Technology - Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks

ISA - INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ISA 5.1	(2009) Instrumentation Symbols and Identification
ISA 5.4	(1991) Instrument Loop Diagrams
ISA 50.1	(1982; R 1992) Compatibility of Analog Signals for Electronic Industrial Process Instruments
ISA S50.1	(1982; R 1992) Compatibility of Analog Signals for Electronic Industrial Process Instruments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment

(1000 Volts Maximum)

NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; Add/Errata 2000; Errata 2006; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 4	(2005) Industrial Control and Systems: Terminal Blocks

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011) National Electrical Code

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST SP 250	(1991) Calibration Services Users Guide

UNDERWRITERS LABORATORIES (UL)

UL 1059	(2001; Rev thru Dec 2006) Terminal Blocks
UL 508	(1999; R thru 2008) Industrial Control Equipment
UL 489	(2009) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

1.2 SYSTEM DESCRIPTION

The process instrumentation and control system project scope consists of providing and installing a Remote Terminal Unit (RTU), configured to monitor the status of two lift stations, and transmit the status signals to an existing SCADA application at KCCS for remote monitoring purposes.

The process instrumentation and control system shall facilitate monitoring and control of the process equipment as specified herein and in the drawings (i.e., P&IDs, Sequence of Operation, Control Schematics, and Details. Provide the necessary hardware configured and sized to meet the specified performance requirements.

1.2.1 General Requirements

The Subcontractor shall provide, install, and configure an RTU to support data transmission to/from the Government's SCADA application. Configure the RTU to communicate with KCCS using Modbus TCP and Ethernet protocol. The communication media shall be fiber optic or copper (Cat 5E). Configure the Government's SCADA application for remote monitoring of the facility.

1.2.2 Operation

Provide monitoring and control features as described in the Sequence of Operation.

1.2.3 Points

Inputs and Outputs to be monitored/controlled by the RTUs or FICs are provided in tabular form as an ATTACHMENT to this Section.

1.2.4 Data Transmission Systems (DTS)

Data transmission between the RTUs and the SCADA application shall use the Government's standard, Ethernet-based, communication protocol; Modbus-TCP. Communication media will be fiber optic or copper (Cat 5e).

1.2.5 Process Control System Sub Contractor Responsibilities

The Process Control System Sub Contractor shall complete the detailed design to achieve the performance requirements specified herein. The work includes the following tasks:

Prepare and make the submittals required herein.

Purchase, fabricate, and install equipment and ancillaries.

Provide instructions, details, and recommendations to, and coordinate with the Contractor.

Prepare new screens for and make revisions to the Government's SCADA application data base for the work specified herein. The SCADA application software is Citect.

Configure and commission all smart instruments and devices.

Verify readiness for operation.

Adjust and calibrate instruments

Perform system start up services.

Test the system and coordinate system testing with other trades, the Government, and the Contracting Officer.

Train the Government's staff in system operation and maintenance.

1.3 DEFINITIONS

a. General: Definitions, symbols, and engineering unit abbreviations shall conform to ISA 5.1, as applicable.

b. Abbreviations:

CP:	Control Panel
EiRP:	Effective Isotropically Radiated Power
FP:	Field Panel
HMI:	Human/Machine Interface
ISA:	Instrumentation Society of America
I/O:	Inputs and Outputs

KCCS: Kennedy Complex Communication System
MCC: Motor Control Center
OIU: Operator Interface Unit
ORT: Operational Readiness Test
PAT: Performance Acceptance Test
PICS: Process Instrumentation and Control System
RTU: Remote Telemetry Unit
SCADA: Supervisory Control and Data Acquisition
TTC: Telephone Termination Cabinet

c. Terms:

1. Enclosure: Control panel, console, cabinet, or instrument housing.

2. Instructor Day: 8 hours of actual instruction time.

3. Software: Programs or configuration data for digital devices, stored in read-only memory, programmable read-only memory, read/write memory, disk, tape, or other electronic storage device.

Types of Software:

Standard Software: Package independent of the project on which they are used. Standard software includes system software and Process Monitoring and Control software.

Application Software: Configuration to provide functions unique to this project.

4. Rising/Falling: Terms used to define actions of discrete devices about their set points.

Rising: Contacts close when an increasing process variable rises through set point.

Falling: Contacts close when a decreasing process variable falls through set point.

d. Signal Types:

Analog Signals, Current Type: 4 to 20 mA de signals conforming to ISA S50.1. Unless otherwise indicated for specific PICS Subsystem components, use the following ISA 50.1 options.

Transmitter Type: Number 2, two-wire.
Transmitter Load Resistance Capacity: Class L.
Fully isolated transmitters and receivers.

Analog Signals, Voltage Type: 1 to 5 volts DC within panels where a common high precision-dropping resistor is used.

Discrete Signals: Two-state logic signals using 24 V dc or 120 V ac sources as indicated.

Pulse Frequency Signals: Direct current pulses whose repetition rate is linearly proportional to process variable. Pulses generated by contact closures or solid state switches as indicated. Power source less than 30 V dc.

Special Signals: Other types of signals used to transmit analog and digital information between field elements, transmitters, receivers, controllers, and digital devices.

e. Instrument Tag Numbers: A shorthand tag number notation is used in the Loop Specifications. For example: 10PI-2(A/B).

Notation	Explanation
10	Unit process/Loop designation
PI	ISA designator for Pressure Indicator
(2)	Unit designation; alphanumeric designation of same process types in a given loop; -1, -2 in this example
(A/B)	Component designation; Alphanumeric designation of same component type within a process; -A, -B in this example

In this example, 10PI-(2)(A/B) is shorthand for:

10PI-1-A, 10PI-1-B, 10PI-2-A, 10PI-2-B

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Panel Fabrication Drawings; G
Installation Drawings; G
Field Wiring Drawings; G

In accordance with the paragraph entitled "DRAWINGS."

SD-03 Product Data

Manufacturer's descriptive and technical literature, performance charts and installation instructions. Product specific catalog cuts shall be in booklet form, indexed to the unique identifiers, and shall consist of data sheets that document compliance with the specification. Where multiple components are shown on a catalog cut, the application specific component shall be marked.

Training Manual; G

Instruction manual within 30 days of Notice to Proceed.

