SECTION 01787

# OPERATION AND MAINTENANCE DATA

## PART 1 GENERAL

### 1.01 SUMMARY

A. Compile product data and related information appropriate for OWNER's maintenance and operation of products furnished under Contract.

1. Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of Specifications.

B. Instruct OWNER's personnel in maintenance of products and in operation of equipment and systems.

### 1.02 RELATED SECTIONS

A. Closeout Procedures - Division 1

B. Shop Drawings, Product Data, and Samples - Division 1

C. Closeout Submittals- Division 1

D. Project Record Documents - Division 1

### 1.03 QUALITY ASSURANCE

A. Preparation of data shall be done by personnel:

1. Trained and experienced in maintenance and operation of described products.

2. Familiar with requirements of this Section.

3. Skilled as technical writers to the extent required to communicate essential data.

4. Skilled as draftsman competent to prepare required drawings.

### 1.04 FORM OF SUBMITTALS

A. Prepare data in form of an instructional manual for use by OWNER's personnel.

B. Format:

1. Size: 8 1/2 inches x 11 inches

2. Paper: 20 pound minimum, white, for typed pages.

3. Text: Manufacturer's printed data, or neatly typewritten.

4. Drawings:

   a. Provide reinforced punched binder tab, bind in with text.

   b. Reduce larger drawings and fold to size of text pages, but not larger than 11 inches x 17 inches.

5. Provide fly-leaf for each separate product, or each piece of operating equipment.

   a. Provide types description of product, and major component parts of equipment.

   b. Provide indexed tabs.

6. Cover:

   a. Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS".

   b. List:

      1) Title of Project

      2) Identity of separate structure as applicable.

      3) Identity of general subject matter covered in this manual.

C. Binders:

1. Commercial quality three-post binders with durable and cleanable plastic covers.

2. Maximum post width: 2 inches

3. When multiple binders are used, correlate the data into related consistent groupings.

1.05 CONTENT OF MANUAL

A. Neatly typewritten table of contents for each volume, arranged in systematic order.

1. Contractor, name of responsible principal, address and telephone number.

2. A list of each product required to be included, indexed to content of the volume.

3. List, with each product, name, address and telephone number of:

a. Subcontractor of installer

b. Maintenance CONTRACTOR, as appropriate

c. Identify area of responsibility of each

d. Local source of supply for parts and replacement.

4. Identify each product name and other identifying symbols as set forth in Contract Documents.

B. Product Data:

1. Include only those sheets that are pertinent to the specific product.

2. Annotate each sheet to:

a. Clearly identify specific product or part installed.

b. Clearly identify data applicable to installation.

c. Delete references to inapplicable information.

C. Drawings:

1. Supplement product date with drawings as necessary to clearly illustrate:

a. Relations of component parts of equipment and systems.

b. Control and flow diagrams.

2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.

3. Do not use Project Record Documents as maintenance drawing.

D. Written text, as required to supplement product date for the particular installation:

1. Organize in consistent format under separate headings for different procedures.

2. Provide logical sequence of instructions of each procedure.

E. Copy of each warranty, bond and service contract issued:

1. Provide information sheet for OWNER's personnel, give:

a. Proper procedures in event of failure.

b. Instances that might affect validity of warranties or bonds

1.06 MANUAL FOR MATERIALS AND FINISHES

A. Submit five copies of complete manual in final form.

B. Content; for architectural products, applied materials and finishes:

1. Manufacturer's data, giving full information on products.

a. Catalog number, size, and composition.

b. Color and texture designations.

c. Information required for re-ordering special-manufactured products.

2. Instructions for care and maintenance.

a. Manufacturer's recommendation for types of cleaning agents and methods.

b. Cautions against cleaning agents and methods, which are detrimental to product.

c. Recommended schedule for cleaning and maintenance.

C. Content, for moisture-protection and weather-exposed products:

1. Manufacturer's data, giving full information on products:

a. Applicable standards.

b. Chemical composition.

c. Details of installation.

2. Instructions for inspection, maintenance and repair.

D. Additional requirements for maintenance data: Respective sections of Specifications.

E. Provide complete information for products specified.

1.07 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit five copies of complete manual in final form.

B. Content, for each unit of equipment and system, as appropriate:

1. Description of unit and component parts.

a. Function, normal operating characteristics and limiting conditions

b. Performance curves, engineering data and tests

c. Complete nomenclature and commercial number of replaceable parts

2. Operating procedures:

a. Start-up, break-in, routine and normal operating instructions

b. Regulation, control, stopping, shut-down and emergency instructions

c. Summer and Winter operating instructions

d. Special operating instructions

3. Maintenance Procedures:

a. Routine operations

b. Guide to "trouble-shooting"

c. Disassembly, repair, and reassembly

d. Alignment, adjusting, and checking

4. Servicing and lubrication schedule

    a. List of lubricants required

5. Manufacturer's printed operating and maintenance instructions

6. Description of sequence of operation by control manufacturer

7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance

    a. Predicted list of parts subject to wear

    b. Items recommended to be stocked as spare parts

8. As-installed control diagrams by controls manufacturer

9. Each CONTRACTOR's coordination drawings
    a. As-installed color coded piping diagrams

10. Charts of valve tag numbers, with location and function of each valve

11. List of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage

12. Other data as required under pertinent sections of specifications

C. Contents, for each electric and electronic system, as appropriate:

1. Description of system and component parts

    a. Function, normal operating characteristics, and limiting conditions

    b. Performance curves, engineering data and tests

    c. Complete nomenclature and commercial number of replaceable parts

2. Circuit directories of panel-boards

    a. Electrical service

    b. Controls

3. As-installed color coded wiring diagrams

4. Operating procedures:

a. Routine and normal operating instructions

b. Sequences required

c. Special operating instructions

5. Maintenance procedures:

a. Routine operations

b. Guide to "trouble-shooting"

c. Disassembly, repair and reassembly

d. Adjustment and checking

6. Manufacturer's printed operating and maintenance instructions

7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

8. Other data as required under pertinent sections of specifications

D. Prepare and include additional data when the need for such data becomes apparent during instruction of OWNER's personnel.

E. Additional requirements for operating and maintenance data: Respective sections of Specifications.

F. Provide complete information for product specified.

1.08 SUBMITTAL SCHEDULE

A. Submit two copies of preliminary draft of proposed formats and outlines of contents of Operation and Maintenance Manuals within thirty (30) days after Notice to Proceed.

1. The ENGINEER will review the preliminary draft and return one copy with comments.

B. Submit two copies of completed data in final form no later than 30 days following the ENGINEER's review of the last shop drawing and submittal.

1. One copy will be returned with comments to be incorporated into final copies.

C. Submit specified number of copies of approved data in final form directly to the offices of the ENGINEER, Craig A. Smith & Associates, within 30 calendar days of product shipment to the project site and preferably within 30 days after the reviewed copy is received.

D. Submit six copies of addendum to the operation and maintenance manuals as applicable and certificates as specified in Division 1 within 30 days after final inspection and plant start-up test.

E. Final Operation and Maintenance submittals shall be in large three ring binders organized by specification Section and plainly marked.

1.09 INSTRUCTION OF OWNER'S PERSONNEL

A. Prior to final inspection or acceptance, fully instruct OWNER's designated operating and maintenance personnel in operation, adjustment and maintenance of products, equipment and systems.

B. Operating and maintenance manual shall constitute the basis of instruction.

1. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

1.10 ENGINEER'S O & M CHECKLIST

A. The ENGINEER will review Operation and Maintenance Manuals submittals on operating equipment for conformance with the requirements of this Section.

1. The review will generally be based upon the checklist presented on the following pages (Form 01780) for the benefit of the CONTRACTOR and his suppliers.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

FORM 01780
OPERATION AND MAINTENANCE DATA
REVIEW CHECKLIST

| | | | |
|---|---|---|---|
| EQUIPMENT | | SUBMITTAL DATE | |
| MANUFACTURER | | APPROVAL TYPE | |
| SECTION NUMBER | | DRAWING NUMBER | |

_____ Does shop drawing and submittal match for model/series/configuration?
_____ Is color & printing correct on binder?
_____ Is submittal properly indexed?
_____ Does submittal pertain only to equipment being submitted?
_____ Is submittal easily understood and instructively arranged?
_____ Does submittal include start-up, shut-down, and trouble-shooting procedures?
_____ Are sufficient drawings and schematics included to supplement written description?
_____ For each piece of equipment supplied, is listing of name plate data provided and attached?
_____ Are drawings provided printed on paper eleven inches high and folded to eight and one half inches wide?
_____ Is proper and complete instruction for servicing included?
_____ Is there a suggested operating log sheet for equipment?
_____ Is a schedule for lubrication provided?
_____ Is there a recommended preventative maintenance schedule?
_____ Are necessary safety precautions clearly indicated where they relate to equipment?
_____ Is area representative information provided (Name, Address, Phone Number)?
_____ Are specified spare parts indicated and listed?

The following are points of rejection necessitating resubmittal by CONTRACTOR:

_____
_____
_____
_____
_____
_____
_____

END OF SECTION

SECTION 02200

SITE PREPARATION

PART 1 GENERAL

1.01 SUMMARY

A. Provide equipment, materials, and labor and performing functions necessary to move personnel and equipment on site, set up offices, trailers, facilities, construction utilities, obtain permits, and prepare the sites for construction.

B. Remove personnel, equipment, temporary facilities, and provide final clean up of the sites when construction is complete.

1.02 WORK SPECIFIED ELSEWHERE

A. Contract Documents

B. General Requirements - Division 1

C. Temporary Utilities - Division 1

D. Earthwork - Division 2

E. Bituminous Concrete Pavement - Division 2

F. Clearing and Grubbing - Division 2

G. Construction Facilities - Division 1

PART 2 PRODUCTS

2.01 TEMPORARY FACILITIES

A. Provide temporary facilities required for performing the work.

2.02 PARKING FACILITIES

A. Provide parking facilities for personnel working on the project.

1. No employee or equipment parking will be permitted on the OWNER's property except as specifically designated for CONTRACTOR's use.

2.03 PROJECT SIGNS

**A. Construction and installation of project sign is required and must be done in accordance with the OWNER'S requirements (Ref. Sec 00800).**

2.04 CONTRACTOR'S STAGING AREA

A. At no expense to the OWNER, arrange for and provide staging area to base CONTRACTORS' office and for material and equipment storage.

1. The OWNER will not provide any land for this purpose.

PART 3 EXECUTION

3.01 LAYOUT

A. Set up construction facilities in a neat and orderly manner within a designated area at the location of his choice as approved by the OWNER and the ENGINEER.

B. Accomplish required work in accordance with applicable sections of these specifications or as approved.

C. Provide the services of a Professional Land Surveyor, currently licensed and registered in Florida, to provide necessary horizontal and vertical survey lines and control, based upon principal control points and bench marks provided by the OWNER, as required by the General Conditions.

3.02 OBSTRUCTIONS

A. Some obstructions may not be shown.

1. Bidders are advised to carefully inspect the existing facilities before preparing their proposals.

2. The removal and replacement of minor obstructions such as electrical conduits, air, water, waste piping, and similar items shall be anticipated and accomplished, even though not shown or specifically mentioned.

B. Major obstructions encountered that are not shown in the Drawings or could not have been foreseen by visual inspection of the site prior to bidding should immediately be brought to the attention of the ENGINEER.

1. The ENGINEER will make a determination for proceeding with the work.

2. If the ENGINEER finds that the obstruction adversely affects the CONTRACTOR's costs or schedule for completion, a proper adjustment to the Contract will be made in accordance with the General Conditions.

3.03 HOUSEKEEPING

A. Maintain the work site and the temporary facilities in a clean and orderly manner.

1. The OWNER reserves the right to maintain the property in a neat and orderly state at the CONTRACTOR's expense if the CONTRACTOR fails to respond to notices by the OWNER within reasonable time.

3.04 DEMOBILIZATION

A. At the completion of work on each phase or portion of the project, remove construction personnel, equipment, and temporary facilities from the site.

B. Transporting unused materials belonging to the OWNER to a place of storage designated by the ENGINEER.

C. Remove and dispose of other materials and debris resulting from the construction, to an approved site.

D. Return areas to their original condition.

3.05 PROJECT SIGNS

A. If the CONTRACTOR is required to erect project signs, the ENGINEER will direct where the signs are to be placed.

1. Maintain signs in good condition until final completion of the project.

2. Remove the signs and restore the sites when directed.

3.06 RECORDS

A. Keep one record copy of Specifications, Drawings, Addenda, Modifications, and Shop Drawings at the site in good order and annotated to show changes made during the construction process.

END OF SECTION

SECTION 02220

SITE DEMOLITION

## PART 1 GENERAL

### 1.01 SUMMARY

A. This section includes furnishing labor, materials, equipment and incidentals required for the demolition, relocation and/or disposal of building materials and equipment to be removed from the project.

B. This section provides for the complete or partial removal and disposal of specified existing structures, foundations, slabs, piping, mechanical, electrical, existing (to be abandoned) piping and miscellaneous appurtenances encountered during construction operations.

C. This Section calls attention to certain activities necessary to maintain and facilitate operation during and immediately following construction and do not purport to cover of the activities necessary.

1. Diligently direct activities toward maintaining continuous operation of the existing facilities and minimizing operation inconvenience.

2. Develop a Demolition and Removal Plan in accordance with Paragraph 1.06 of this Section.

D. Demolition includes:

1. Demolition, partial removal and cutting of existing masonry as required for the new construction.

2. Distribution of salvageable and excess unacceptable material as specified below.

3. Off-site disposal of excess and unacceptable materials.

E. Examine the drawings regarding the existing system, visit the site and determine the extent of the work and operational conditions under which the work is to be perform.

### 1.02 PERMITS AND NOTICES

A. Permits and Licenses:

1. Obtain necessary permits and licenses for performing the work and furnish a copy to the ENGINEER prior to commencing the work.

2. Comply with the requirements of the permits.

B. Notices:

1. Issue written notices of planned demolition to companies or local authorities owning utility conduit, wires or pipes running to or through the project site.

2. Submit copies of the notices to the ENGINEER.

C. Utility Services:

1. Notify utility companies or local authorities furnishing gas, water, electrical, telephone, or sewer service to remove equipment owned by them in structures to be demolished and to remove, disconnect, cap, or plug their services to facilitate demolition.

1.03 CONDITIONS OF STRUCTURES

A. The OWNER and the ENGINEER assume no responsibility for the actual condition of the structures to be demolished or modified.

B. Conditions existing at the time of inspection for bidding purposes will be maintained by the OWNER insofar as practicable.

1. However, variations within the structure may occur prior to the start of demolition work.

1.04 RULES AND REGULATIONS

A. The Standard Building Codes shall control the demolition, modification or alteration of the existing buildings or structures.

B. No blasting shall be done on site.

1. Do not bring to or store explosives on the project site.

1.05 DISPOSAL OF MATERIAL

A. Salvageable or specifically requested material is the property of the OWNER.

1. Dismantle material to such a size that it can be readily handled, and deliver the salvageable material requested by the OWNER to a storage area designated by the OWNER.

B. Materials that the OWNER rejects shall become the CONTRACTOR's property and must be removed from the site.

C. Haul concrete, concrete block, and unsalvageable brick to a waste disposal site.

D. Haul other material to a waste disposal site.

E. On site storage or sale of removed items is not allowed.

1.06 SUBMITTALS

A. Submit to the ENGINEER for approval, six (6) copies of the proposed Demolition and Removal Plan for the structures and modifications specified below prior to the start of work.