Performance Verification Test (PVT); G

The performance verification test procedure; it shall refer to the actions and expected results to demonstrate that the control system performs in accordance with the sequence of control. Include a list of the equipment to be used during the testing plus manufacturer's name, model number, equipment function, the date of the latest calibration and the results of the latest calibration.

SD-05 Design Data

Control Drawings; G

Provide ladder logic or other logic diagrams reflective of the hardwired logic proposed.

SCADA Application 50 Percent Development Submittal; G

Submit color graphic screens representative of the work described herein. The screens shall be produced using Citect Graphics Builder. Include the navigation map(s), Genies, Super Genies, Cicode functions, and metadata proposed for this work. The submittal shall be reproducible, hard-copy as a minimum.

SCADA Application 90 Percent Development Submittal; G

Submit the completed color graphic screens for the work described herein. The screens shall be produced using Citect Graphics Builder. Include the navigation map(s), Genies, Super Genies, Cicode functions, and metadata proposed for this work. The submittal shall be reproducible, hard-copy as a minimum. The submittal also shall include one electronic copy of the operational Citect project.

SCADA Application Metadata; G

Submit the metadata for all points monitored/controlled by the Government's existing SCADA application. The Contracting Officer shall provide an example presentation of metadata from previous work. Presentation of the metadata shall comply with this example, be clearly and logically organized, and clearly describe the monitored/controlled data. This data shall be used to facilitate the integration of the Citect projects unique to this work with the Government's overall SCADA application.

SD-06 Test Reports

Testing, Adjusting and Commissioning; G
Performance Verification Test (PVT); G

SD-07 Certificates

Submit names, resumes, certificates, or other documents descriptive of the technicians' and supervisor's qualifications with respect to programming and configuring of Citect SCADA. Provide documentation in accordance with the paragraph entitled "QUALIFICATIONS."

SD-10 Operation and Maintenance Data

Instrumentation and Control System

Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. Include in the instructions layout, wiring and control diagrams of the system as installed, the manufacturer's name, model number, service manual, parts list and a brief description of all equipment and their basic operating features.

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs and trouble shooting guides.

SD-11 Closeout Submittals

Submit Record Drawings for the completed work.

Submit an annotated copy of the programming code implemented for the FIC. Provide a submittal that is both paper and in electronic format. Ensure that the electronic format submittal is in a form suitable for access and editing with the FIC hardware programming software.

1.5 SITE ENVIRONMENTAL CONDITIONS

a. Location; Kennedy Space Center

1. Latitude	28.62
2. Longitude	80.72
3. Altitude (above MSL)	16 ft

b. Outside Design Conditions

1. Winter Design Temperature: 35 degrees F

2. Summer Design Temperature: T_{db} = 90 degrees F, T_{wb} = 78 degrees F

c. Inside Design Conditions, Air Conditioned

1. Winter Design Temperature: 62 degrees F
2. Summer Design Conditions: T_{db} = 90 degrees F, T_{wb} = 78 degrees F

d. Inside Design Conditions, Non-Air Conditioned

1. Winter Design Temperature: 45 degrees F
2. Summer Design Conditions: T_{db} = 90 degrees F, T_{wb} = 78 degrees F

1.6 DRAWINGS

Panel Fabrication Drawings: Detailed drawings illustrating sufficient information for a panel shop to purchase the component parts and fabricate/wire the panel.

Installation Drawings: Detailed drawings illustrating how instruments, panels, and other components are to be installed in the field, complete.

Field Wiring Drawings: Detailed drawings illustrating the termination of

analog and discrete signals for instruments and panels in the field. As a minimum, the field wiring drawings shall include 'Analog Loop Diagrams', in compliance with ISA 5.4.

1.7 QUALIFICATIONS

List of projects programming/configuring Citect SCADA, completed within the last 3 years.

Certificates of Completion:

Citect HMI/SCADA configuration training
Cicode Programming

Programming Supervisor contact information (name, address, mobile phone).

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

First Named Manufacturer: PICS design is based on first named manufacturers of equipment and materials.

1. If an item is proposed from other than first named manufacturer, obtain approved from Contracting Officer for such changes in accordance with paragraph entitled "Submittals".

2. If proposed item requires change in system design, (i.e., different installation, wiring, raceway, enclosures, intrinsically safe barriers, and accessories), the PICS contractor shall be responsible for any additional cost. The PICS contractor shall first obtain approval from the Contracting officer before furnishing equipment and work.

Use product of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.

Implement all same or similar functions in same or similar manner. For example, control logic, sequence control, and display layouts.

2.2 GENERAL REQUIREMENTS

The diagrams, as shown in the drawings, are diagrammatic and supplement PICS performance requirements.

PICS functions are as shown on the drawings and as described herein. Furnish equipment items as required. Furnish all materials, equipment, and software necessary to affect required system and loop performance.

Equipment located outdoors, not provided with climate controlled enclosure, shall be capable of operating in the ambient temperature range indicated in paragraph SITE ENVIRONMENTAL CONDITIONS - Outdoor Conditions, unless otherwise specified.

Equipment located inside a structure or building facility without air conditioned environment shall be capable of operating in the ambient temperature range indicated in paragraph ENVIRONMENTAL CONDITIONS - Indoor,

Non-Air Conditioned, unless otherwise specified.

Equipment located inside a structure or building facility with air conditioned environment shall be capable of operating in the ambient temperature range indicated in paragraph ENVIRONMENTAL CONDITIONS - Indoor, Air Conditioned, unless otherwise specified.

Electrical equipment will conform to Division 26 ELECTRICAL. Equipment and wiring must be in accordance with NFPA 70, with proper consideration given to environmental conditions such as moisture, dirt, corrosive agents, and hazardous area classification.

2.3 NAMEPLATES

Provide the manufacturer's name and address and the model and serial number on each major component of equipment in a conspicuous place.

Nameplates shall be laminated plastic and shall identify the device, such as pump "P-1" or valve "VLV-402". Nameplates shall be 1/8 inch thick, white with black center core, 1 by 3 inches in size as a minimum, 1/4 inch high engraved block lettering.

Attach nameplates for devices smaller than 1 by 3 inches using a nonferrous metal chain. All other nameplates shall be physically attached (screwed) to the device.

Coordinate labels with the schedules and the process and instrumentation drawings.

2.4 SCHEDULES

Listed below are schedules included as an ATTACHMENT to this Section. The Contractor shall consider these sections as integral to this Section.