1. Include in the coordination of shutoff, capping and continuation of utility service as required.

2. Include in the Demolition and Removal Plan, the following:

a. A detailed sequence of demolition and removal work to ensure the uninterrupted progress of the OWNER's operations, and the expeditious completion of the CONTRACTOR's work.

b. Evidence (by signature) of approval of the OWNER of the work plan.

B. Before commencing demolition work, modifications necessary to bypass the affected structure will be completed.

1. Actual work will not begin until the ENGINEER has inspected and approved the modifications, and authorized commencement of the demolition work.

C. The above procedure must be followed for each individual demolition operation.

1.07 TRAFFIC AND ACCESS

A. Conduct demolition and modification operations, and the removal of equipment and debris to ensure minimum interference with roads, streets, walks both on-site and off-site and to ensure minimum interference with occupied or used facilities.

**B. Special attention is directed towards maintaining safe and convenient access to the existing facilities by plant personnel and plant associated vehicles.**

**1. Relocation of the CONTRACTOR's materials, labor, or equipment due to uncoordinated interruption will be at the CONTRACTOR's expense.**

C. Do not close or obstruct streets, walks or other occupied or used facilities without permission from the ENGINEER and Plant Supervisor.

1. Provide alternate routes around closed or obstructed traffic in access ways.

1.08 DAMAGE

A. Promptly repair damage caused to adjacent facilities by demolition operations as directed by the ENGINEER and at no cost to the OWNER.

1.09 UTILITIES

A. Maintain existing utilities to remain in service and protect against damage during demolition operations.

B. Do not interrupt existing utilities serving occupied or used facilities, except when authorized by the ENGINEER.

1. Provide temporary services during interruptions to existing utilities as acceptable to the ENGINEER.

C. Cooperate with the OWNER to shut off utilities serving structures of the existing facilities as required by demolition operations.

D. Assume responsibility for making necessary arrangements and performing work involved in connections with the discontinuance or interruption of public and private utilities or services under the jurisdiction of the utility companies.

E. At the service mains disconnect and terminate utilities being abandoned

1. Maintain conformance with the requirement of the utility companies or the municipality owning or controlling them.

1.10 POLLUTION CONTROL

A. For pollution control, use water sprinkling, temporary enclosures, and other suitable methods as necessary to limit the amount of dust and dirt rising and scattering in the air to the lowest level of air pollution practical for the conditions of work.

1. Comply with the governing regulations.

B. Clean structures and improvements of dust, dirt and debris caused by demolition operations as directed by the ENGINEER.

1. Return areas to conditions existing prior to the start of work.

1.11 QUALITY CONTROL

A. Protect existing materials and equipment to be salvaged or reused from damage.

B. Cup or plug pipelines to be abandoned.

1. Place covers and label junction boxes, conduits and wire as abandoned.

C. Leave exposed ends of pipe and conduit or junction boxes covered and safe.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SEQUENCE OF WORK

A. The sequence of demolition and renovation of existing facilities will be in accordance with the approved Demolition and Removal Plan as specified in Paragraph 1.06 of this Section.

B. Reduce the out of service time for the equipment to be removed, refurbished, and relocated.

3.02 REMOVAL OF EXISTING PROCESS EQUIPMENT, PIPING, AND APPURTENANCES

A. Clean, flush, and drain equipment, piping, and appurtenances.

1. Equipment to be retained by the OWNER as specified in Paragraph 1.05 above shall be dismantled sufficiently to permit thorough cleaning and draining.

2. Leave valves open.

3. Cap and sleeve abandoned piping.

4. Plug and seal openings remaining after removal of the existing equipment, piping, and appurtenances, as directed by the ENGINEER.

**3.03 STRUCTURES TO BE COMPLETELY DEMOLISHED**

**A. Demolish existing structures as shown in the Drawings.**

**1. Demolish above ground structures to make room for construction or new facilities, unless otherwise shown in the Drawings.**

2. **Remove demolished material and equipment from site.**

3. **Remove mechanical, electrical, instrumentation, piping, and miscellaneous appurtenances before commencing structural demolition.**

B. Removal of existing structures by blasting will not be acceptable.

END OF SECTION

SECTION 02231

CLEARING AND GRUBBING

PART 1 GENERAL

1.01 SUMMARY

A. Supply equipment, materials, and labor and performing functions required for clearing and grubbing the work site in preparation for the Construction.

B. Clear and grubbing the area within the limits of construction as required, including utility easements.

1.02 WORK SPECIFIED ELSEWHERE

A. General Conditions

B. General Requirements - Division 1

C. Site Preparation - Division 2

D. Earthwork - Division 2

1.03 STANDARDS AND REGULATIONS

A. Comply with regulations and ordinances of the State of Florida, County, and City regarding burning and disposal of debris resulting from the clearing and grubbing operation.

1.04 SUBMITTALS

A. Submit for approval, the location of sites to be used for disposal of debris resulting from the clearing and grubbing operation.

1.05 MEASUREMENT AND PAYMENT

A. Measurement and payment will be included in the lump sum prices bid for each Construction Work Section, as shown on the Bid Schedule, for which price and payment shall constitute full compensation for furnishing materials, equipment and performing work in connection therewith.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 CONSTRUCTION

A. The work of clearing and grubbing shall include the removal and satisfactory disposal of structures and of other obstructions, including underground obstructions, except for work, which might be specifically included for removal under other items of work.

B. Deposits of muck, peat, bark, trash, or other debris occurring within the limits of clearing and grubbing or where directed by the ENGINEER shall be removed to their full depth and backfilled with native sand.

C. Protect from injury property obstructions that are to remain in place, such as buildings, sewers, drains, water, or gas pipes, except for unusual cases when so directed by the ENGINEER.

D. Areas of the right-of-way outside of the limits of construction may be shown in the Drawings or designated by the ENGINEER to be landscaped.

E. Clearing and grubbing shall include removal of undesirable trees, stumps, undergrowth, and vegetation within the areas of work.

F. Save natural growth and trees for landscaping as the ENGINEER directs.

G. Standard clearing and grubbing shall consist of the complete removal and disposal of sidewalks, drives, trees, shrubs, walls, timber, brush, stumps, roots, grass, weeds, sawdust, rubbish, and other obstructions resting on or protruding through the surface of the existing ground and the excavated areas.

H. Remove stumps, roots, and other debris from excavation for construction of roadway embankment, roadway base, or building pads, to a depth of at least one (1) foot below the ground surface.

I. Plow the surface to a depth of not less than six (6) inches and remove stumps and roots thereby exposed to a depth of at least one (1) foot.

J. Remove stumps and roots protruding through or appearing on the sides and surface of the completed excavation to a depth of at least one (1) foot.

3.02 DISPOSAL OF MATERIALS

A. Timber, stumps, brush, roots, rubbish and other objectionable material resulting from clearing and grubbing shall be disposed of by the CONTRACTOR in locations and by methods approved by the ENGINEER.

B. Burning shall be subject to applicable laws, ordinances, and regulations and shall be done at locations where trees and shrubs adjacent to the cleared area will not be harmed.

   1. Obtain necessary permits for on-site burning.

C. Where burning is prohibited by law, ordinance, or regulation, dispose of the materials within approved areas or hauled to the county landfill in accordance with local laws and regulations.

D. Applicable landfill or dumping fees will be paid by the CONTRACTOR.

END OF SECTION

SECTION 02300

EARTHWORK

## PART 1 GENERAL

### 1.01 SUMMARY

A. Furnish equipment, materials, and labor and performing functions required for earthwork as specified in the Drawings and Specifications as well as unspecified earthwork necessary to complete the work as specified, including demucking, excavating, filling, grading, compaction, and disposal of excess material.

B. Any list of equipment and/or materials set forth in this section shall not be taken to exclude other incidentals necessary to complete the work in accordance with the Drawings and Specifications for the intended use.

### 1.02 RELATED SECTIONS

A. General Conditions - Bidding and Contract Requirement

B. General Requirements - Division 1

C. Site Conditions - Division 1

D. Payment Procedures - Division 1

E. Site Preparation - Division 2

F. Pipe and Tubes - Division 2

### 1.03 STANDARDS AND REGULATIONS

A. Florida Department of Transportation - Standard Specifications for Road and Bridge Construction - Latest Edition.

B. American Association of State Highway and Transportation Officials (AASHTO).

### 1.04 SUBMITTALS

A. Submit a schedule of earthwork activities together with an estimated list of equipment to be used.

B. The schedule shall be subject to approval by the ENGINEER and shall be updated periodically as requested by the ENGINEER.

1.05 MEASUREMENT AND PAYMENT

A. Measurement and payment will be compensated on a unit and/or lump sum price as delineated in the Proposal Bid Form for which price and payment shall constitute full compensation for furnishing labor, equipment, and materials to perform work in connection therewith.

1.06 GUARANTEES

A. Guarantee materials and work performed for a period of one (1) year from the date of substantial completion.

B. Take corrective action to eliminate defective materials or workmanship for the guarantee period.

1.07 TESTS AND CERTIFICATES

A. Perform compaction tests as specified, as requested by the ENGINEER, and in accordance with AASHTO.

1.08 EXISTING CONDITIONS

A. Project borings and soils report are presented in Division 1.

PART 2 PRODUCTS

2.01. BEDDING AND BACKFILL:

A. Refer to Division 2 Excavation and Fill and as shown in the Drawings.

B. UNSATISFACTORY MATERIALS

1. Unsatisfactory materials, as are identified below.

a. Materials that cannot be satisfactorily placed and compacted to a stable and durable condition.

b. Soil that contains excessive moisture or moisture that will limit the degree of compaction.

1) At the CONTRACTORS option and expense, material may be dried and used for backfill.

2) New material shall be at CONTRACTORS expense.

c. Materials including, but not limited to, materials containing roots, loam, wood, or other organic matter, trash, debris, muck, sod, peat, or other objectionable materials which may be compressible or cannot be properly compacted.

d. Man-made fills, refuse, or backfills from previous construction.

B. UNYIELDING MATERIALS

1. Shall consist of rock and gravely soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

D. SATISFACTORY MATERIALS

1. Refer to the details shown in the Drawings for specific requirements.

E. ROCK BEDDING, HAUNCHING, AND INITIAL BACKFILL MATERIAL

1. Rock bedding shall meet the Florida Department of Transportation Standard Specification for No. 57 stone.

2. Pipe haunching shall contain good clean structural type fill.

3. Initial backfill material shall be common fill as described above.

F. BACKFILL MATERIALS

1. Shall consist of satisfactory material consisting of natural, predominantly well graded materials with no more than 40 percent by weight passing the No. 200 sieve and at a moisture content that will facilitate compaction, free from stones of such size as recommended by the pipe manufacturer, or larger than 2 inches in any dimension, whichever is smaller.

2. The backfill material shall be free of stones larger than 1 inch in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, when pipe is coated or wrapped for protection against corrosion.

3. Shall be clean earth fill, composed of sand, sand and clay, sand and rock, or crushed rock.

4. Where concrete or other encasement of pipe or other utilities is indicated, the backfill shall begin after the encasement has been inspected and approved and has attained 3/4 of its designed strength.

5. Material for the first layers of backfill shall be lowered to within 2 feet above the top of pipes before it is allowed to fall on the pipes, unless the material is placed with approved chutes or other devices that protect the pipes from the impact of stones conveyed from greater height.

G. FINE MATERIALS

1. Shall be carefully placed and tamped around the lower half of the utility; backfilling shall be carefully continued in layers not exceeding 6-inches above the top of the utility, using the best available material from the excavation, if approved, and excluding stones or rock fragments larger than:

| | |
|---|---|
| 3 inches | On concrete, cast-iron or steel pipe |
| 1 1/2 inches | On clay pipe |
| 1 inch | On plastic pipe |
| 1/2 inch | On fiber and asbestos cement pipe |

H. BORROW MATERIALS

1. Shall be used if suitable material from the excavation is not available.

2.02 PLASTIC WARNING TAPE:

A. Plastic marking tape shall be acid and alkali resistant polyethylene film, 6 inches wide with minimum thickness of 0.004 inch.

B. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise.

C. The tape shall be manufactured with integral wires, foil backing, or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep.

D. The tape shall be of a type specifically manufactured for marking and locating underground utilities.

E. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion.

F. Tape color shall be as specified in Table 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

| | |
|---|---|
| Red: | Electric |
| Orange: | Telephone, Alarm, and Communications |
| Blue: | Water Systems |
| Green: | Sewer Force Mains, Sewer Service Laterals |

2.03 GEOTEXTILE FILTER FABRIC:

A. Filter fabric for mats and liners shall be a pervious sheet of polyester, nylon, or polypropylene filaments woven or otherwise formed into a uniform pattern with distinct and measurable openings.

B. The filter fabric shall provide an Equivalent Opening Size (EOS) no finer than the US Standard Sieve No. 100 and no coarser than the US Standard Sieve No. 50.

1. EOS is defined as the number of the US Standard Sieve having openings closest in size to the filter fabric openings.

C. The filaments shall consist of a long-chain synthetic polymer composed of at least 85 percent, by weight, of propylene, ethylene, or vinylidene-chloride.

D. The filaments shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure.

E. The fabric shall have a minimum physical strength of 50 pounds per inch in direction when tested in accordance with ASTM D 1682, using the Grab Test Method with one square inch jaws and a constant rate of travel of 12 inches per minute.

F. Elongation at failure shall be between 30 and 70 percent.

G. The fabric shall be constructed so that the filaments will retain their relative position with respect to each other.

H. The edges of the fabric shall be selvaged or otherwise finished to prevent the outer material from pulling away from the fabric.

I. The fabric shall be woven into a width such that it may be installed without longitudinal seams.

PART 3 EXECUTION

3.01 DEMUCKING

A. Muck, organic matter, or other unsuitable material within the limits of the worksite, shall be excavated and removed.

B. Depth of removal shall be that required to reach suitable material.

C. The muck hole shall be dewatered to provide visual inspection by the ENGINEER.

D. The muck shall be removed in such a manner as to prevent the unsuitable materials from mixing with suitable material to be used for backfilling.

E. Where muck is encountered at the boundary of the site; sheeting shall be installed and left in place to preclude future damage to the installed fill by adjacent muck.

F. Suitable material shall be placed and compacted where muck or other unsuitable material has been removed and as required to elevate the site to finish grade as specified in this section.

G. Muck and other unsuitable material shall be disposed of at locations secured by the CONTRACTOR and approved by the ENGINEER.

H. Furnish to the ENGINEER, a written release from the OWNER of the property on which the excess material is disposed, stating that the agreements have satisfactorily been fulfilled.

I. Material shall be spread in a manner to drain properly and not disturb existing drainage conditions.

J. Where approved by the ENGINEER muck may be stockpiled and used for top dressing on areas to be grassed.

   1. The muck to be used for top dressing shall be free from appreciable quantities of hard clods, stiff clay, hard pan, gravel, brush, large roots, or other deleterious materials, and of reasonably uniform quality.

   2. The organic content shall be at least 5 percent and the pH shall be in the range of 5.0 to 7.0.

3.02 UTILITIES

A. Furnish equipment, materials, and labor required to complete excavating, trenching and backfilling for utilities, including dewatering, shoring, bracing, utility bed compacting, protecting slabs, restoration of surfaces, and disposing of surplus materials as identified in the Drawings and/or Specifications.

B. Length of trench to be excavated ahead of pipelaying shall be limited to sufficient trench for one day's pipe laying operation.

C. Where existing utilities are indicated, or their presence is suspected, employ appropriate detection methods to locate the utilities.

D. Excavation in the vicinity of utilities shall be carefully carried out to prevent damage to the existing utilities.

E. Excavation within 12-inches of existing utility shall be by hand.

3.03 TRENCH EXCAVATION

A. Where trenches are to be cut in pavement, the pavement cut shall be made ahead of the excavation, leaving a uniform edge with minimum disturbance of the remaining pavement.

B. Pavement pieces 6-inches and larger are not to be mixed with other excavated material, but are to be disposed of away from the work site before the remainder of the excavation is made.

C. Minimum width of the trench shall be equal to the outside diameter of the pipe at the joint plus 12-inches on each side.

D. Maximum trench width shall not exceed the nominal diameter plus 2-feet.

E. Trench walls shall be vertical, however, for large diameter piping, or where deep trenching is required, sloped sides may be permitted subject to the approval of the ENGINEER.

3.04 BEDDING

A. The pipe bed shall be adequately graded and shaped such that the pipe will be in continuous contact for its full length and the bottom 1/3 of its circumference, spaces for joints, fittings, manholes and pump stations shall be excavated with space to install joint couplings and other connecting devices.

B. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing.

C. Stones of one inch or greater in dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

D. Filter material and bedding shall be provided under utility lines, where indicated or specified.

E. Trench grade for utilities or structures not requiring special bedding material are to be defined as the grade of the bottom surface of the utility or structure to be considered to be part of this work.

F. Trench grade for utilities in rock shall be defined as 4-inches below the outside of the bottom of the utility or structure, which 4-inches shall be backfilled with suitable bedding material.

G. Overexcavation made in error shall be backfilled to trench grade with suitable compacted fill at the CONTRACTOR's expense.

3.05 GRAVITY PIPE AND STRUCTURES

A. Where the Drawings indicate a force main paralleling a gravity sewer, the CONTRACTOR may utilize a common trench, subject to the ENGINEER's approval.

B. Where a common trench is used, the force main shall be founded on a shelf of undistributed soil.

C. Excavation for manholes and wetwells, or similar structures, shall be of sufficient size to permit the installation of precast structures or the placement and removal of forms for the full length and width of cast-in-place structure footings and foundations, as shown.

D. 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.

E. Excavation to the final grade level shall be verified before the concrete or masonry is to be placed.

3.06 ROCK

A. Rock shall be cleaned of loose debris and cut to a firm surface, either level, stepped or serrated, as shown or as directed.

B. Loose disintegrated rock and thin strata shall be removed.

3.07 SHEETING

A. Sheeting and bracing shall be provided and continuously maintained where required to prevent damage to property, injury to persons, or erosion and cave-ins.

B. Where practical sheeting shall be driven prior to excavation to avoid loss of material to be retained.

C. When excavating below the sheeting, care shall be taken to avoid trimming that will cause voids in the banks to be retained.

D. Sheeting and bracing shall be removed as backfilling progresses and shall be completely removed when the trench has been backfilled to at least 1/2 its depth or when removal will not endanger construction or adjacent structures.

E. Voids caused by removal shall be backfilled immediately with sand or other approved fine material and compacted by ramming or by watering.

F. When required and directed in writing, by the ENGINEER, sheeting, bracing, or shoring shall be left in place and the top shall be cut off neatly at an approved elevation below finished grade.

3.08 SEQUENCE OF EXCAVATION

A. Excavation in a given area shall proceed from the deepest excavation to the shallowest excavation to avoid undermining completed roadways, utilities or structures.

3.09 DEWATERING

A. Utilities are to be laid "in the dry."

1. Trench excavations may be dewatered by using one or more of the following methods:

a. Well point systems:

1) Shall be efficient enough to lower the water level in advance of the excavation and maintain the level continuously to keep the trench bottom and sides firm and dry

2) Shall designed especially for this type of service, and the pumping unit used is to be capable of maintaining a high vacuum and at the same time of handling large volumes of air as well as water.

3) Shall be operated in such a manner as to prevent damage to other property.

b. Gravity underdrain systems

1) Shall have adequate capacity to lower the water level in the trench such that the main utility may be laid “in the dry.”

c. Sumps

1) Shall be provided at various points along the route of the underdrain system for the use of pumps to remove the water.

2) If the material encountered at trench grade is suitable for passage of water without destroying the sides or bottom of the trench sumps may be provided at intervals at the at the side of the main trench excavation and pumps may be used to lower the water level by taking their suction from these sumps.

3) Care shall be exercised to prevent the movement of utility foundation material and a bed of crushed stone may be required.

B. Grading shall be done, as may be necessary to prevent surface water from flowing into the excavation, and water accumulating therein shall be removed so that the stability of the bottom and sides of the excavation is maintained.

C. The excavation shall be dewatered by appropriate methods where and when necessary to maintain a dry and stable excavation bottom, and keep free from water during construction.

D. Obtain required dewatering permits from applicable agency having jurisdiction.

1. Costs of complying with such permit requirements shall be borne solely by the CONTRACTOR.

E. Water from trench dewatering operations shall be disposed of without causing damage or inconvenience to the work, the surrounding area or general public.

3.10 OBSTRUCTIONS

A. The exact location of pipes, conduits, wires, mains, footings and other underground structures and obstructions encountered in trenching or excavating shall be determined.

B. The obstructions shall be protected adequately from damage or displacement.

C. Damage thereto shall be promptly and properly repaired, and displacements shall be corrected.

D. Survey monuments or benchmarks, which are to be disturbed by this work, shall be carefully witnessed before removal and replaced upon completion of the work by a Registered Land Surveyor.

3.11 BEDDING, BACKFILL, AND COMPACTION

A. Bedding shall be of the type and thickness shown.

B. Maximum stone size shall not exceed 3/4-inch, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

C. Initial backfill material shall be placed in layers of a maximum of 6 inches loose thickness and compacted with approved tampers to 95 percent maximum density and to a height of at least 1-foot above the utility pipe or conduit.

D. The first layers of the backfill shall be thoroughly compacted and be completed before the remainder of the trench is backfilled.

    1. Compaction shall be equal to 98 percent of maximum density, as determined by AASHTO Specification T-99.

E. Compaction by water flooding or jetting will not be permitted.

F. Density tests for determination of the above-specified compaction shall be made by a testing laboratory designated by the ENGINEER and at the expense of the CONTRACTOR.

G. Test locations will be determined by the ENGINEER, but shall be spaced not more than 300 feet apart where the trench cut is continuous in pavements or areas to be paved.

H. Tests shall also be made where a trench crosses a paved roadway or future paved roadway.

I. If test results are unsatisfactory, re-excavate and re-compact the backfill at his expense until the desired compaction is obtained.

J. For continuous trenches, additional compaction tests shall be made on each side of an unsatisfactory test to determine the extent of re-excavation and re-compaction necessary.

K. Spacing of the additional tests will be determined by the ENGINEER.

L. Backfilling operations for excavations for utilities within buildings that have soil-bearing floor slabs shall be conducted in a manner resulting in densities comparable to the densities of the soil adjacent to the excavation.

M. Excavation within buildings shall be maintained free of water until the backfilling is completed.

N. Flooding or puddling with water to consolidate backfill may be done in unpaved areas, only when approved by the ENGINEER.

O. Where approved, the flooding or puddling operation shall be repeated with each 2 feet of backfill placed.

P. Mechanical compaction shall be accomplished using pneumatic or gasoline-powered tampers and/or flat plate vibrators, except in close proximity to the utility in the first layers of the backfill where compaction is to be obtained with hand-operated tamping devices.

3.12 BACKFILL ON SIDES OF PIPE

A. The backfill shall be brought up evenly on both sides of pipe for the full length of the pipe.

B. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.13 BACKFILL ABOVE THE PIPE

A. The remainder of the trench shall be backfilled in layers not exceeding 9-inches.

B. Maximum dimension of a stone or rock fragment shall be 6-inches.

C. Backfill shall be suitably compacted by rolling, tamping, or other settlement.

D. When trenches are cut in pavements or areas to be paved, compaction, as determined by AASHTO Specification T-99, shall be equal to 98 percent of maximum density; in other areas compaction shall not be less than 98 percent of maximum density.

E. Backfill for sidewalks, turned, or seeded area and miscellaneous areas not specifically designated above shall be deposited in layers of a maximum of 10 inches loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils.

F. Plastic warning tape shall be placed directly over the pipes and conduits at a depth of 18 inches below finished grade for the sewage force main, sewer service laterals, water lines, electric lines, alarm and communications lines.

3.14 SLAB

A. Where insufficient cover, excessive loads or local jurisdiction require, a protective concrete slab 6 inches thick, as indicated in the Drawings or as required by local authority, whichever is of greatest depth, shall be provided.

B. The trench shall be properly stepped back, as required, but the width of the slab shall not be less than the width of the trench plus 2 feet.

C. Concrete shall be ready-mixed and have twenty-eight (28) day compressive strength of 3,000 psi.

1. Finished top surface shall be screened.

D. Minimum reinforcement shall be welded wire fabric, 6 inches by 6 inches - w2.9 by w2.9.

E. Top of slab shall be 1-inch minimum below finished grade of the final surface course.

3.15 EXISTING OBSTRUCTIONS

A. Pavement cut or damaged in connection with the work under this section shall be rebuilt or repaired.

B. Restored pavement shall be at least equal in every respect to the pavement that was cut or damaged, including the base course, surface treatment and grade.

C. Temporary sand seal coat pavement surface shall be applied to the cut or damaged areas.

D. This temporary surfacing shall be replaced by the final restored pavement.

E. Sand seal coat temporary surfacing shall not be removed until fifteen (15) days after it has been constructed.

F. Existing pavement shall be cut back a minimum of 1 foot beyond each edge of the pavement that was cut when the trenching was done or 1 foot beyond each edge of the trench, whichever is greater.

G. Temporary surfacing, backfill, existing pavement and its base course shall be removed to a depth of 7 inches or to the depth indicated.

3.16 STOCKPILING OF SUITABLE EXCESS MATERIAL

A. During excavation, excess material from one trench area that is satisfactory for backfilling shall be stockpiled for use in other areas of the work in an orderly manner, at a distance from the banks of the trench sufficient to avoid overloading and to prevent slides or cave-ins.

B. Failure to protect the stockpiles and allowing material to becomes unsatisfactory as a result, such material, if directed, shall be removed and replaced with satisfactory on-site or imported material from approved sources at no additional cost to the OWNER.

C. Excavated material not required or not satisfactory for backfill shall be removed from the site and shall be disposed of in designated areas.

D. Excess suitable material shall be carefully stockpiled for use in other portions of the work, as specified below.

E. Debris and excess material shall be disposed of off site, as approved by the ENGINEER.

END OF SECTION

SECTION 02310

GRADING

## PART 1 GENERAL

### 1.01 SUMMARY

A. Perform grading work within the limits, elevations and grades indicated in the Drawings and as specified herein.

B. This Section specifies material and placement of fill above existing grades that is not to be located under roads or under structures.

### 1.02 QUALITY CONTROL

A. Grade the site to the required elevations.

B. Spot elevations are shown in the Drawings and uniformly slope the finished surfaces between these locations.

C. Excavated material meeting the requirements noted in the paragraph “Fill” may be used in the formation of embankments as shown in the Drawings.

D. Provide from off-site sources additional fill material required to complete the embankments.

## PART 2 PRODUCTS

### 2.01 FILL

A. Fill material shall meet the requirements as described in Division 2 - “Earthwork”.

B. Fill material shall be reviewed by the Engineer prior to use.

C. Determine the volume of material required for the site.

## PART 3 EXECUTION

### 3.01 GRADING AND COMPACTION

A. Place fill material in lifts not to exceed 12-inches and compacted to a density of not less than 95 percent of maximum dry density at optimum moisture as determined by ASTM D1557 method D.

B. Place fill material with a moisture content within plus or minus 2 percentage points of optimum.

3.02 FINE GRADING

A. Fine grade disturbed areas after structures, bases, and pavements are completed and the yard piping trenches backfilled.

B. Remove lumber, undesirable materials and rocks larger than the 3-inch size from the surface.

C. Shaped and sloped the completed surface to drain away from the structures.

D. Completed surface elevations shall be within 0.1 foot of the elevation shown in the Drawings, unless directed by the ENGINEER.

E. Minor adjustments to line and grade may be required as the work progresses in order to satisfy field conditions.

END OF SECTION

SECTION 02315

EXCAVATION AND FILL

PART 1 GENERAL

1.01 SUMMARY

A. Furnish labor, materials, equipment, and incidentals necessary to perform excavation, backfill, grading, and slope protection required to complete the piping work, as shown in the Drawings and Specifications.

B The work shall include, but not necessarily be limited to: manholes, pits and pipe, bedding, backfilling, fill and required borrow; grading and disposal of surplus and unsuitable materials; and related work such as sheeting, bracing, and water handling.

C. Provide trench safety systems such as sheeting and bracing in accordance with state and local regulations.

D. No claims for additional monies will be allowed or considered based on substrata or ground water conditions.

E. Prior to commencing the excavation, submit a plan of CONTRACTORS proposed operations to the ENGINEER for review.

1.02 RELATED SECTIONS

A. Site Preparation - Division 2

B. Earthwork - Division 2

C. CONTRACTOR’s Quality Control - Division 1

1.03 REFERENCES

A. Florida Chapter 90-96 “Trench Safety Act”.

1.04 TRENCH PROTECTION

A. Construct and maintain sheeting and bracing as required to support the sides of excavations, to prevent movement which could diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures, existing piping and foundation material from disturbance, undermining, or other damage.

B. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed they shall be immediately filled and compacted.

C. For pipe trench sheeting, no sheeting is to be withdrawn if driven below mid-diameter of pipe, and no wood sheeting shall be cut off at a level lower than 1 foot above the top of pipe unless otherwise directed by the ENGINEER.

D. If during the progress of the work the ENGINEER decides that additional wood sheeting should be left in place, he may direct the CONTRACTOR in writing.

E. If steel sheeting is used for trench sheeting, removal shall be as specified above, unless written approval is given by the ENGINEER for an alternate method of removal.

F. Sheeting and bracing, not left in place, shall be carefully removed in such a manner as not to endanger the construction or other structures, utilities, existing piping.

G. Voids left or caused by withdrawal of sheeting shall immediately be refilled with sand or ramming with tools especially adapted to that purpose, by watering or otherwise as may be directed.

H. The right of the ENGINEER to order sheeting and bracing left in place shall not be construed as creating obligation on his part to issue these orders, and his failure to exercise his right to do so shall not relieve the CONTRACTOR from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the CONTRACTOR to leave in place sufficient sheeting and bracing to prevent caving or moving of the ground.

1.05 JOB CONDITIONS

A. Examine the site and review the available test borings or undertake soil borings prior to submitting bid, taking into consideration conditions that may affect work.

B. Assume responsibility for variations of sub-soil quality or conditions at locations other than places shown and at the time the investigation was made.

C. Existing Utilities: Locate existing underground utilities in the areas of work.

1. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

2. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the ENGINEER and the OWNER of such piping or utility immediately for directions.

3. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation.

4. Repair damaged utilities to satisfaction of utility OWNER.

5. Demolish and completely remove from site existing underground utilities indicated in the Drawings to be removed.

D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

1. Operate warning lights as recommended by authorities having jurisdiction.

E. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

1.06 SUBMITTALS

A. Furnish the ENGINEER, for approval, laboratory test report of a representative sample of fill material obtained from on site sources weighing approximately 50 pounds, at least ten calendar days prior to the date of anticipated use of this material.