2.4.1 Instrument List

No instruments are specified in this Section. Refer to other sections in the project manual for instrument requirements.

2.4.2 RTU Input/Output List

The Input/Output for the RTU are listed in the RTU Input/Output List referenced in Article ATTACHMENT. Furnish all equipment and labor necessary to achieve the required Input/Output.

2.4.3 Component Specifications

Generalized specifications for each type of component are located in Article ATTACHMENT.

2.5 CONTROL PANELS

2.5.1 Panel Assembly

Control panels shall be factory assembled and shipped to the jobsite as a single unit. Panels shall be fabricated as indicated and devices shall be mounted as shown or required. Each panel shall be fabricated as a bottom-entry connection point for control system electrical power, control system wiring, communications system wiring to KCCS.

All panels shall be UL 508 certified.

2.5.2 Components

2.5.2.1 Enclosures

The enclosure for each control panel shall conform to the requirements of NEMA 250 for the types specified. Finish the enclosure exterior with white baked epoxy, unless otherwise noted. Damaged surfaces shall be repaired and refinished using original type finish.

Enclosures shall be Type 3R, 304 stainless steel unless otherwise noted.

Provide enclosure with a single, continuously hinged exterior door with print pocket, 3-point latching mechanism and key lock.

Cutouts shall be cut, punched, or drilled and finished to have smooth rounded edges.

2.5.2.2 Pilot Devices

When called for in the drawings and specifications, the pilot devices shall conform to these specifications, as a minimum.

Indicator lights, NEMA 4 rated, complying with NEMA ICS 1, NEMA ICS 2 and UL 508. Lights shall be heavy duty, round and shall mount in a 0.875 inch mounting hole. Indicator lights shall be LED type and shall operate at 120 V ac or 24 V dc. Long life bulbs shall be used. Indicator light shall be provided with a legend plate labeled as shown on the drawings. Lens color shall be as indicated on the drawings. Lights shall be push to test (lamp) type.

Selector switches, NEMA 4 rated, complying with NEMA ICS 1, NEMA ICS 2 and UL 508. Selector switches shall be heavy duty, round and shall mount in a 0.875 inch mounting hole. The number of positions shall be as indicated on the drawings. Switches shall be non-illuminated. Switches shall be rated for 600 volts, 10 amperes continuous. Selector switches shall be provided with a legend plate labeled as shown on the drawings. Where indicated or required, dual auxiliary contacts shall be provided for the automatic position to provide position sensing at the central station or workstation. Auxiliary contacts shall be rated for 120 V ac, 1A as a minimum.

Push buttons, NEMA 4 rated, complying with NEMA ICS 1, NEMA ICS 2 and UL 508. Push buttons shall be heavy duty, round and shall mount in a 0.875 inch mounting hole. The number and type of contacts shall be as indicated on the drawings or required by the Sequence of Operation. Push buttons shall be rated for 600 volts, 10 amperes continuous. Push buttons shall be provided with a legend plate labeled as shown on the drawings.

2.5.2.3 Relays

Relays shall comply with IEEE C37.90 and derated for altitude above 1,500 m. Relays shall be double-pole, double-throw (DPDT). Relay coil shall be 120 V ac and shall be provided with matching mounting socket. Power consumption shall not be greater than 3 watts.

2.5.2.4 Terminal Blocks

Terminal blocks shall comply with NEMA ICS 4 and UL 1059. Terminal blocks for conductors exiting control panels shall be two-way type with double terminals, one for internal wiring connections and the other for external wiring connections. Terminal blocks shall be made of bakelite or other suitable insulating material with full deep barriers between each pair of terminals. A terminal identification strip shall form part of the terminal block and each terminal shall be identified by a number in accordance with the numbering scheme on the approved wiring diagrams.

2.5.2.5 Alarm Horns

Alarm horns shall be provided where indicated on the drawings. Horns shall be vibrating type and shall comply with UL 508. Horns shall provide 100 dB at 10 feet. Exterior mounted horns shall be weather proof by design or shall be mounted in a weather proof enclosure that does not reduce the effectiveness of the horn.

2.5.2.6 Hour Meter

Hour meter shall be provided where indicated on the drawings, providing a totalized readout of the number of hours of operation for the equipment monitored. Meter shall provide readout with a minimum of six digits including 1 decimal place. The display shall be non-resettable. The meter shall be driven by a 120 V ac synchronous motor.

2.5.3 Electrical Requirements

Each panel shall be powered by a dedicated separate 120 V ac circuit, or 120 V ac from a leg of the 3-phase power supply via a control power transform appropriately sized for the anticipated loads, and provided in the panel enclosure. Protect the control power feed with a fuse sized appropriately for the anticipated loads. Provide a suitable disconnect switch internal to the panel for the control power. Electrical work shall be as specified in Division 26 ELECTRICAL and as shown on the drawings.

Certifications or Ratings: All I&C and electrical components, terminals, wires, and enclosures shall be UL recognized or UL listed.

Circuit Breakers: In compliance with NEMA AB 1 and UL 489 35,000 RMS symmetrical rating, minimum at 480 volts, unless otherwise specified. Tripping indication; Operator handle position.

Non-Motor Branch Circuit Breakers: Molded case thermal magnetic.

Motor Branch Circuit Breakers: Molded case with manufacturer's recommended trip setting for maximum motor protection.

50 horsepower or less: Magnetic

Larger than 50 horsepower: Thermal magnetic with adjustable magnetic trips.

Padlock provisions: OPEN position.

Wire within Enclosures:

AC Circuits:

Type: 300-volt, Type MTW stranded copper.
Size: For current to be carried but not less than No. 18-AWG.

Analog Signal Circuits:

Type: 300-volt stranded copper, twisted shielded pairs.
Size: No. 18-AWG minimum.

Other DC Circuits:

Type: 300-volt, Type MTW stranded copper.
Size: No. 18-AWG minimum.

Special Signal Circuits: Use manufacturer's standard cables.

Wire Identification: Numbered and tagged at each termination.

Wire Tags: Snap-on or slip-on PVC wire markers with legible machine printed markings and numbers. Adhesive or taped-on tags are not acceptable.

Wire entering or leaving enclosures, terminate and identify as follows:

Analog and discrete signal, terminate at numbered terminal blocks.

Special signals terminated using manufacturer's standard connectors.

Identify wiring in accordance with Division 26 ELECTRICAL.

Terminal Blocks for Enclosures:

General:

Provide sufficient terminal blocks necessary to accommodate present, indicate future, and spares, as specified below. Land no more than one (1) wire per terminal block. Wire spare and unused panel mounted elements to their panels' terminal blocks.

Provide twenty (20) percent of all connected terminals but not less than 5 per terminal blocks as spares.

Common Terminal Blocks Configuration:

Connection Type: Screw compression clamp.

Compression clamp: Complies with DIN-VDE 0611. Hardened steel clamp with transversal groves that penetrate wire strands providing a vibration-proof connection. Clamp shall guide strands of wire into terminal.

Screws: Hardened steel, captive and self-locking.

Current Bar: Copper or treated brass.

Insulation: Thermoplastic rated for minus 55 to 110 degrees C. Insulation shall be shaped at inputs to facilitate wire entry.

Mounting: Stranded DIN rail, suitable to allow Terminal block

extraction from an assembly without displacing adjacent blocks.

End Stops: Minimum of one at each end of rail.

Wire Preparation: Stripping only permitted.

Jumpers: Allow jumper installation without loss of space on terminal or rail.

Marking System:

Terminal number shown on both sides of terminal block. Allow use of preprinted and field marked tags. Mark terminal block and terminal strip numbers as shown on Panel Control Diagrams and Loop Diagrams.

Mark the top of fuse protected terminal blocks with fuse voltage and amperage.

Test Plugs: Soldered connections for 18-AWG wire.

Pin Diameter: 0.079 inch.

Terminal Block, General-Purpose:

Rated Voltage:	600 V ac
Rated Current:	30 amp
Wire Size:	22- to 10-AWG
Rated Wire Size:	10-AWG
Color:	Gray body
Spacing:	0.25 inch, maximum
Test Sockets:	One screw test socket 0.079-inch diameter
Manufacturer and Product:	Entrelec; Type M4/6.T

Terminal Block, Ground:

Wire Size:	22- to 10-AWG
Rated Wire Size:	10-AWG
Color:	Green and yellow body
Spacing:	0.25 inch, maximum
Grounding:	Ground terminal blocks electrically grounded to the mounting rail
Manufacturer and Product:	Entrelec; Type M4-6.P

Terminal Block, Blade Disconnect Switch:

Rated Voltage:	600 V ac
Rated Current:	10-amp
Wire Size:	22- to 12-AWG
Rated Wire Size:	12-AWG
Color:	Gray body, orange switch
Spacing:	0.25 inch, maximum
Manufacturer and Product:	Entrelec; Type M4/6.SN.T

Terminal Block, Fused, 24 V dc:

Rated Voltage:	600 V dc
Rated Current:	16-amp

Wire Size:	22- to 10-AWG
Rated Wire Size:	10-AWG
Color:	Gray body
Fuse:	0.25 inch by 1.25 inch
Indication:	LED diode 24 V dc
Spacing:	0.512 inch, maximum
Manufacturer and Product:	Entrelec; Type M10/13T.SFL

Analog Signal Isolators: Furnish signal isolation for analog signals that are sent from one enclosure to another. Do not wire in series instruments on different panels, cabinets, or enclosure.

Power Distribution within Enclosures:

Feeder Circuits: One or more 120 V ac, 60-Hz feeder circuits. Make provisions for feeder circuit conduit entry. Furnish terminal board for termination of wires.

Power Panel: Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel. Locate to provide clear view of and access to breakers when door is open.

Breaker sizes: Coordinate such that fault in branch circuit will blow only branch breaker but not trip the main breaker. Branch circuit breakers shall be 15 amps to 250 V ac, maximum/

Breaker Manufacturers and Products: Square D, Type QOU.

Circuit Wiring: Use following rules for actual circuit wiring:

Devices on Single Circuit: 20, maximum.

Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation do not group all units on the same branch circuit.

Branch Circuit Loading: 12 amperes continuous, maximum.

Panel Lighting and Service Outlets: Put on separate 15-amp, 120 V ac branch circuit.

Provide 120-volt AC plug-mold for panel components with line cords.

Signal Distribution:

Within Panels: 40 to 20 mA DC signals may be distributed as 1 to 5 V dc.

Outside Panels: Isolated 4 to 20 mA DC only.

Signal Wiring: All signal wiring twisted in shielded pairs.

Signal Switching:

Use dry circuit type relays or switches.
No interruption of 4 to 20 mA loops during switching.
4 to 20 mA DC Signals: 0.2 mA, maximum.
1 to 5 V dc Signals: 0.05V, maximum.

Power Supplies:

Provide power for devices requiring external dc power, including two-wire transmitters (instruments) and dc relays. Unit shall convert 120 V ac, 60-Hz power to 24 V dc power, 10 A as a minimum. Provide unit with battery backup to power the connected devices during periods of complete or partial interruption of incoming power. The power supply shall provide sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.

Provide output over voltage and over current protective devices to:

Protect instruments from damage due to power supply failure.
Protect power supply from damage due to external failure.

Power supply enclosures shall be NEMA 1 rated in accordance with NEMA 250. Mount such that dissipated heat does not adversely affect other components.

Provide a fuse on the DC supply line to each individual two-wire transmitter in an indicating holder or terminal block. Mount so fuses can be easily seen and replaced.

Provide a fuse on the DC supply line to each individual two-wire transmitter in an indicating holder or terminal block. Mount so fuses can be easily seen and replaced.

The unit shall have sufficient capacity to provide 'trickle charge' to the batteries. Provide the unit with two 7 Ah, 12 V dc lead gel type, wired in series. The assembly shall support continuous no-break power with no measurable transfer time.

The unit shall have isolated contact closures, suitable for external interface, to monitor the following conditions:

AC FAIL
Low Battery
Battery Supervision

The Unit shall be as manufactured by Altronix, or equal.

Electrical Transient Protection:

The electrical transient protection device shall serve to protect elements of PICS against damage due to electrical transients induced in interconnecting lines by lightning and nearby electrical systems. Provide, install, coordinate, and inspect grounding of surge suppressors at:

Connection of AC power to PICS equipment including panels, console assemblies, and field mounted analog transmitters and receivers.