B. For each material obtained from other than on site sources, notify the ENGINEER of the source of the material and shall furnish the ENGINEER, for approval, laboratory test reports of a representative sample weighing approximately 50 pounds, at least ten calendar days prior to the date of anticipated use of this material.

PART 2 PRODUCTS

2.01 MATERIALS

A. Description:

1. Materials for use as base, fill and backfill shall be described below:

a. Satisfactory soil materials are defined as those complying with American Association of State Highway and Transportation Officials (AASHTO) M-145, soil classification Groups A-1, A-2-4, A-2-5, and A-3.

b. Unsatisfactory soil materials are those defined in AASHTO M-145 soil classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 along with peat and other highly organic soils.

B. Structural Fill:

1. Structural fill material shall be a well graded, suitable soil material consisting of a minimum of 60 percent clean medium fine grain sized quartz sand, free of organic, deleterious and/or compressible percent clean medium fine grain sized quartz sand, free of organic, deleterious and/or compressed material.

2. Rock in excess of 2 1/2-inches in diameter shall not be used in the fill material.

3. Structural fill shall not contain hardpan, stones, rocks, cobbles, or other similar materials.

C. Common Fill:

1. Common fill material shall be satisfactory soil material containing no more than 20 percent by weight finer than No. 200 mesh sieve.

2. It shall be free from organic matter, muck, marl, and rock exceeding 2 1/2-inches in diameter.

3. Common fill shall not contain broken concrete, masonry, rubble or other similar materials.

4. Materials falling within the above Specifications, encountered during the excavation, may be stored in segregated stockpiles for reuse.

5. Material, which in the opinion of the ENGINEER is not suitable for reuse, shall be spoiled as specified herein for disposal of unsuitable materials by the CONTRACTOR.

D. Rock Bedding:

1. Rock bedding shall be 3/8-inch to 3/4-inch washed and graded limerock.

2. This rock shall be graded so that 99 percent will pass a 3/4-inch screen and 80 percent will be retained on a No. 8 screen.

3. Material meeting the Florida Department of Transportation Standard Specification for No. 57 stone shall be acceptable.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Excavation, backfill, and grading necessary to complete the work shall be made by the CONTRACTOR and this cost shall be included in the Contract price.

B. Material shall be furnished as required from off site sources and hauled to site.

C. Take necessary precautions to maintain the work area in a safe and workable condition.

D. Protect work by flagging, marking, lighting and barricading.

E. Preserve and protect existing above and underground structures, pipelines, conduits, cables, drains, or utilities.

F. Failure of the Drawings to show the existence of these obstructions shall not relieve the CONTRACTOR from this responsibility.

G. The cost of repair from damage, which occurs to these obstructions during or as a result of construction, shall be borne by the CONTRACTOR without additional cost to the OWNER.

H. Trench Boxes, Drag Boxes, or Drag Shields made of steel may be used.

3.02 TRENCH EXCAVATION

A. Excavation for trenches required for the installation of pipes shall be made to the depths indicated in the Drawings.

B. Excavate trench to provide minimum of 36-inch clear cover over the pipe bell unless otherwise noted in the Drawings.

C. Excavate in a manner and to a width that will give suitable room for laying the pipe within the trenches, for bracing and supporting and for pumping and drainage facilities.

D. The trench width at the top of the pipe shall not exceed the allowable as determined by the depth of cut and indicated in the Drawings.

E. Rock shall be removed to a minimum 8-inches clearance around the bottom and sides of the pipe or ducts being laid.

F. Where pipe is to be laid in limerock bedding or encased in concrete, the trench may be excavated by machinery to or just below the designated subgrade provided that the material remaining in the bottom of the trench remains undisturbed.

G. Where the pipes or ducts are to be laid directly on the trench bottom the lower part of the trenches shall not be excavated to the trench bottom by machinery.

H. The last of the material being excavated shall be done manually in such a manner that will give a flat bottom true to grade so that pipe can evenly and uniformly supported along its entire length on undisturbed material or bedding rock.

I. Bell holes shall be made as required manually so that there is no bearing surface on the bells and pipes are supported along the barred only.

J. The bottom of the excavations shall be firm and dry and acceptable to the ENGINEER.

K. Excavate organic soil material from the bottom of the trench and replace with rock bedding, at least 6 inches thick.

3.03 PIPE INTERFERENCES AND ENCASEMENT

A. Abide by the following schedule of criteria concerning interferences with other utilities.

1. In no case shall there be less than 0.3-feet between two pipelines and structures.

2. Class I Concrete Encasement: Wherever there is clearance between water mains or water services, then a concrete encasement shall be provided in accordance with the typical detail as shown in the Drawings.

3. Class II Concrete Encasement: Wherever there is more than 0.3 foot, but less than 1.0 foot clearance between two pipe lines, or between pipe lines and structures, then a concrete encasement shall be provided in accordance with the typical detail as shown in the Drawings.

B. The ENGINEER shall have full authority to direct the placement of the various pipes and structures in order to facilitate construction, expedite completion and to avoid conflicts.

3.04 BACKFILLING

A. Backfilling over pipes shall begin as soon as practical after the pipe has been laid, jointed, and inspected and the trench filled with suitable compacted material to the mid-diameter of the pipe.

B. Backfilling over ducts shall begin not less than three days after placing concrete encasement.

C. Backfilling shall be prosecuted expeditiously as detailed in the Drawings.

D. Space remaining between the pipe and sides of the trench shall be packed full by hand shovel with selected earth, from stones having a diameter no greater than 2-inches and thoroughly compacted by non-mechanical methods, as fast as materials are placed, up to a level of one foot above the crown of pipe.

E. Compact to 98 percent maximum density in layers not to exceed 4-inches up to the centerline of the pipe from the trench bottom and in layers not to exceed 6-inches from the pipe centerline to 12-inches above the pipe.

F. The filling shall be carried up evenly on both sides with at least one man tamping for each man shoveling material into the trench.

G. The remainder of the trench above the compacted backfill, as just described above, shall be filled and thoroughly compacted with common fill by rolling, ramming, or puddling, as the ENGINEER may direct.

H. Compact common fill in 12-inch layers to 98 percent maximum density.

I. The bedding rock in muck areas shall consist of the at least 10-inches of washed and grade limerock placed in the trench to the proposed elevation of the centerline of the pipe prior to pipelaying.

J. This bedding shall not be used as a drain for ground water.

K. Take precautions necessary to maintain the bedding in a compacted state and to prevent washing, erosion or loosening of this bed.

L. In locations where pipes pass through building walls, take the following precautions to consolidate the refill up to an elevation of at least 1-foot above the bottom of the pipes:

1. Place structural fill in these areas for a distance of not less than 3-feet either side of the centerline of the pipe in level layers not exceeding 6-inches in depth.

2. Wet each layer to the extent directed and thoroughly compact each layer with a power tamper.

3.05 GRADING

A. Grading shall be performed at places indicated in the Drawings, to the lines, grades and elevations shown or as directed by the ENGINEER and shall be made in a manner that the requirements for formation of embankments can be followed.

B. Unacceptable material encountered, of whatever nature within the limits indicated, shall be removed and disposed of as directed.

C. During the process of excavation, the grade shall be maintained in a well-drained condition.

1. When directed, temporary drains and drainage ditches shall be installed to intercept or divert surface water, which may affect the prosecution or condition of the work.

D. If at the time of excavation it is not possible to place material in its proper section of the permanent structure, it shall be stockpiled in approved areas for later use.

E. No extras will be considered for the stockpiling or double handling of excavated material.

F. The right is reserved to make minute adjustments or revisions in lines or grades if found necessary as the work progresses, due to discrepancies in the Drawings or in order to obtain satisfactory construction.

G. Stones or rock fragments larger than 2 1/2-inches in their greatest dimensions will not be permitted in the top 6-inches of the subgrade line of fills or embankments.

H. Fill slopes shall be uniformly dressed to the slope, cross-section and alignment shown in the Drawings, or as directed by the ENGINEER.

I. In cut, loose, or protruding rocks on the back slopes shall be barred loose or otherwise removed to line or finished grade of slope.

J. Cut and fill slopes shall be uniformly dressed to the slope, cross-section and alignment shown in the Drawings or as specified by the ENGINEER.

K. No grading is to be done in areas where there are existing pipe lines that may be uncovered or damaged until these lines which must be maintained are relocated, or where lines are to be abandoned, required valves are closed and drains plugged at manholes.

L. Replace pavement cut or otherwise damaged during the progress of the work as specified elsewhere herein or as shown in the Drawings.

3.06 DISPOSAL OF UNSUITABLE AND SURPLUS MATERIAL

A. Surplus and unsuitable excavated material shall be disposed of at the CONTRACTOR's cost in one of the following ways as directed by the ENGINEER.

1. Transport to soil storage area on OWNER's property and stockpile or spread as directed by the ENGINEER.

2. Transport from OWNER's property and legally dispose of.

3. Permits required for the hauling and disposing of this material beyond OWNER's property shall be obtained prior to commencing hauling operations.

4. Copies of required permits shall be provided to the ENGINEER.

5. Suitable excavated material may be used for fill if it meets the Specifications for common fill and is approved by the ENGINEER.

6. Excavated material so approved may be neatly stockpiled at the site where designated by the ENGINEER provided there is an area available where it will not interfere with the operation of the facility nor inconvenience traffic or adjoining property owners.

3.07 FIELD QUALITY CONTROL

A. Retain a certified laboratory and make arrangements for testing necessary to comply with these Specifications, in accordance with Division 1.

B. Provide copies of laboratory test results to the ENGINEER.

C. Conduct one test per lift for each 500 linear feet of pipeline, or a minimum of two compaction tests per lift for projects with less than 1,000 linear feet of pipeline, at locations directed by the ENGINEER.

D. Provide, at CONTRACTOR expense, additional compaction tests requested by the ENGINEER to insure that proper compaction is provided.

END OF SECTION

SECTION 02319

TRENCHING

## PART 1 GENERAL

### 1.01 SUMMARY

A. Furnish labor, materials, equipment, and incidentals necessary to perform excavation, backfill, grading, and slope protection required to complete the piping work, as shown in the Drawings and Specifications.

B. The work shall include, but not necessarily be limited to: manholes, pits and pipe, bedding, backfilling, fill and required borrow; grading and disposal of surplus and unsuitable materials; and related work such as sheeting, bracing and water handling.

C. Provide trench safety systems such as sheeting and bracing in accordance with state and local regulations.

### 1.02 RELATED WORK

A. Site Preparation - Division 2

B. Earthwork - Division 2

C. Excavation and Fill - Division 2

### 1.03 TRENCH PROTECTION

A. Structural Excavation Backfill & Compaction

1. Construct and maintain sheeting and bracing as required to support the sides of excavations, to prevent movement which could diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures, existing piping and foundation material from disturbance, undermining, or other damage.

2. Prevent voids outside of the sheeting, but if voids are formed they shall be immediately filled and compacted.

3. For pipe trench sheeting, no sheeting is to be withdrawn if driven below mid-diameter of pipe, and no wood sheeting shall be cut off at a level lower than 1 foot above the top of pipe unless otherwise directed by the ENGINEER.

4. If during the progress of the work the ENGINEER decides that additional wood sheeting should be left in place, he may direct the CONTRACTOR in writing.

5. If steel sheeting is used for trench sheeting, removal shall be as specified above, unless written approval is given by the ENGINEER for an alternate method of removal.

6. Sheeting and bracing, not left in place, shall be carefully removed not to endanger the construction or other structures, utilities, existing piping.

7. Voids left or caused by withdrawal of sheeting shall immediately be refilled with sand or ramming with tools especially adapted to that purpose, by watering or otherwise as may be directed.

8. The right of the ENGINEER to order sheeting and bracing left in place shall not be construed as creating obligation on the ENGINEER to issue an order, and the ENGINEER's failure to exercise the ENGINEER's right to do so shall not relieve the CONTRACTOR from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the CONTRACTOR to leave in place sufficient sheeting and bracing to prevent caving or moving of the ground.

1.04 JOB CONDITIONS

A. Examine the site and review the available test borings or undertake his own soil borings prior to submitting his bid, taking into consideration conditions that may affect Construction work.

B. The OWNER and ENGINEER will not assume responsibility for variations of sub-soil quality or conditions at locations other than places shown and at the time the investigation was made.

C. Existing Utilities: Locate existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the ENGINEER and the OWNER of this piping or utility immediately for directions.

2. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation.

3. Repair damaged utilities to satisfaction of utility OWNER.

4. Demolish and completely remove from site existing underground utilities indicated in the Drawings to be removed.

C. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

D. Operate warning lights as recommended by authorities having jurisdiction.

1. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

1.05 SUBMITTALS

A. Furnish the ENGINEER, for approval, a representative sample of fill material obtained from on site sources weighing approximately 50 pounds, at least ten calendar days prior to the date of anticipated use of this material.

B. For each material obtained from other than on site sources, notify the ENGINEER of the source of the material and shall furnish the ENGINEER, for approval, a representative sample weighing approximately 50 pounds, at least ten calendar days prior to the date of anticipated use of this material.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:

1. Materials for use as base, fill, and backfill is described below:

a. Satisfactory soil materials are defined as those complying with American Association of State Highway and Transportation Officials (AASHTO) M-145, soil classification Groups A-1, A-2-4, A-2-5, and A-3.

b. Unsatisfactory soil materials are those defined in AASHTO M-145 soil classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 along with peat and other highly organic soils.

B. Structural Fill:

1. Structural fill material shall be a well graded, suitable soil material consisting of a minimum of 60 percent clean medium fine grain sized quartz sand, free of organic, deleterious and/or compressible percent clean medium fine grain sized quartz sand, free of organic, deleterious and/or compressed material. Rock in excess of 2 1/2 inches in diameter shall not be used in the fill material.

2. Structural fill shall not contain hardpan, stones, rocks, cobbles, or other similar materials.

C. Common Fill:

1. Common fill material shall be satisfactory soil material containing no more than 20 percent by weight finer than No. 200 mesh sieve. It shall be free from organic matter, muck, marl, and rock exceeding 2 1/2 inches in diameter.

2. Common fill shall not contain broken concrete, masonry, rubble, or other similar materials.

3. Materials falling within the above Specifications, encountered during the excavation, may be stored in segregated stockpiles for reuse.

4. Material, which in the opinion of the ENGINEER is not suitable for reuse, shall be spoiled as specified herein for disposal of unsuitable materials.

D. Rock Bedding:

1. Rock bedding shall be 3/8-inch to 3/4-inch washed and graded limerock.

2. This rock shall be graded so that 99 percent will pass a 3/4-inch screen and 80 percent will be retained on a No. 8 screen.

3. Material meeting the Florida Department of Transportation Standard Specification for No. 57 stone shall be acceptable.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Excavation, backfill and grading necessary to complete the work shall be made by the CONTRACTOR and the cost thereof shall be included in the Contract price.

B. Material shall be furnished as required from off site sources and hauled to site.

C. Take necessary precautions to maintain the work area in a safe and workable condition.

D. Protect work by flagging, marking, lighting and barricading.

E. Preserve and protect above and underground structures, pipe lines, conduits, cables, drains, or utilities which are existing at the time the CONTRACTOR encounters them.

F. Failure of the Drawings to show the existence of these obstructions shall not relieve the CONTRACTOR from this responsibility.

G. The cost of repair of damage, which occurs to these obstructions during or as a result of construction, shall be borne by the CONTRACTOR without additional cost to the OWNER.