At the field and panel, console, or assembly connection of signal circuits that have portions of the circuit extending outside of a protective building.

Connection of data or phone line to PICS equipment.

All field surge suppressors and related enclosures shall be furnished by the PICS Contractor and installed under Division 26, ELECTRICAL. Install in accordance with manufacturer's instructions and installation details provided in the drawings.

Grounding equipment, installation of grounding equipment, and terminations for field mounted devices are provided under Division 26, ELECTRICAL.

The electrical transient protection device shall be multistage hybrid type responding to a surge within 5 nanoseconds maximum. The device shall recover automatically and shall be suitable for operating within a temperature range of -20 degrees C to 85 degrees C.

Power supply (120 V ac, 60-Hz, single-phase) electrical transient protection devices shall be tested and rated for a minimum of 50 occurrences of IEEE Std 587 Category B test waveform and shall have a first-stage clamping voltage rating of 350 volts or less and a second-stage clamping voltage rating of 210 volts or less. The power supply electrical transient protection device be suitable for continuous operation 30 amps minimum at 130 V ac.

Encapsulate the devices in a flame-retardant epoxy.

Test analog signal lines (1 - 5 V dc or 4 - 20 mA) electrical transient protection devices using a linear waveform, 8 microsecond rise in current from 0 amp to a peak current value followed by an exponential decay of current reaching one-half peak value in 20 microseconds. Test and rate the device for 50 occurrences of 2,000-amp peak test waveform.

The device shall exhibit DC clamping 20 to 40 percent above operating voltage for circuit with a tolerance of less than plus/minus 10 percent. The unit shall have a maximum loop resistance of 18 ohms per conductor.

The devices shall be suitable for both field and panel installation. The field-mounted device electronics shall be epoxy-potted (flame-retardant) and encased in a stainless-steel pipe nipple. The panel-mounted device electronics shall be epoxy-potted (flame retardant, suitable for panel or DIN rail mounting).

Field-mounted, two-wire devices shall be EDCO Model No. SS64-036-2, or equal.

Panel-mounted devices shall be EDCO Model No. PC642 or EDCO Model No. COHOP-036 mounted on compatible mounting blocks or equivalent.

Provide field-mounted four-wire transmitters, e.g. magnetic flowmeter or analyzers (indoor and outdoors) with units that afford hybrid AC power protection and signal line protection in a single NEMA 4X fiberglass enclosure. The combination surge protection units shall be EDCO Model No. SLAC-32036 or approved equal. All signal lines must have surge protections at both panel and field sensor end.

Wiring Within an Enclosure:

Restrain all wiring by plastic ties or ducts or metal raceways. Do not exceed manufacturer's fill recommendations when using plastic ducts or

metal wireways. Secure wire passing over a hinged joint at each end so that bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve. Ducts and wireways mounted inside the enclosure shall be screwed to the panel. Mounting with adhesive or tape is not acceptable.

Arrange wiring neatly, cut to proper length, and remove surplus wire. Provide abrasion protection for wire bundles which pass through holes or across edges of sheet metal.

Use locking-fork-tongue or ring-tongue lugs when making connections to screw type terminals. Use manufacturer's recommended tool with required sized anvil to make crimp lug terminations. Terminate a maximum of one (1) wire per crimp lug, two (2) per screw terminal.

Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations when making connections to compression clamp type terminals. Terminate a maximum of one (1) wire per terminal.

Splice or tap of wires at device terminals or terminal blocks only.

Terminate 24 V dc and analog signal circuits on separate terminal block from AC circuit terminal blocks.

Separate analog and DC circuits by at least 6 inches from AC power and control wiring except at unavoidable crossover points and at device terminations.

Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.

Land all field wiring on terminal blocks and not on individual components, except where noted.

2.5.4 Grounding

Provide a solid copper ground bus for each control panel enclosure. Anchor the ground bus securely to the enclosure so as to effectively ground the entire structure. Clamp-type terminals sized large enough to carry the maximum expected current shall be provided on the ground bus for grounding cables. Where a definite circuit ground is required, a single wire not less than #10 AWG shall run independently to the panel ground bus and shall be fastened to the ground bus with a bolted terminal lug. Cases of instruments, relays and other devices shall be effectively grounded through the enclosures steel structure unless otherwise indicated. Insulated wiring having a continuous rated current of not less than the circuit fuse rating shall be used for grounding. Grounding terminals of power receptacles shall be solidly grounded to the panel enclosure.

2.5.5 Convenience Outlet

Provide one 120 volt ac, 20 amp, ground fault interruption (GFI) type duplex convenience outlet inside the panel. The outlet circuit shall be separate from the panel power circuit.

2.5.6 Panel Interior Light

Provide one 40 watt fluorescent light in any control panel 12 cubic feet in volume or greater. The light shall be operated by a manual on-off switch

mounted on the interior door of the enclosure. The light shall be powered by the same circuit as the convenience outlet.

2.5.7 Temperature Control

Size enclosures to adequately dissipate heat generated by equipment mounted on or inside.

PART 3 EXECUTION

3.1 SCADA APPLICATION DEVELOPMENT

3.1.1 Pre-Development Meeting

The Contractor and their SCADA Development Team shall meet with the Contracting Officer before commencing any programming or configuration efforts with respect to the SCADA Application. At this meeting the Contracting Officer will supply the Contractor with the Government's SCADA graphic and data standard, example graphical screen, Genies, Super Genies, Cicode functions, and metadata for use on this work. This submittal shall be reproducible, hard-copy as a minimum.

3.1.2 50 Percent Development Coordination Meeting

The Contractor and the SCADA Application Development Team shall attend a meeting with the Contracting Officer and team to review the SCADA Application 50 Percent Development Submittal. At that meeting, the Contractor and SCADA Application Development Team shall be prepared to discuss options available to the Government with respect to the configuration, presentation, and control of data graphically on the Government's SCADA application. A consensus will be reached and forwarded onto the Contractor in writing after the meeting. These shall be implemented in the SCADA Application for this project and submitted as the SCADA Application 90 Percent Development Submittal.

3.1.3 90 Percent Development Coordination Meeting

The Contractor and the SCADA Application Development Team shall attend a meeting with the Contracting Officer and their team to review the SCADA Application 90 Percent Development Submittal. The Contractor and SCADA Application Development Team shall perform a live demonstration of the SCADA Application developed for this project. Provide hardware (laptop computer) and software necessary for the demonstration. The Contracting Officer and team shall have the opportunity to operate the application to their satisfaction. A consensus will be reached and forwarded onto the Contractor in writing after the meeting. These shall be implemented in the SCADA Application for this project.

3.1.4 Field Testing

The Contractor and the SCADA Application Development Team shall demonstrate the operation of the SCADA Application in the field as part of the Performance Verification Test (PVT). The Contractor shall provide a computer, complete with Citect SCADA and the specific application developed for the work. The Contractor shall demonstrate to the Government the full function of the SCADA application while communicating with the FIC using the Government's standard communication protocol.

3.1.5 Transfer of SCADA Application

The Contractor shall deliver, in electronic format, a fully documented version of the SCADA Application, complete, to the Contracting Officer for integration in the Government's overall SCADA Application. The Government will perform the final integration of the SCADA Application project prepared for this work.

3.2 EQUIPMENT INSTALLATION REQUIREMENTS

3.2.1 Installation

Install system components and appurtenances in accordance with the manufacturer's instructions and shall provide necessary interconnections, services, and adjustments required for a complete and operable system. Instrumentation and communication equipment and cable grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation. Adjust or replace devices not conforming to the required accuracies. Factory sealed devices shall be replaced (rather than adjusted). Wiring in exposed areas, including low voltage wiring, shall be installed in metallic raceways or EMT conduit as specified in Division 26 ELECTRICAL. Wiring in air plenum areas installed without conduit shall be plenum-rated in accordance with NFPA 70.

3.2.1.1 Isolation, Penetrations and Clearance from Equipment

Dielectric isolation shall be provided where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exteriors shall be made watertight. Holes in concrete, brick, steel and wood walls shall be drilled or core drilled with proper equipment; conduits installed through openings shall be sealed with materials which are compatible with existing materials. Openings shall be sealed with materials which meet the requirements of NFPA 70. Installation shall provide clearance for control-system maintenance. Control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.2.1.2 Device Mounting

Devices shall be installed in accordance with manufacturers' recommendations and as shown. Control devices to be installed in piping shall be provided with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Any deviations shall be documented and submitted to the Government for approval prior to mounting. Damaged insulation shall be replaced or repaired after devices are installed to match existing work. Damaged galvanized surfaces shall be repaired by touching up with zinc paint.

3.3 INSTALLATION OF EQUIPMENT

Install equipment as specified, as shown and as required in the manufacturer's instructions for a complete and fully operational control system.

3.3.1 Control Panels

Control panels shall be located as indicated on the drawings. Devices located in the control panels shall be as shown on the drawings or as

needed to provide the indicated control sequences.

3.3.2 Electric Power Devices

3.3.2.1 Potential and Current Transformers

Install potential and current transformers in enclosures unless otherwise shown. Current transformer leads shall be shorted when they are not connected to the measurement circuits.

3.3.2.2 Hour Meters

Meters shall be located in the control panel or as otherwise shown. Power to the meter shall be connected to the motor starter auxiliary contacts for pumps, blowers and other motor driven devices. For devices without motor starters, the meter shall be connected in parallel with the load. Where the meter voltage differs from the metered devices voltage, transformer shall be provided as necessary.

3.3.2.3 Transducers

Transducers shall be wired in accordance with the manufacturer's instructions, and installed in enclosures.

3.3.3 Output Devices

Output devices (transducers, relays, contactors, or other devices) which are not an integral part of the control panel, shall be mounted in an enclosure mounted adjacent to the control panel, unless otherwise shown. Where H-O-A and/or override switches on the drawings or required by the control sequence, the switches shall be installed so that the control system controls the function through the automatic position and other controls work through the hand position.

3.3.4 Enclosures

All enclosure penetrations shall be from the bottom of the enclosure, and shall be sealed to preclude entry of water using a silicone rubber sealant.

3.3.5 Transformers

Transformers for control voltages 120 V ac or less shall be fed from the nearest power panel or motor control center, using circuits provided for the purpose. Provide a disconnect switch on the primary side and a fuse on the secondary side. Transformers shall be enclosed in a steel cabinet with conduit connections.

3.4 WIRE, CABLE AND CONNECTING HARDWARE

3.4.1 Metering and Sensor Wiring

3.4.1.1 Power Line Surge Protection

Control panels shall be protected from power line surges. Protection shall meet the requirements of IEEE C62.41.1 and IEEE C62.41.2. Fuses shall not be used for surge protection.

3.4.1.2 Sensor and Control Wiring Surge Protection

Digital and analog inputs shall be protected against surges induced on control and sensor wiring. Digital and analog outputs shall be protected against surges induced on control and sensor wiring installed outdoors and as shown. Fuses shall not be used for surge protection.

3.5 CONTROL DRAWINGS

Provide control drawings, reproducible, with corresponding CADD files for equipment furnished and for interfaces to equipment at each respective equipment location. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation and procedures for safely starting and stopping the system manually shall be prepared in typed form, reproducible, with corresponding word processor files and posted beside the diagrams. Diagrams and instructions shall be submitted prior to posting.

3.6 FIELD TESTING AND ADJUSTING EQUIPMENT

Provide personnel, equipment, instrumentation, and supplies necessary to perform site testing. The Government will witness the PVT, and written permission shall be obtained from the Government before proceeding with the testing. Original copies of data produced, including results of each test procedure, during PVT shall be turned over to the Government at the conclusion of each phase of testing prior to Government approval of the test. The test procedures shall cover actual equipment and functions specified for the project.

3.6.1 Testing, Adjusting and Commissioning

Upon completion of the installation, test, adjust, and commission each control loop and system in accordance with NIST SP 250 and shall verify proper operation of each item in the sequences of operation, including hardware and software. Calibrate field equipment, including control devices, adjust control parameters and logic (virtual) points including control loop set points, gain constants, constraints, and verify data communications before the system is placed online. Test installed ground rods as specified in IEEE Std 142. Calibrate each instrumentation device connected to the control system control network by making a comparison between the reading at the device and the display at the workstation, using a standard at least twice as accurate as the device to be calibrated. Verify operation of systems in the specified failure modes upon Control system network failure or loss of power, and verify that systems return to control system control automatically upon a resumption of control system network operation or return of power. Deliver a report describing results of functional tests, diagnostics, calibrations and commissioning procedures including written certification to the Government that the installed complete system has been calibrated, tested, adjusted and commissioned and is ready to begin the PVT. The report shall also include a copy of the approved PVT procedure.