3.02 TRENCH EXCAVATION

A. Excavation for trenches required for the installation of pipes shall be made to the depths indicated in the Drawings.

B. Excavate trench to provide minimum of 36-inch clear cover over the pipe bell, unless otherwise noted in the Drawings.

C. Excavate in a manner and to a width that will give suitable room for laying the pipe within the trenches, for bracing and supporting, and for pumping and drainage facilities.

D. The trench width at the top of the pipe shall not exceed the allowable as determined by the depth of cut and indicated in the Drawings.

E. Rock shall be removed to a minimum 8-inches clearance around the bottom and sides of the pipe or ducts being laid.

F. Where pipe is to be laid in limerock bedding or encased in concrete, the trench may be excavated by machinery to or just below the designated subgrade provided that the material remaining in the bottom of the trench remains undisturbed.

G. Where the pipes or ducts are to be laid directly on the trench bottom the lower part of the trenches shall not be excavated to the trench bottom by machinery.

H. The last of the material being excavated shall be done manually in a manner that will give a flat bottom true to grade so that pipe can evenly and uniformly supported along its entire length on undisturbed material or bedding rock.

I. Bell holes shall be made as required manually so that there is no bearing surface on the bells and pipes are supported along the barred only.

J. The bottom of the excavations shall be firm, dry, and acceptable to the ENGINEER.

K. Excavate organic soil material from the bottom of the trench and replace with rock bedding, at least 6 inches thick.

## 3.03 PIPE INTERFERENCES AND ENCASEMENT

A. Abide by the following schedule of criteria concerning interferences with other utilities.

1. In no case shall there be less than 0.3-feet between two pipelines and structures.

2. Class I Concrete Encasement: Wherever there is clearance between water mains or water services, then a concrete encasement shall be provided in accordance with the typical detail as shown in the Drawings.

3. Class II Concrete Encasement: Wherever there is more than 0.3-foot, but less than 1.0-foot clearance between two pipe lines, or between pipe lines and structures, then a concrete encasement shall be provided in accordance with the typical detail as shown in the Drawings.

B. The ENGINEER shall have full authority to direct the placement of the various pipes and structures in order to facilitate construction, expedite completion, and to avoid conflicts.

## 3.04 BACKFILLING

A. Backfilling over pipes shall begin as soon as practical after the pipe has been laid, jointed, and inspected and the trench filled with suitable compacted material to the mid-diameter of the pipe.

B. Backfilling over ducts shall begin not less than three days after placing concrete encasement.

C. Backfilling shall be prosecuted expeditiously as detailed in the Drawings.

D. Space remaining between the pipe and sides of the trench shall be packed full by hand shovel with selected earth, from stones having a diameter greater than 2-inches and thoroughly compacted with a tamper as fast as placed, up to a level of one foot above the top of pipe.

1. Compact to 95 percent maximum density in layers not to exceed 4 inches up to the centerline of the pipe from the trench bottom and in layers not to exceed 6 inches from the pipe centerline to 12 inches above the pipe.

E. The filling shall be carried up evenly on both sides with at least one man tamping for each man shoveling material into the trench.

F. The remainder of the trench above the compacted backfill, as just described above, shall be filled and thoroughly compacted with common fill by rolling, ramming, or puddling, as the ENGINEER may direct. Compact common fill in 12-inch layers to 95 percent maximum density.

G. The bedding rock in muck areas shall consist of the at least 10 inches of washed and grade limerock placed in the trench to the proposed elevation of the centerline of the pipe prior to pipe laying.

1.This bedding shall not be used as a drain for ground water.

2. Take precautions necessary to maintain the bedding in a compacted state and to prevent washing, erosion or loosening of this bed.

H. In locations where pipes pass through building walls, take the following precautions to consolidate the refill up to an elevation of at least 1 foot above the bottom of the pipes:

1. Place structural fill in these areas for a distance of not less than 3 feet either side of the centerline of the pipe in level layers not exceeding 6-inches in depth.

2. Wet each layer to the extent directed and thoroughly compact each layer with a power tamper.

3.05 GRADING

A. Grading shall be performed at these places as are indicated in the Drawings, to the lines, grades and elevations shown or as directed by the ENGINEER and shall be made in a manner that the requirements for formation of embankments can be followed.

1. Unacceptable material encountered, of whatever nature within the limits indicated, shall be removed and disposed of as directed.

2. During the process of excavation, the grade shall be maintained in a well-drained condition.

3. When directed, temporary drains and drainage ditches shall be installed to intercept or divert surface water, which may affect the prosecution or condition of the work.

B. If at the time of excavation it is not possible to place material in its proper section of the permanent structure, it shall be stockpiled in approved areas for later use.

1. No extras will be considered for the stockpiling or double handling of excavated material.

C. The right is reserved to make minute adjustments or revisions in lines or grades if found necessary as the work progresses, due to discrepancies in the Drawings or in order to obtain satisfactory construction.

D. Stones or rock fragments larger than 2 1/2 inches in their greatest dimensions will not be permitted in the top 6 inches of the subgrade line of fills or embankments.

E. Fill slopes shall be uniformly dressed to the slope, cross-section and alignment shown in the Drawings, or as directed by the ENGINEER.

F. In cut, loose or protruding rocks on the back slopes shall be barred loose or otherwise removed to line or finished grade of slope.
   1. Cut and fill slopes shall be uniformly dressed to the slope, cross-section and alignment shown in the Drawings or as specified by the ENGINEER.

G. No grading is to be done in areas where there are existing pipe lines that may be uncovered or damaged until the lines which must be maintained are relocated, or where lines are to be abandoned, required valves are closed and drains plugged at manholes.

H. Replace pavement cut or otherwise damaged during the progress of the work as specified elsewhere herein or as shown in the Drawings.

3.06 DISPOSAL OF UNSUITABLE AND SURPLUS MATERIAL

A. Surplus and unsuitable excavated material shall be disposed of at the CONTRACTOR's cost in one of the following ways as directed by the ENGINEER.

   1. Transport to soil storage area on OWNER's property and stockpile or spread as directed by the ENGINEER.

   2. Transport from OWNER's property and legally dispose of surplus and unsuitable materials.

      a. Any permit required for the hauling and disposing of this material beyond OWNER's property shall be obtained prior to commencing hauling operations.

      b. Provide copies of required permits to the ENGINEER.

   3. Suitable excavated material may be used for fill if it meets the Specifications for common fill and is approved by the ENGINEER.

a. Excavated material so approved may be neatly stockpiled at the site where designated by the ENGINEER provided there is an area available where it will not interfere with the operation of the facility nor inconvenience traffic or adjoining property owners.

4. Removal as described in Division 2.

3.07 FIELD QUALITY CONTROL

A. The CONTRACTOR shall retain a certified laboratory and make arrangements for testing necessary to comply with these Specifications, in accordance with Division 1.

1. One copy of the laboratory test results will be sent to the ENGINEER.

B. Conduct one test per lift for each 300 linear feet of pipeline, or a minimum of two compaction tests per lift for projects with less than 300 linear feet of pipeline, at locations directed by the ENGINEER.

END OF SECTION

SECTION 02630

STORM DRAINAGE

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemental Conditions and Division 1 Specification Sections, apply to work specified in this section.

### 1.02 SCOPE

A. The work specified in this section consists of furnishing drainage pipe, conforming to these specifications and of the particular types, sizes and dimensions shown in the plans. This work shall include the installation of the pipe at locations called for, in conformity with the lines and grades given, and the furnishing and construction of such catch basins, inlets, manholes, walls, joints, connections, etc., to new and existing pipes as may be required to complete the work as indicated in the plans.

### 1.03 WORK SPECIFIED ELSEWHERE

A. Cast-in-Place Concrete – Section 03300

### 1.04 STANDARDS AND REGULATIONS

A. Applicable Standards:

1. American Association of State Highway and Transportation Officials (AASHTO).

2. American Society for Testing and Materials (ASTM).

3. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction – latest edition.

B. Governmental Agencies: All work shall conform to the applicable standards of the FDOT.

### 1.05 SUBMITTALS

A. The CONTRACTOR shall submit five (5) copies of shop drawings of all pipe, pipe joints, pipe connecting bands, drainage structures, structure frames and grates and any other materials used for construction of the storm drainage.

1.06 GUARANTEE

A. The CONTRACTOR shall guarantee all materials and equipment furnished and installed and all work performed for a period of one (1) year from the date of substantial completion. The guarantee shall stipulate that the completed system is free from all defects due to faulty materials or workmanship and the CONTRACTOR shall promptly make such corrections as may be necessary by reason of such defects, including the repairs of any damage to other parts of the system resulting from such defects.

PART 2 - PRODUCTS

2.01 PIPE MATERIALS

A. Reinforced Concrete Pipe: Concrete pipe shall be of first quality and manufactured conforming to ASTM Designation C 76, latest revision, minimum design requirements shall be for Class III Reinforced Concrete Pipe, as modified by Section 941 Concrete Pipe, Section 942 Pipe Gaskets, and Section 430-7 Requirements for Concrete Pipe, FDOT, Standard Specifications for Road and Bridge Construction.

B. Reinforced Concrete Box Culvert: shall conform to the requirements of Section 400, FDOT Standard Specifications for Road and Bridge Construction, Index No. 290 FDOT Roadway and Traffic Design Standards, and Section 02640 – Precast Concrete Box Culverts.

C. Corrugated Aluminum Pipe: Corrugated Aluminum Pipe shall conform to the requirements of AASHTO M 196 (circular corrugated pipe) or AASHTO M 211 (helically corrugated pipe), and Section 945 FDOT, Standard Specifications.

D. Corrugated Steel Pipe: Corrugated Steel Pipe shall conform to the requirements of AASHTO M36 and Section 943, FDOT Standard Specifications and shall be bituminous coated.

E. Corrugated High Density Stormwater Polyethylene Pipe: shall conform to the requirements of ASTM D3212 and AASHTO M294 and FDOT Section 948-2 as manufactured by Advanced Drainage Systems, Inc. (ADS). The corrugated HDPE stormwater pipe shall have corrugated exterior and smooth interior walls.

F. Polyvinyl Chloride Pipe: Polyvinyl Chloride Pipe shall conform to the requirements of ASTM D-3034, SDR 35.

G. High Density Polyethylene Forcemain Pipe: shall conform to AWWA C906, ductile iron pipe with fusion welded but joints. Refer to section pipes and tubes for a complete specification for HDPE pipe.

H. Contech A-2000 perforated PVC drainage pipe corrugated pipe with a smooth interior shall conform to the requirements of ASTM Designation F949 & F794 Dual Wall Corrugated Profile (DWCP) Pipe. Pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. Pipe shall be manufactured to 46 psi stiffness when tested in accordance with ASTM Test Method D2412. There shall be no evidence of splitting, cracking or breaking when the pipe is tested per ASTM Test Method D2412 and F949 section 7.5. The pipe shall be made of PVC compound having a minimum cell classification of 12454B as defined in ASTM Specification D1784.

2.02 JOINTS (pipes shall be wrapped at joints)

A. Concrete Pipe Joints: Except where otherwise specified, rubber gaskets for use in concrete pipe joints shall meet with the requirements of Article 6.9 of ASTM C361, with the additional requirements that the gasket used shall be of such cross sectional area and perimeter as to properly fit the space provided in the pipe joint in which it is to be used, and shall be the sole element relied on to maintain a tight joint. Prior to use, the gasket shall be stored in as cool a place as practicable. The concrete joints shall conform to FDOT Standards Section 941 Concrete Pipe, Section 942 Pipe Gaskets, Section 430-7 Requirements for Concrete Pipe, and ASTM C443.

B. Reinforced Concrete Box Culvert Joints: Reinforced Concrete Box Culvert: shall conform to the requirements of Section 400, FDOT Standard Specifications for Road and Bridge Construction, Index No. 290 FDOT Roadway and Traffic Design Standards, and Section 02640 – Precast Concrete Box Culverts.

C. Corrugated Steel Pipe Joints: Field joints for steel pipe shall be made with bands fabricated of the same alloy as the culvert sheeting and shall meet the requirements of AASHTO M36. The banded joints shall be gasketed with a neoprene gasket of a design shown to secure a soil-tight or watertight joint.

D. Corrugated Polyethylene Pipe Joints: series 65 Pro Link WT watertight joining system with O-ring gaskets as manufactured by Advanced Drainage Systems, Inc. (ADS). Performance specifications ASTM D3212 and AASHTO M294.

E. Polyvinyl Chloride Pipe Joints: Rubber sealing rings for pipe joints shall conform to ASTM D-3212.

F. Contech A-2000 perforated PVC drainage pipe fittings for corrugated sewer pipe with a smooth interior shall conform to ASTM F949, Section 5.2.3 or F794, Section 7.2.4. To insure compatibility, the pipe manufacturer shall provide all fittings.

G. Contech A-2000 perforated PVC drainage pipe joints shall be made with integrally-formed bell and spigot gasketed connections. Elastomeric seals (gaskets) shall meet the requirements of ASTM Designation F477.

2.03 FRENCH DRAINS

A. French drains shall conform to the requirements of Section 443 FDOT Standard Specifications.

B. Filter fabric shall conform to the requirements of Sections 514 and 985, FDOT Standard Specifications.

C. Contech A-2000 slotted, standard perforated pipe, the perforation dimensions shall be in accordance with ASTM F949 table 5 and section 7.9. Instead of slots, round holes (min. 1/4" Ø) may be used for 15"-36" diameter pipe.

2.04 INLETS MANHOLES AND JUNCTION BOXES

A. All drainage inlets, manholes, and junction boxes shall be precast concrete conforming to ASTM C-478 and 64T. All concrete shall have not less than 4000-psi compressive strength at 28 days.

B. Structure sections shall be joined with a mastic sealing compound. The remaining space shall be filled with the cement mortar and finished so as to produce a smooth continuous surface inside and outside the wall sections.

C. All openings in precast structures shall be cast at the time of manufacture. Holes for piping shall be six inches larger than the outside diameter of the proposed pipe. All spaces between the manhole and the pipe shall be completely filled with mortar and finished smooth.

D. Mortar used for concrete structures shall conform to M C-270. Mortar material shall be mixed one part Type 2 Portland cement to two parts aggregate by volume. Portland cement shall conform to ASTM C-144 and aggregate shall conform to ASTM C-144.

E. The CONTRACTOR shall furnish the ENGINEER with shop drawings of all precast structures for his approval prior to fabrication. Shop drawings shall show all dimension, reinforcing steel and specifications.

F. Handling and Storing: Pipe shall be protected during shipping, storage and handling against impact shocks, free fall or other damage. Any damaged pipe shall be removed from the job site immediately.

G. A-2000 PVC pipe Manhole flexible connections like rubber boots, A-Loks, etc. are recommended. Rubber boot manhole connectors, install either a standard A-2000/A-2026 double gasket (8”-10”) or an A-2000 manhole gasket (12’-36”)

on the pipe spigot under the stainless steal strap A-Lok: where manholes are manufactured with A-Lok connections, use a CONTECH PVC manhole sleeve A-Lok manhole sleeve are available already attached to the pipe. If the manhole sleeves are not attached and the need arises in the field, follow the procedure below.

A. Place a standard gasket on the pipe about 6” from the end. Lube the gasket and the manhole sleeve and slide the manhole sleeve onto the pipe end. Restrict the coupling from sliding and push the unit (pipe and coupling) into the A-Lok connection (lube the A-Lok).

B. Non-flexible (waterstop type) Flexible manhole connections are recommended. For cast-in-place concrete bottoms, precast bottoms with “mouse hole” or similar pipe-to-manhole entry that does not incorporate a flexible connection, use two standard A-2000/A-2026 double gaskets for 8”-and 10”-diameter pipe, positioned on the pipe in the center of the manhole wall with the leading (the lower) edge of the gaskets in adjacent corrugations, then concrete grout or seal the pipe/manhole connections as required. For pipe with diameters of 12”-36” inches, use one standard A-2000 double gasket, positioned on the pipe in the center of the manhole wall, with the leading (lower) edge of the gasket closest to the inside of the manhole.

2.05 GRATINGS

A. Iron frames, grates, and lids shall conform to ASTM A48 and shall be Class 30. The castings shall be true to design, dimension, weight, and detail as shown on the contract drawings.

2.06 FORMS

A. Forms for cast in place headwalls or other concrete structures shall be wood or metal, so designed and constructed that they may be removed without injury to the concrete. They shall be built true to line and grade and braced in a substantial and unyielding manner, and shall be approved by the ENGINEER before being filled with concrete.

2.07 CONCRETE

A. Class I, concrete shall be used for headwalls, pipe, end walls, and other miscellaneous concrete items. Except as may be modified in the plans or special provisions the required minimum 28-day compressive strength for Class I concrete shall be 2500 psi.

2.08 CONCRETE REINFORCEMENT

A. Concrete reinforcement in sizes No. 3 (3/8-inch) and larger shall be deformed steel bars of the shapes and sizes indicated on the drawings.

B. The steel shall be newly rolled stock, substantially free from mill scale, rust, dirt, grease, or other foreign matter. Bars shall be domestic billet steel.

C. Reinforcing bars shall be Grade 60, in conformance with ASTM Specifications for Concrete Reinforcement, Designation A615, except stirrups and ties shall be Grade 40.

D. Deformations on bars for concrete reinforcement shall conform to the ASTM Specifications for concrete reinforcement, Designation A615.

E. Tie Wire - The tie wire shall be 16 gauge or heavier, black annealed wire.

F. Metal Accessories - metal accessories shall be galvanized and sufficient in size and number to rigidly support the reinforcing steel under all conditions.

G. Clean loose rust, grease, or any other coating that could interfere with bond. Where there is delay in depositing concrete after reinforcement is in place, bars shall be reinspected and cleaned when necessary.

H. All steel reinforcing shall be placed in the exact positions and with the spacing shown on the plans or as ordered, during the placing of the concrete. The clear distance between parallel bars shall not be less than one and one half times the bar diameter, and shall in no case be less than one inch, nor less than one and one-third times the maximum size of coarse aggregate. Unless shown otherwise on the drawings, bars shall be lapped not less than 24 diameters nor less than 12 inches.

I. Minimum concrete coverings over reinforcement shall be as follows:

1. For footings and slabs deposited against earth -three inches.

2. For formed surfaces to be exposed to weather, dampness, or in contact with ground after removal of forms - two inches.

2.09 RIP RAP HEADWALLS

A. Portland cement shall be from an approved source and the product of an established and reputable manufacturer.

B. Fine aggregate shall meet the requirements of Section 902-2.3 of FDOT Standard Specifications.

C. Sacks shall be jute sacks, or any suitable sacks of any material which will hold the sand-cement mixture without leakage when handled and which are

permeable or absorptive enough to permit the passage of water when wetted. The sacks shall be of uniform size and dimensions, in order to provide uniformity of lines in the completed work. They shall be free from holes and strong enough to stand handling without ripping or splitting. Only one type and size of sack shall be used at any one structure.

## PART 3 – EXECUTION

### 3.01 EXCAVATION

A. Requirements for all Excavation: Foundation pits shall be excavated to permit the placing of the full widths and lengths of footings shown in the plans with full horizontal beds. Corners or edges of footings shall not be rounded or undercut. All excavation shall be carried to foundation materials satisfactory to the ENGINEER regardless of the elevation shown on the plans. Unless a firm footing can be established on solid rock before such depths is reached, it shall be carried to such additional depth as may be necessary to eliminate any danger of undermining. Wherever rock bottom is secured, the excavation shall be done in such manner as to allow the solid rock to be exposed and prepared in horizontal beds for receiving the masonry. All loose and disintegrated rock or thin strata shall be removed. All foundation excavations shall be inspected and approved by the ENGINEER prior to the placing of masonry.

B. Earth Excavation - Foundation Material other than Rock:

1. When masonry is to rest on an excavated surface other than rock, special care shall be taken to avoid disturbing the bottom of the excavation, and the final removal of the foundation material to grade shall not be made until just before the masonry is to be placed. In case the foundation material is soft or mucky the ENGINEER may require the CONTRACTOR to excavate to a greater depth and to backfill to grade with approved material.

C. Removal of Obstructions:

1. The CONTRACTOR shall perform all excavation of whatever substances encountered to the depths indicated on the drawings or as necessary. Excavation shall be unclassified regardless of material encountered. This shall include necessary clearing and grubbing of any foreign substance encountered within the structure or trench area.

2. Boulders, logs, or any unforeseen obstacles encountered in excavating shall be removed and no additional compensation will be allowed because of difficulties met in driving through or removing such obstructions.

3. No separate payment for excavation as such will be made. The cost thereof shall be included in the prices for the pipe installation. Excavation material

suitable for backfill shall be piled in an orderly manner at a sufficient distance from the trench to avoid overloading and to prevent slides or cave-ins.

D. Rock Excavation:

1. All rock and other hard foundation material shall be freed of all loose material, cleaned, and cut to a firm surface; either level, stepped vertically and horizontally, or serrated, as may be directed by the ENGINEER. All seams shall be cleaned out and filled with concrete or mortar.

E. Removal of Unstable Material:

1. It is the intent of this specification that all pipe and other structures shall be provided with a stable foundation, and that any material, which by reason of kind or condition is not and cannot be made stable by drainage or compaction, shall be removed or replaced. Therefore, any material encountered at the elevation shown on the drawings or specified for pipe that will not or cannot be improved to provide a stable foundation for the pipe, shall be removed and replaced. All unstable material below the grade line of the pipe shall be removed for the full width of the trench and replaced with suitable selected material, compacted as specified elsewhere in these specifications. For the purpose of this specification, muck, peat and other highly organic soils shall be considered to be unstable materials. Also, any soil which is or might become wet to such a degree that its moisture content is equal to or greater than 90 percent of its liquid limit will have to be specifically approved by the ENGINEER with regard to stability, or shall be considered to be an unstable material requiring removal and replacement.

3.02 PIPE TRENCH EXCAVATION

A. Trenches for pipe culverts and for storm sewers shall be excavated to the required depth and to a width sufficient to provide adequate working room. For pipe lines placed above the natural ground line the embankment shall be placed and compacted, prior to excavation of the trench, to an elevation at least two feet above the top of the pipe and to a width equal to four pipe diameters, and the trench then excavated to the required grade. Where the soils permit, the trench sides shall be vertical up to at least the mid-point of the pipe.

B. Work shall be performed in compliance with applicable Trench Safety Standards identified in the Occupational Safety and Health Administration's Excavation Safety Standards (OSHA), 29 C.F.R.S. 1926.650 Subpart P will be adhered to during trench excavation in accordance with Florida Statutes 553.60 through 533.64 inclusive (1990), "Trench Safety Act".

C. For all pipe culverts and storm sewers 24 inches or over in diameter (except side drain), the bedding shall be shaped to conform to the outside of the pipe,

for a depth of not less than 10 percent of its total height (outside dimensions) and recesses provided to receive the bell.

D. Where wet conditions are such that dewatering by normal pumping methods, including wellpointing, would not be effective, then this requirement may be modified by the ENGINEER. No payment will be allowed for select bedding material, which might be utilized by the CONTRACTOR for his own convenience in lieu of dewatering.

E. For all side drains, and for pipe culverts less than 24 inches in diameter, the trench bottom may be either flat, or shaped to fit the bottom of the pipe, except as provided for trenches, cut below grade and for areas of unsuitable foundation material. Regardless of the shape of the trench bottom, excavation shall be made for the hubs as required to allow the pipe barrel to rest firmly on the trench bottom. The bottom of the trench shall be rounded so that the bottom quadrant of the pipe will rest firmly on undisturbed soil for as nearly the full length of the barrel as proper jointing operations will permit. This part of the excavation shall be done manually only a few feet in advance of the pipelaying by men skilled in this type of work. Unauthorized overdepths shall be backfilled with loose, granular, moist earth, thoroughly tamped. Whenever the presence of incipient slides is noted during excavation, the trench walls shall be restrained with adequate sheeting, shoring and bracing. Trench excavation in the proximity of certain existing sanitary sewers and other utility lines shall be protected by either steel or wood sheeting. Used sheet piling in good condition, which has been inspected and approved by the ENGINEER, may be used in place of new sheet piling.

F. The CONTRACTOR shall provide adequate equipment for the removal of storm or subsurface waters, which may accumulate in the excavated areas. If subsurface water is encountered, the CONTRACTOR shall utilize approved means to adequately dewater the excavation so that it will be dry for working and pipelaying. A wellpoint system or other approved dewatering method shall be utilized, if necessary, to maintain the excavation in a dry condition for preparation of the trench bottom and for pipe laying.

G. Contractor shall, wherever necessary, provide temporary sidewalks and driveway entrances at his own expense, including safe bridges over trench and fencing around excavations for pedestrian protection.

H. Contractor to adhere to the construction pollution prevention plan prior to any activities.

3.03 UNSUITABLE MATERIAL

A. When rock, boulders, or other hard, lumpy or unyielding materials are encountered in the trench bottom they shall be removed to a depth at least 12 inches below the bottom of the pipe. Muck or other soft material considered by

the ENGINEER to be unsuitable as foundation for the pipe shall be removed to a depth as where sand or other acceptable material is encountered, and to the width of the trench as directed by ENGINEER.

3.04 PIPE BEDDING

B. When undercutting is required in order to remove unsuitable material (either hard or soft), the trench shall be backfilled to a point six inches above the bottom of the pipe, with suitable granular material which will form a firm bed for the pipe, and the bottom shall be shaped to fit the pipe to a point six inches above the bottom of the pipe. Such bedding material shall be coarse sand, washed limerock or other suitable granular material. Where bell and spigot pipe is used, the bell holes shall be deep enough to ensure that the bell does not bear on the bottom of the excavation, and shall not be excessively wide in the longitudinal direction of the culvert or storm drain.

Contech PVC A-2000 pipe bedding materials can be 4-inch to 6-inch compacted thickness, Class I, II, or III accordance with ASTM D2321. See blow for material specification.

A. Class IA materials if used for bedding, must be used as haunching material to the spring line in a dry trench. To minimize the potential for migration, Class IA materials should be used to the top of the pipe in wet trenches or in trenches that will fall below the water table.

B. Class IB Install in 6-inch maximum lifts and compact to minimum 85% Standard Proctor Density.

C. Class II Install in 6-inch maximum lifts and compact to 85% Standard Proctor Density.

D. Class III materials are suitable only in dry conditions. Install in 6-inch maximum lifts and compact to 90% Standard Proctor Density.

E. Class IV and V materials are **not allowed** as bedding.

3.04A Embedment Materials

Embedment materials are those used for bedding, haunching, and initial backfill. All materials should be installed and compacted in 6-inch maximum lifts. ASTM D2321 classifies soil materials as:

A. Class IA Manufactured aggregates: Open graded clean, angular, crushed stone or rock, crushed gravel, broken coral, crushed slag, cinders or shells, large void content, with little or no fines. These materials compact with little or no mechanical effort.

B. Class IB Manufactured, processed aggregates: Dense, graded clean, angular, crushed stone (or other Class IA materials) and stone/sand mixtures with gradations selected to minimize migration of adjacent soils, containing little or no fines. Compact to 85% Standard Proctor Density with hand tampers or vibratory compaction.

C. Class II Clean, coarse-grained materials, such as gravel, coarse sands, and gravel/sand mixtures (1 1/2 inches maximum size). These materials are classified by the USC System as GW, GP, SW, SP, and GW-GC or SP-SM. Hand tamping or mechanical vibration is required to provide the necessary 85% Standard Proctor Density.

D. Class III Coarse-grained materials with fines including silty or clayey gravels or sands. Gravel or sand must comprise more than 50 percent of Class III materials (1 1/2 inches maximum size). Soils classified as GM,GC,SM, or SC meet these requirements. Hand tamping or mechanical vibration is required to provide the necessary 90% Standard Proctor Density.

E. Class IV Fine-grained materials, such as fine sands and soils, containing 50 percent or more clay or silt. Soils classified as Class IVA (ML or CL) have medium to low plasticity and the restrictive installation requirements may make their use prohibitive in the embedment zone. Soils classified as Class IVB (MH or CH) have high plasticity and are not allowed as embedment materials.

F. Class V These
materials include organic silts and clays, peat, and other organic materials. They are not allowed as embedment materials.

3.04B Haunching

Proper haunching provides a major portion of the pipe's strength and stability. Poor workmanship will lead to excessive pipe deflection and grade and alignment problems. Haunching materials can be Class I, II, or III.

A. Class I Materials
Where the pipe will be below existing or future ground water levels or where the trench will be inundated, Class IA materials, when used, must be placed to the top of the pipe.

Where conditions are dry and will remain dry, Class I materials need only be placed to the springline allowing Class II, III, or low plasticity Class IVA materials to be used as initial backfill. Class IA materials require less compactive effort than other haunching materials.

B. Class IB materials should be placed in 6-inch maximum lifts and compacted to 85% Standard Proctor Density by hand tampers or vibratory compaction.

C. Where Class I materials are used for bedding. Class I materials must be used for haunching materials to the springline in dry conditions and to the top of the pipe in wet conditions.

D. Class II Materials Need to be compacted to a minimum 85% Standard Proctor Density by hand tamping, mechanical vibrations, or where trench conditions allow, by flooding or puddling. Compaction by tamping or vibration must be done in 6-inch maximum lift thicknesses. Flooding or puddling requires a trench foundation capable of absorbing the water quickly so water movement down into the foundation consolidates the haunching materials.

E. Class III materials used as haunching materials must be compacted by hand or mechanical tamping. Place material under the lower haunch area of the pipe and compact to 90% Standard Proctor Density

All Class IV and Class V materials should not be used as haunching material. They are difficult to compact and often don't supply continuing support.

3.05 COMPACTION

A. When a pipe trench is undercut in order to remove unsuitable material or for other reasons, it shall be brought to required grade using suitable materials, after which the bottom shall be compacted to match approximately the density of the soil in which the trench was cut.

3.06 PIPELAYING

A. As pipe laying progresses, the interior of the pipe shall be cleaned of all dirt and superfluous materials. The CONTRACTOR shall, at all times, take whatever measures are necessary to prevent the entrance of dirt and other foreign matter into the storm sewer system. In the event that it is necessary to clean the pipe before final acceptance, the CONTRACTOR shall do so without additional compensation.

B. Open Trench - No more than 200 linear feet, or the length of trench between consecutive drainage structures, shall be left open behind pipe laying, whichever distance is greater. In no instance shall any trench be left open for more than 24 hours before backfilling in accordance with these specifications.