3.6.2 Performance Verification Test (PVT)

Prepare test procedures for the PVT. The test procedure shall describe all tests to be performed and other pertinent information such as specialized test equipment required and the length of the PVT. The test procedures shall explain, in detail, step-by-step actions and the expected results, to demonstrate compliance with all the requirements of the drawings and this

specification. The test procedure shall be site specific and based on the inputs and outputs, required calculated points and the sequence of control. Demonstrate that the completed Control system complies with the contract requirements. All physical and functional requirements of the project including communication requirements shall be demonstrated and shown. Demonstrate that each system operates as required in the sequence of operation. The PVT as specified shall not be started until after receipt by the Contractor of written permission by the Government, based on the Contractor's written report including certification of successful completion of testing, adjusting and commissioning as specified, and upon successful completion of training as specified. Upon successful completion of the PVT, deliver test reports and other documentation as specified to the Government.

3.7 MANUFACTURERS' FIELD SERVICES

Obtain the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installing, adjusting, and testing of the equipment.

3.8 FIELD TRAINING

Field training oriented to the specific system shall be provided for designated personnel. A copy of the training manual for each trainee plus two additional copies shall be delivered to the Contracting Officer. Manuals shall include an agenda, the defined objectives for each lesson, and a detailed description of the subject matter for each lesson. Furnish audiovisual equipment and other training supplies and materials. Copies of the audiovisuals shall be delivered with the printed training manuals. The Government reserves the right to videotape training sessions for later use. A training day is defined as 8 hours of classroom instruction, excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility. Approval of the Contractor's training schedule shall be obtained from the Government at least 30 days before the training.

3.8.1 Preliminary Operator Training

Prior to the start of field testing, preliminary operator training shall be taught at the project site for one training day. Upon completion of this course, each student, using appropriate documentation, should be able to perform elementary operations with guidance and describe the general hardware architecture and functionality of the system. This course shall include: general system architecture; functional operation of the system, including workstations; operator commands; application programs, control sequences, and control loops; database entry and modification; reports generation; alarm reporting; diagnostics; and historical files.

3.8.2 Additional Operator Training

Following the field testing, provide one 4-hour classroom instruction session for operator questions and training consisting of one 2-hour morning session and one 2-hour afternoon session. Instruction shall consist of "hands-on" training under the constant monitoring of the instructor. Classroom training shall include instruction on the specific hardware configuration of the installed control system and specific instructions for operating the installed system.

Upon completion of the course, the students should be fully proficient in system operation and have no unanswered questions regarding operation of the installed control system. Each student should be able to start the system, operate the system, recover the system after a failure and describe the specific hardware architecture and operation of the system and be fully proficient in all system operations.

Report the skill level of each student at the end of this course.

3.8.3 Maintenance Training

Provide one 4-hour training session by a factory representative or a qualified Contractor trainer on maintenance of the equipment. The training shall include: physical layout of each piece of hardware, calibration procedures, preventive maintenance procedures, schedules, troubleshooting, diagnostic procedures and repair instructions.

3.9 ATTACHMENTS

3.9.1 RTU and FIC Input/Output List

Lift Station RTU I/O				
Tag Number	Type	I/O	Description	PLC Register
101-QS-1	Discrete	Input	Control Power Status, Lift Station 1	
101-QA-1 (LOCAL)	Discrete	Input	LOCAL Status, Lift Station 1, Pump 1	Future
101-QS-1 (RUN)	Discrete	Input	RUN Status, Lift Station 1, Pump 1	
101-HS-1 (RUN)	Discrete	Output	RUN Command, Lift Station 1, Pump 1	Future
101-QA-2 (LOCAL)	Discrete	Input	LOCAL Status, Lift Station 1, Pump 2	Future
101-QS-2 (RUN)	Discrete	Input	RUN Status, Lift Station 1, Pump 2	
101-HS-1 (PUMP 1)	Discrete	Input	LED Pump Selection, Pump 1, Lift Station 1	Future
101-HS-1 (PUMP 2)	Discrete	Input	LEAD Pump Selection, Pump 2, Lift Station 1	Future
101-HS-1 (Alt)	Discrete	Input	LEAD Pump Selection, Alternate, Lift Station 1	Future
101-LIT-1	Analog	Input	LEVEL, Lift Station 1, Wet Well	Future
101-LSHH-1	Discrete	Input	HIGH HIGH LEVEL, Lift Station 1, Wet Well	
101-LSM-1	Discrete	Input	MEDIUM LEVEL, Lift Station 1, Wet Well	Future
101-LSL-1	Discrete	Input	LOW LEVEL, Lift Station 1, Wet Well	Future
101-LSLL-1	Discrete	Input	LOW LOW LEVEL, Lift Station 1, Wet Well	
102-QS-1	Discrete	Input	Control Power Status, Lift Station 2	
102-QA-1 (LOCAL)	Discrete	Input	LOCAL Status, Lift Station 2, Pump 1	Future
102-QS-1 (RUN)	Discrete	Input	RUN Status, Lift Station 2, Pump 1	
102-HS-1 (RUN)	Discrete	Output	RUN Command, Lift Station 2, Pump 1	Future

102-QA-2 (LOCAL)	Discrete	Input	LOCAL Status, Lift Station 2, Pump 2	Future
102-QS-2 (RUN)	Discrete	Input	RUN Status, Lift Station 2, Pump 2	
102-HS-1 (PUMP 1)	Discrete	Input	LED Pump Selection, Pump 1, Lift Station 2	Future
102-HS-1 (PUMP 2)	Discrete	Input	LEAD Pump Selection, Pump 2, Lift Station 2	Future
102-HS-1 (Alt)	Discrete	Input	LEAD Pump Selection, Alternate, Lift Station 2	Future
102-LIT-1	Analog	Input	LEVEL, Lift Station 2, Wet Well	Future
102-LSHH-1	Discrete	Input	HIGH HIGH LEVEL, Lift Station 2, Wet Well	
102-LSH-1	Discrete	Input	HIGH LEVEL, Lift Station 2, Wet well	Future
102-LSM-1	Discrete	Input	MEDIUM LEVEL, Lift Station 2, Wet Well	Future
102-LSL-1	Discrete	Input	LOW LEVEL, Lift Station 2, Wet Well	Future
102-LSLL-1	Discrete	Input	LOW LOW LEVEL, Lift Station 2, Wet Well	