3.07 DEWATERING

A. The CONTRACTOR shall provide adequate equipment for the removal of storm or subsurface waters that may accumulate in the excavation. If subsurface water is encountered, the CONTRACTOR shall utilize suitable equipment to adequately dewater the excavation so that it will be dry for work and pipelaying. A wellpoint system or other ENGINEER approved dewatering method shall be

utilized, if necessary, to maintain the excavation in a dry condition for preparation of the trench bottom and for pipe laying. Dewatering by trench pumping will not be permitted if migration of fine-grained natural material from bottom, sidewalls or bedding material will occur. In the event that satisfactory dewatering cannot be accomplished due to subsurface conditions or where dewatering could damage existing structures, the CONTRACTOR shall obtain the ENGINEER's approval of wet trench construction procedure before commencing construction. Dewatering shall cease in a manner to allow the subsurface water to slowly return to normal levels.

B. Water pumped from the trench or other excavation shall be disposed of in storm sewers having adequate capacity, canals or suitable disposal pits. CONTRACTOR is responsible for acquiring all permits required to discharge the water, and shall protect waterways from turbidity during the dewatering operation. In areas where adequate disposal sites are not available, partially backfilled trenches may be used for water disposal only when the ENGINEER approves the CONTRACTOR's plan for trench disposal in writing. The CONTRACTOR's plan shall include temporary culverts, barricades and other protective measures to prevent damage to property or injury to any person or persons. No flooding of streets, roadways, driveways or private property will be permitted. Engines driving dewatering pumps shall be equipped with residential type mufflers.

## 3.08 PUMPING

A. Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of any portion of the concrete materials being carried away. No pumping shall be done while concrete is being placed, or for a period of at least 24 hours thereafter, unless it is done from a suitable pump separated from the concrete work by a watertight wall.

## 3.09 BACKFILLING

A. Backfill Materials:

1. Backfilling to the original ground surface or subgrade surface of openings made for structures, with a sufficient allowance for settlement, shall be a part of the work of excavation, although the ENGINEER may require that the material used in making the backfill be obtained from a source entirely apart from the structure. All material used for backfill shall be of a quality acceptable to the ENGINEER, and shall be free from large lumps, wood, or other extraneous material.

2. Heavy construction equipment will not be permitted to cross over culvert or storm sewer pipes until backfill material has been placed and compacted to the finished earthwork grade or to an elevation at least 2-1/2 feet above the crown of the pipe.

B. Compaction Under Wet Conditions:

1. Where wet conditions do not permit the use of mechanical tampers, compaction of the backfill shall be done with hand tampers. Only A-3 material will be allowed for use in the hand tamped portions of the backfill. When the backfill has reached an elevation and condition such as to make the use of the mechanical tampers practicable, the mechanical tamping shall be done in such a manner and to such extent as to transfer the compaction force into the sections previously tamped by hand.

C. Compaction Requirements for Pipe Culverts and Storm Sewers:

1. The backfilling of pipe trenches shall be done in three stages as follows:

   a. In the first stage the CONTRACTOR shall provide adequate compacted fill beneath the haunches of the pipe, using mechanical tampers suitable for this purpose. This compaction applies to the material placed beneath the haunches of the pipe.

   b. In the second stage the CONTRACTOR shall obtain a well-compacted bed and fill along the sides of the pipe and to a point at lest one foot above the top of the pipe. The width of backfill and compaction to be done under this second stage shall be the width of the portion of the trench having vertical sides, or, when no portion of the trench having vertical sides, it shall be to a width at least equal to twice the outside diameter of the pipe.

   c. In the third stage the remainder of the trench shall be backfilled with suitable material, which shall be compacted in accordance with the requirements below.

2. Compaction:

   a. The backfill for the first and second stages shall be placed in six-inch layers (compacted thickness) and shall be compacted to 98% of maximum density as determined by AASHTO T180. Where the backfill lies within the roadway embankment or subgrade, it shall be compacted to the densities specified for these areas.

   b. When pavement is to be constructed over the pipe, the backfill for the third stage shall be placed in the manner and compacted to the degree required for the first and second stages. Where no pavement is to be constructed and vehicular traffic is not to pass over the pipe, the third stage backfill shall be compacted to a firmness approximately equal to that of the soil adjacent to the pipe trench.

D. Backfill Under Wet Conditions:

1. Where wet conditions are such that dewatering by normal pumping methods would not be effective, the procedure outlined below may be used when specifically authorized by the ENGINEER in writing and noted in the job diary. In such specifically authorized cases the backfill material used below the elevation at which mechanical tampers would be effective shall be of the A-3 soil classification (based on AASHTO Designation M145-49). After the pipe is bedded properly, the A-3 material shall be placed, and rammed and compacted under the pipe haunches by the use of timbers or hand tampers, and hand-tamping continued during the placing of the backfill until the backfill reaches an elevation such that its moisture content will permit the use of mechanical tampers. When the backfill has reached such elevation, normally acceptable backfill material may be used and compaction shall be obtained by the use of mechanical tampers. The mechanical tamping shall be done in such manner and to such extent as to transfer the compacting force into the previously hand-tamped fill.

E. Requirements for Thick Lift Compaction in Granular Materials:

1. If the CONTRACTOR has compaction equipment with which the required density can be obtained in thicker lifts than permitted above and upon satisfactory evidence that the proposed equipment will produce work equal in quality to that produced by the specified methods, the ENGINEER may permit placement of granular material of soil groups A-1, A-2, or A-3 in lifts up to a maximum of three foot compacted thickness. The CONTRACTOR will be required to furnish equipment and labor to excavate and backfill test pits to be dug for the performance of density tests.

2. Use of thick lift compaction procedures will not be allowed for first stage backfilling (beneath the haunches) of pipe culverts and storm sewers.

## 3.10 CONSTRUCTION METHODS FOR RIP RAP HEADWALLS

A. The sand and cement shall be mixed dry, in the proportions of five cubic feet of sand to one bag of cement, until the mixture is of uniform color.

B. The mixed material shall be accurately measured into each sack, with care being taken to place the same amount of material in each sack, and at least the top six inches of the sacks shall remain unfilled to allow for properly tying or folding and to insure against breakage of the sack during placing.

C. The filled sacks shall be placed with their tied or folded ends all in the same direction unless otherwise shown on the plans. The sacks shall be laid with broken joints, in a regular pattern. The sacks shall be rammed or backed against each other so as to form a close and molded contact after the sand and cement mixture has set up. Sacks ripped with sound, unbroken sacks.

Reinforcing rods shall be added as shown on the plans. All sacks shall then be thoroughly saturated with water.

D. Immediately after watering, all openings between sacks shall be filled with dry grout composed of one part Portland cement and five parts sand.

E. After the bags have been set up, a concrete cap shall be formed and poured on the headwall as shown on the plans.

3.11 TESTING

A. The Contractor is required to perform lamping and infiltration/exfiltration tests on the gravity stormwater pipe system to verify that the pipe system is soil tight.

B. Upon completion of placement of concrete pavement or structural asphalt pavement, but prior to final friction course the Contractor will be required to video the gravity stormwater pipe system after completion to verify that the pipe system is soil tight.

C. Upon completion of placing concrete pavement or structural asphalt pavement, but prior to final friction course, for flexible (metal, HDPE, and PVC), the Contractor shall test for deflection using a mandrel. Pipe deflected 5 percent or greater shall be removed and replaced at no additional cost to the Owner. Reshaping of deflected pipe shall not be allowed.

3.12 REPLACING PAVEMENT

A. Where existing pavement, curb, curb and gutter, sidewalk or valley gutter is removed only for the purpose of constructing or removing box culverts, pipe culverts, storm sewers, inlets, manholes, etc., such pavement, etc., shall be replaced and restored to as good condition as determined by the ENGINEER, as before removal, and without direct compensation therefore. The replaced pavement shall be of the same or similar type as that removed.

3.13 CLEANING UP

A. Upon completion of the work, the CONTRACTOR shall leave the structure and all adjacent areas affected by his operations in a neat and presentable condition, and shall remove and clean up all rubbish and surplus material at locations and methods approved by the ENGINEER.

3.14 SUBMITTALS

A. As-Built Drawings - During the progress of work of the storm drain system, the Contractor shall record on a spare set of site drawings the exact locations, as installed, of all underground and otherwise concealed piping and other storm

drainage system items not installed in locations shown on the Contract Drawings.

B. These drawings shall be submitted to the Owner prior to request for final payment.

END OF SECTION

SECTION 02631
STORM WATER TREATMENT DEVICE

## 1.0 GENERAL

1.1 This item shall govern the furnishing and installation of the CDS® by Contech Engineered Solutions LLC, complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents.

1.2 The Contractor shall furnish all labor, equipment and materials necessary to install the storm water treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.

1.3 The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a CDS® device manufactured by:

Contech Engineered Solutions LLC
9025 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

1.4 Related Sections

1.4.1 Section 02240: Dewatering
1.4.2 Section 02260: Excavation Support and Protection
1.4.3 Section 02315: Excavation and Fill
1.4.4 Section 02340: Soil Stabilization

1.5 All components shall be subject to inspection by the engineer at the place of manufacture and/or installation. All components are subject to being rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair where final acceptance of the component is contingent on the discretion of the Engineer.

1.6 The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.

1.7 The SWTD manufacturer shall submit to the Engineer of Record a “Manufacturer’s Performance Certification” certifying that each SWTD is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research

1.8 No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

## 2.0 MATERIALS

2.1 Housing unit of stormwater treatment device shall be constructed of pre-cast or cast-in-place concrete, no exceptions. Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:

- 2.1.1 Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
- 2.1.2 Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
- 2.1.3 Cement shall be Type III Portland Cement conforming to ASTM C 150;
- 2.1.4 Aggregates shall conform to ASTM C 33;
- 2.1.5 Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185, or A 497.
- 2.1.6 Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
- 2.1.7 Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.

2.2 Internal Components and appurtenances shall conform to the following:

- 2.2.1 Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
- 2.2.2 Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
- 2.2.3 Fiberglass components shall conform to the ASTM D-4097
- 2.2.4 Access system(s) conform to the following:
- 2.2.5 Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

## 3.0 PERFORMANCE

3.1 The SWTD shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load or treat a flow rate designated by the jurisdiction in which the project is located. Both methods should be sized using a particle size distribution having a mean particle size ($d_{50}$) of 125 microns unless otherwise stated.

3.2 The SWTD shall be capable of capturing and retaining 100 percent of pollutants greater than or equal to 2.4 millimeters (mm) regardless of the pollutant's specific gravity (i.e.: floatable and neutrally buoyant materials) for flows up to the device's rated-treatment capacity. The

SWTD shall be designed to retain all previously captured pollutants addressed by this subsection under all flow conditions. The SWTD shall be capable of capturing and retaining total petroleum hydrocarbons. The SWTD shall be capable of achieving a removal efficiency of 92 and 78 percent when the device is operating at 25 and 50 percent of its rated-treatment capacity. These removal efficiencies shall be based on independent third-party research for influent oil concentrations representative of storm water runoff (20 ± 5 mg/L). The SWTD shall be greater than 99 percent effective in controlling dry-weather accidental oil spills.

3.3 The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. The sump chamber shall be separate from the treatment processing portion(s) of the SWTD to minimize the probability of fine particle re-suspension. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.

3.4 The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.

3.5 The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

3.6 The SWTD shall have completed field tested following TARP Tier II protocol requirements

4.0 EXECUTION

4.1 The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be borne by the contractor.

4.2 The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.

4.3 The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.

4.4 The contractor shall removal all loose material and pooling water from the SWTD prior to the transfer of operational responsibility to the Owner.

**TABLE 1**
**Storm Water Treatment Device**
**Storage Capacities**

| CDS Model | Minimum Sump Storage Capacity $(yd^3)/(m^3)$ | Minimum Oil Storage Capacity (gal)/(L) |
|---|---|---|
| CDS2015-4 | 0.9(0.7) | 61(232) |
| CDS2015-5 | 1.5(1.1) | 83(313) |
| CDS2020-5 | 1.5(1.1) | 99(376) |
| CDS2025-5 | 1.5(1.1) | 116(439) |
| CDS3020-6 | 2.1 (1.6) | 184(696) |
| CDS3025-6 | 2.1(1.6) | 210(795) |
| CDS3030-6 | 2.1 (1.6) | 236(895) |
| CDS3035-6 | 2.1 (1.6) | 263(994) |
| CDS3535-7 | 2.9(2.2) | 377(1426) |
| CDS4030-8 | 5.6(4.3) | 426(1612) |
| CDS4040-8 | 5.6 (4.3) | 520(1970) |
| CDS4045-8 | 5.6 (4.3) | 568(2149) |
| CDS5640-10 | 8.7(6.7) | 758(2869) |
| CDS5653-10 | 8.7(6.7) | 965(3652) |
| CDS5668-10 | 8.7(6.7) | 1172(4435) |
| CDS5678-10 | 8.7(6.7) | 1309(4956) |
| | | |
| CDS7070-DV | 3.6(2.8) | 914 (3459) |
| CDS10060-DV | 5.0 (3.8) | 792 (2997) |
| CDS10080-DV | 5.0 (3.8) | 1057 (4000) |
| CDS100100-DV | 5.0 (3.8) | 1320 (4996) |

**END OF SECTION**

# SECTION 02743

# BITUMINOUS CONCRETE PAVEMENT

## PART 1 GENERAL

1.01 SUMMARY

A. Furnish labor, equipment, and material required for cutting, removing, protecting, replacing or stabilizing existing roadways, driveways and pavement of the various types encountered, removed or damaged under this Contract.

B. Existing utility castings, including valve boxes, manholes, handholes, pull boxes, inlets and similar structures in the areas of trench restoration, pavement replacement and pavement overlay shall be adjusted to be flush with the surface of the finished work, at no additional cost to the OWNER.

C. Protection for pavements, limerock base courses and asphaltic surface courses, within the work area.

1. Payment for pavement restoration will be made only where such limerock base courses or surface courses are encountered within the limits defined in the pavement repair details shown in the Drawings and/or in the Standard Details.

2. Base course or surface course beyond those limits, damaged as a result of the CONTRACTOR's operation, shall be restored in accordance with the applicable requirements of these Specifications, at no additional cost to the OWNER.

3. In writing, notify the authority having jurisdiction over the street, of existing damaged pavement prior to proceeding with work in the vicinity.

4. Forward a copy of these notices to the ENGINEER.

D. Permanent pavement repair shall be in accordance with the details shown in the Drawings and/or in the FDOT Standard Details herein with edges straight and parallel and patches rectangular in plan.

1. Paving replacement required beyond the limits shown in the details, and as called for in the Specifications, shall be at the CONTRACTOR’s expense.

2. Where trenches are located out of the existing pavement and damage occurs to the pavement, it shall also be replaced at no expense to the OWNER.

E. Promptly replace pavement markings removed or obliterated, using like materials and without expense to the OWNER.

## PART 2 PRODUCTS

2.01 MATERIALS

A. The percentages of maximum density for subgrade and limerock base specified herein are minimum.

1. Greater percentages of maximum density shall be obtained, if so required by the governing authority having jurisdiction over the work location.

B. Asphaltic concrete mixtures shall be obtained only from plants, which comply with the requirements of D.O.T. Specifications, Section 320 as applicable, using materials specified herein, and producing the specified mixture.

1. General construction requirements for hot bituminous mixtures specified herein shall conform to D.O.T. Specifications, Section 330, as applicable.

C. Equipment necessary for construction shall be on the job site in first class working condition.

1. Spilling or dropping of petroleum products is prohibited and defective equipment shall be removed or replaced immediately.

2. Comply with clean up requirements.

D. Asphaltic concrete shall be laid only where the surface to be covered is intact, firm, cured and dry, and only when weather conditions are suitable.

1. The temperature of the mixture at the time of spreading shall be within 25 $^{o}$F of the temperature set by the ENGINEER.