3.9.2 Component Specifications

A. Y-30 Communication Interface Module:

1. General:

a. Function: Serve as a network interface for control components.
b. Performance:
(1) Unit shall support network communication using EtherNetI/P protocol.
(2) Unit shall communicate with the control device using RS-232 or DF-1 Serial Communication protocols. Communication data rates shall be programmable, 2400 to 38.4 Kbaud.
(3) Ethernet communication shall be auto-detecting 10/100 base-T, half- or full-duplex.
c. Features:
(1) Communication Ports:
(a) Ethernet: RJ-45.
(b) Serial: RS232.
(2) Mounting: DIN rail.
d. Power:
(1) Voltage: 24 V dc, maximum.
(2) Current: 100 mA, maximum.

e. Environment:
(1) Temperature: minus 40 to plus 85 degrees C.
(2) Humidity: 55 to 95 percent, non-condensing.
f. Manufacturer and Model: Allen Bradley 1761-NET-ENI, or approved equal.

B. Y-54 Small Programmable Controller:

1. General:

a. Function: Multi-loop analog and discrete control.
b. Type: PLC shall be 'brick' type, i.e. having integral I/O and communication capability, but shall also support I/O expansion.
c. Parts: Unit shall be all-in-one. No additional parts are required unless noted (i.e. remote I/O or communication interface module).

2. Performance:

a. Memory:
(1) Unit shall have 8 kB of non-volatile, battery backed-up memory, 4kB for user program, 4 kB for data.
(2) Unit shall have capacity of up to 128 kB for data logging.
(3) Unit shall have provisions for addition of removable memory.
b. Instructions:
(1) A minimum of one PID loop.
(2) Support floating-point mathematics.
(3) Real-time clock.
(4) Support on-line, real-time editing.

3. Features:

a. Display: Unit shall have an integral LCD allowing access to monitor/adjust 48 bits and 48 integral values, as a minimum.
b. Trim Potentiometers: Unit shall provide two digital trim potentiometers.
c. Communication: Two channels.
(1) Channel 0: RS-232/RS-485 combination port; RS-232 supporting all serial communication protocols; RS-485 supporting DH-485, DF-1 half-duplex, ASCII, Modbus RTU Master/Slave.
(2) Channel 1: RJ-45, supporting EtherNet I/P messaging (peer-to-peer).

4. Power Supply: Integral to unit using 12 or 24 V dc.

5. Input/Output (I/O):

a. Integral to unit.
b. General requirements:
(1) Unit shall have integral a minimum of two isolated digital input groups, one isolated analog input group, and six isolated relay output groups. All relays shall be individually isolated.
(2) Unit shall support a maximum of 80 discrete I/O using expansion modules.
(3) Unit shall support a minimum of four expansion modules (input/output, discrete, and analog).
c. Specific requirements:

(1) Discrete input: Ten 12 or 24 V dc sink or source, four high speed (40KHz catch).
(2) Output: Six, individual, isolated, relay contacts.
(3) Analog Input: Two, 0 to 10 V dc, non-isolated, 10-bit resolution.

6. Programming Software:

Suitable for programming the PLC processor, communication interface module, and expansion I/O Modules:
a. Ladder diagram and function block diagram.
b. Provides communication configuration support for serial protocols.
c. Product:
(1) RS Logix 500 or approved equal.

7. Environmental Requirements:

a. Operating temperature: Minus 4 to plus 149 degrees F.
b. Relative humidity: 5 to 95 percent, non-condensing.

8. Manufacturer and Product:

Allen-Bradley MicroLogix 1100, or approved equal.

C. Y-85 Light Interface Unit (LIU), 12 Fiber:

1. General:

a. Function: LIU that interfaces fiber optic cable to electronic equipment.
b. Type: Uses flexible fiber optic cable assemblies (patch cords).
c. Parts: Interconnect center, two connector panels, patch cords, including spares.

2. Features:

a. Interconnect Center:
(1) 12-fiber modular unit.
(2) Two installed 6-fiber capacity connector panels.
(3) Adapters per each connector panel: Six SC compatible single-mode adapters with plastic insert installed.
(4) Wall-mounted.
(5) Strain relief for multiple cables.
b. Fiber Optic Cable Assemblies:
(1) Quantity: As required for application plus two spare zipcord cables per LIU.
(2) Length: As required.
(3) SC Compatible, PC Composite, multimode.
(4) Zipcord cable: 2 fibers per cable.
(5) Fiber type: 62.5 micrometers.
(6) Attenuation (db/km): 3.75/1.5.
(7) Bandwidth (MHz/km): 160/500.

3. Manufacturer and Model:

a. Corning Cable Systems: Wall-Mountable Interconnect Center (WIC), or approved equal.

D. Y-87 Media Converter, Ethernet

1. General:

a. Stand alone media converter used to convert 10/100/1000Base TX UTP to 1000Base FX Ethernet.
b. Fiber optic shall be multi-mode, unless otherwise noted.

2. Power: 12 V dc, 1.25 A unregulated, standard.

3. Physical Characteristics:

a. Physical Dimensions: 3.25 x 4.8 x 1 inches.
b. Connections:
(1) One RJ-45.
(2) One SC pair.
c. Status Indication:
(1) Power ON.
(2) TP (Duplex/Link/Activity).
(3) TP (10 Mbps, 100 Mbps, 1000 Mbps).
(4) LACT (Fiber Link/Active).
d. Enclosure: NEMA 1/IP20.
e. Temperature: 0 to 50 degrees C.
f. Humidity: 5 to 95 percent, noncondensing.

4. Performance:

a. Communication Protocol: Ethernet (IEEE Std 802.3, IEEE Std 802.3ab, IEEE Std 802.3u, IEEE Std 802.3z.
b. Fiber:
(1) Multi-Mode 62.5/125 um.
(2) Light wave length: 1310 nm.
(3) Optic link budget: 15 dB/2 km.
c. Electric link budget: 100 m.

5. Manufacturer and Product:

a. Transition Network.
b. Or Equal.

-- End of Section --