2. No mixture shall be spread when the air temperature is less than forty (40$^{o}$) degrees F, nor when the spreading cannot be finished and compacted during daylight hours.

E. Mixture caught in transit by a sudden rain may be laid at the CONTRACTOR's risk, if the base is in suitable condition.

1. Under no circumstances shall asphalt material be placed while rain is falling, or when there is water on the area to be covered.

## PART 3 EXECUTION

3.01 TEMPORARY PAVING

A. Prior to commencing excavation, the asphalt surface shall be saw cut within the limits of the allowable trench width.

1. Temporary paving will be required along the entire route where the original paved surface is removed.

2. Temporary paving shall be placed the same day the trench is backfilled.

3. The trench shall be backfilled as required in Trenching - Section 02319, up to one (1) inch below the existing pavement surface and a temporary, cold mixed sand/asphalt pavement shall be constructed up to the level of the existing pavement surface.

4. The liquid asphalt shall be Grade RC-70 conforming to the requirements of D.O.T. Specifications, Section 916-2.

5. The sand shall conform to the requirements of D.O.T. Specifications, Section 902 for fine aggregate.

B. The cold mix shall be installed one block at a time not crossing intersections to a maximum unpaved ditch length of 1,200 feet.

1. When either of these limits are reached, complete the installation of paving prior to continuing with his excavation work.

2. Backfill, compaction and temporary paving is to keep pace with the pipe installation.

3. Written permission must be obtained from the Department and the municipal agency permitting the work to allow greater lengths than 1,200 feet.

4. Permitting agencies may reduce the allowable limits in their permit, or for other unforeseen right-of-way conditions.

C. Prior to completion of the work remove the one (1) inch of cold mix and surplus backfill.

1. Replace one (1) inch of cold mix and surplus backfill with the specified compacted limerock base course and asphalt within the approved working limits.

2. Municipal agencies permitting this work may accelerate the time for removal of the cold mix, at their discretion.

D. Maintain the temporary pavement in a condition satisfactory to the ENGINEER until its removal.

1. Removal shall include surplus backfill material.

2. Replacement shall be made within thirty (30) days with the permanent pavement.

3. In replacing the temporary paving with permanent pavement, work shall be completed in sections compatible with specified traffic maintenance procedures.

E. No payment shall be made for temporary paving work and the cost for such work shall be included in the prices bid for other applicable items of work.

F. Should the CONTRACTOR elect to install temporary hot mix asphalt, to be left in place, in lieu of cold mix asphalt, a suitable credit for cold mix will be provided to the OWNER when the hot mix temporary asphalt is left in place and installed over properly compacted Limerock base course and shall be incorporated into the specified permanent pavement restoration as part of Type I paving replacement.

G. Sand seal on the limerock base course will not be permitted in lieu of temporary paving.

3.02 TYPE I PAVING REPAIRS (LIMEROCK BASE AND ASPHALTIC CONCRETE SURFACE)

A. Type I paving repairs shall be made with an eight (8) inch thick compacted limerock base and a minimum one and one-half (1-1/2) inches thick Asphaltic concrete surface.

B. Limerock for pavement base shall be obtained from local sources where the overburden was removed from the pits prior to mining operations.

1. The limerock shall comply with the requirements of D.O.T. Specifications, Section 911.

C. The backfill previously placed and compacted shall be excavated to the required depth below the existing road surface and the existing paving shall be cut back beyond excavations, using an abrasive disc saw to trim the edges to straight and true lines.

1. Eight (8) inches of limerock base shall be placed in two layers, each layer compacted to not less than 98 percent standard density.

2. During rolling, it shall be wet down as necessary to secure the greatest possible compaction.

3. After rolling, the entire surface shall be thoroughly scarified to a depth of not less than three (3) inches and shaped to conform to the existing surface, then watered and rolled again.

4. Rolling and watering shall continue until the entire depth of the base is bonded and compacted into an unyielding mass.

D. If the subgrade material becomes churned up and mixed with the limerock base course materials, without additional compensation, dig out and remove the mixture, reshape and compact the subgrade and replace the materials removed with clean rock which shall be watered and rolled until satisfactorily compacted.

E. After the limerock base course has been properly prepared and is dry and ready to receive the wearing surface, a prime coat of emulsified asphalt (Grade RS 2) shall be applied at a rate of 0.10 gallon per square yard, or as approved by the ENGINEER, immediately followed by the asphaltic concrete.

1. The prime coat shall be applied to the entire limerock base course uniformly, and shall thoroughly coat surfaces.

2. Care shall be taken to tack coat and bond the edges of surrounding pavement.

3. The tack coat shall not advance ahead of the paving by more than three hundred (300) feet in business or residential areas unless otherwise approved by the ENGINEER.

F. The Asphaltic concrete shall be plant mixed, using the best grade of local aggregates of approved size and gradation and mixed with an approved binder and conforming to either the State of Florida Department of Transportation Specifications, Type S-1 Asphaltic Concrete, Section 331-1 through 331-5, or as ordered by the ENGINEER.

1. Where the width of the repair permits, the material shall be placed by means of an approved mechanical spreader and finisher.

2. The mixture shall be compacted to true grade and cross section by means of a tandem roller weighing not less than eight (8) tons.

3. The compacted asphaltic concrete mixture shall not be less than one and one-half (1½) inches in thickness.

4. Rolling shall proceed as closely behind the spreader as possible and material shall be completely compacted the same day it is placed.

3.03 TYPE II PAVING REPAIR (SPECIAL LIME ROCK BASE AND ASPHALTIC CONCRETE SURFACE)

A. Type II repairs will be used only when the restoration work falls within the limits of a State Road and shall be performed in accordance with the latest Florida Department of Transportation Standard Specifications for Road and bridge Construction, current edition.

3.04 TYPE V PAVING REPAIRS (ASPHALTIC CONCRETE WEARING SURFACE OVERLAY)

A. Since the quantity of Type V repairs that may be required is usually unknown until Contract pavement restoration work begins, Type V based on pricing listed in the Bid Summary Sheet.

1. A Contingent Item may or may not be used at the option of the OWNER, and provisions contained within the Contract Documents for quantity overruns will not be applicable.

B. Type V paving repairs shall consist of a machine-laid asphaltic concrete wearing surface overlay which shall be nominal one-inch thick asphaltic concrete meeting the material requirements of Type I repairs as specified.

1. As used herein, "overlay" shall mean Type V paving repairs.

2. A special wearing surface may be substituted if required.

C. In general, the overlay will be applied in a full lane width or widths, after the permanent paving repairs over the trench have been made.

D. Longitudinal and transverse asphalt replacement overlay wearing surfaces shall butt into adjacent existing asphalt wearing surfaces in full lane asphalt restoration.

1. The finish elevation of the new full lane overlay shall meet existing elevations adjacent to the new work.

E. The existing asphaltic concrete surface shall be saw cut for its full depth or one and one-half (1½) inch minimum, and then stripped back for at least two (2) feet into the area to be overlaid to a second cut which shall also be in clean straight lines.

1. The second, or interior, cut edge shall be rolled with a tandem roller weighing not less than eight (8) tons before the overlay is applied.

2. The stripped area shall be used to provide a smooth transition between the overlay and the existing pavement.

3. Before placing the overlay, cut edges and the stripped area shall be tack coated with specified emulsified asphalt.

F. If the CONTRACTOR requests in writing to "feather" the longitudinal edge, and if written permission is granted to "feather" the asphalt by the Department and the local municipality, a sanded mix of 70-30 type shall be used.

1. "Feathering" shall begin eighteen (18) inches from the tapered edge.

G. Prior to installing a full lane width overlay over existing asphalt the trench and shoulders over the pipe shall be saw cut and filled with asphalt to the required depth and terminating flush with the existing adjacent asphalt in accordance with the municipality having jurisdiction over the work for Types I, II.

1. Type V overlay will be installed as detailed above.

H. When a minor amount of asphalt surface will remain, generally with large pipe installations, after the pipe is installed and the required longitudinal saw cutting the asphalt, the CONTRACTOR may request permission to remove the asphalt in the lane, at his expense, by saw cutting the asphalt adjacent to the existing lane, then placing the Type V overlay flush with the adjacent asphalt.

1. This would require that the Type I, II finish elevation be lowered one (1) inch to allow for the Type V overlay.

I. Before the overlay is applied, existing surfaces shall be swept clean of dirt and debris, using a power driven broom if warranted by the size of the location to be overlaid and/or as ordered by the ENGINEER.

1. Pavement edges shall be cleared of encroaching vegetation, loose sand, rock and other foreign matter.

2. When the existing surface is thoroughly clean, a tack coat of Emulsified asphalt, Grade RS-2 (anionic) shall be applied at the rate of approximately 0.10 gallon per square yard, immediately followed by the asphaltic concrete overlay.

3. The tack coat shall not advance ahead of the paving by more than three hundred (300) feet in business or residential areas unless otherwise approved by the ENGINEER.

J. Machine-laid overlay shall be place by means of an approved mechanical spreader, and the mixture shall be compacted to true grade and cross section by means of a tandem roller weighing not less than eight (8) tons.

K. The compacted overlay shall be thicker as required to produce a smooth uniform surface free of irregularities, but shall not be less than one (1) inch in thickness.

1. Existing depressed areas in the asphalt collecting water after a rainfall shall be corrected before placing the asphalt overlay.

2. Rolling after proceed as close behind the spreading of the asphalt as possible, and materials shall be completely compacted the same day it is placed.

3.05 STATE ROAD PAVEMENT RESTORATION (1:10 CONCRETE BACKFILL AND ASPHALTIC CONCRETE SURFACE)

A. State Road pavement Restoration, where required, shall be made with a backfill/base of 1:10 cement/s concrete mix.

1. In cases, regardless of water table, the 1:10 mix shall be placed from twelve (12) inches above the top of the pipe to an elevation three (30) inches below the adjacent asphalt surface.

2. A three (3) inch thick asphaltic concrete course, machine-laid in two (2) equal layers, cold-milled removal of one and one-half (1½) inches of pavement (for full lane width), one (1) inch thick asphaltic concrete wearing surface where shown in the Drawings.

B. After the base surface has been properly prepared and is dry and ready to receive the wearing surface, a tack coat of emulsified asphalt (Grade RS-2) shall be applied at a rate of 0.10 gallon per square yard, immediately followed by the asphaltic concrete.

1. The tack coat shall be applied to the entire base uniformly, and shall thoroughly coat surfaces.

2. Care shall be taken to tack coat and bond the edges of surrounding pavement.

C. The three (3) inch asphaltic concrete course, two (2) lifts/layers of one and one-half (1½) inches each, shall be plant mixed, using the best grade of local aggregates of approved size and gradation and mixed with an approved binder and conforming to either the State of Florida Department of Transportation Specifications, Type S-1 Asphaltic Concrete, Section 331-1 through 331-5, or as ordered by the ENGINEER.

1. Where the width of the repair permits, the material shall be placed by means of an approved mechanical spreader and finisher.

2. The mixture shall be compacted to true grade and cross section by means of a tandem roller weighting not less than eight (8) tons.

3. The compacted asphaltic concrete mixture shall not be less than three (3) inches in thickness.

4. Rolling shall proceed as closely behind the spreader as possible and material shall be completely compacted the same day it is placed.

3.06 COLD MILLING

A. Cold milling of the existing pavement for one and one-half (1½) inches deep shall be done by using an automated pavement planer capable of maintaining an accurate depth of one and one-half (1½) inches.

1. Cold milling equipment shall meet the approval of the Florida Department of Transportation, or other municipality having jurisdiction, before work is started.

B. After the pavement has been milled and mechanically cleaned, a tack coat shall be applied as specified above.

C. A full lane of one and one-half inches (1½) inches thick asphaltic concrete wearing surface Type S-1 Asphalt Concrete (per Florida Department of Transportation

Specifications, Sections 331 and 337, respectively) shall then be applied in accordance with the above specifications.

## 3.07 PAVEMENT MARKINGS

### A. Traffic Paint

1. Traffic paint used for this work shall conform with the requirements of Section 971-12 of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, or, at the CONTRACTOR's option, fast dry traffic paint, as specified in D.O.T. Specifications, Section 971-13 may be used.

2. The colors of the paint shall be yellow or white as existed before the repair.

3. Equipment shall be of a type and design, which will readily obtain the required uniformity of application of the stripes, both as to thickness of coating and as to alignment.

    a. The paint machine shall be of the spray type and shall be capable of spraying the paint to the required spread without thinning of the paint.

    b. The paint tank shall be equipped with a mechanical agitator.

    c. The nozzle shall have cut-off valves, which will apply broken or skip lines automatically.

    d. Each nozzle shall also be provided with suitable line guides, either metallic shrouds or air blasts.

4. Painting shall be done only during daylight hours and, as far as practicable, shall be terminated in time to permit sufficient drying by sunset.

    a. No paint shall be applied when moisture is present on the surface to be painted or when the air temperature is below forty (40) degrees $^{o}$F.

    b. Painting shall not be done when winds are sufficient to cause spray dust.

5. The surface, which is to be painted, shall be cleaned, by compressed air or other effective means, immediately before the start of painting, and shall be clean and dry when the paint is applied.

    a. Vegetation or soil shall be removed from the pavement before edge stripping is begun.

6. The paint shall be thoroughly mixed before it is poured into the painting machine and no thinning of the paint will be allowed.

    a. Before the start of each day’s work the paint container, the connections, and the spray nozzles on the machine shall be thoroughly cleaned with paint thinner or other suitable cleaner.

7. The traffic stripe shall be of the specified width with clean, true edges and without sharp breaks in the alignment.

    a. A uniform coating of paint shall be obtained and the finished stripe shall contain no light spots or paint skips.

    b. Stripes, which do not have a uniform, satisfactory appearance, both day and night, shall be corrected.

8. Newly painted stripes, including edge stripes, shall be protected until the paint is sufficiently dry to permit vehicles to cross stripe without damage from the tires.

    a. While the center line stripes are being painting, traffic shall be routed to the right side of the painting operations and the newly painted stripe.

        b. When necessary, a pilot car shall be used to protect the painting operations from traffic interference.

9. Portions of the stripes damaged by passing traffic or from other cause shall be repainted at the CONTRACTOR's expense.

B. Thermoplastic Traffic Stripes and Markings

1. Thermoplastic pavement markings, including stripes, pavement messages, stop bars, directional arrows, reflective pavement markers and other miscellaneous items, will be replaced as existed before the repair was made.

    a. The thermoplastic compound shall be as specified in Section 711 of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction.

    b. The thermoplastic compound shall be extruded or sprayed onto the pavement surface in a molten state by mechanical means, with surface application of glass spheres; when required, and upon cooling to ambient pavement temperature shall produce an adherent pavement marking of specified thickness and width and capable of resisting deformation.

2. The colors of the compound shall be white or yellow as existed before the repair.

3. Reflective Pavement Markers and their installation shall conform to the D.O.T. Specifications, Section 706.

4. Where thermoplastic is to be applied to cement concrete pavement, a sealing primer as specified in D.O.T. Specifications, Sections 711-2.2, shall be applied in advance of the placing of the stripes.

5. The thermoplastic shall be applied to the pavement utilizing extrusion or spray application equipment.

    a. The application equipment shall be so constructed as to provide continuous mixing and agitation of the material.

b. Conveying parts of the equipment between the main material reservoir and the shaping die or gun shall be so constructed as to prevent accumulation and clogging.

c. The equipment shall be constructed so that mixing and conveying parts up to and including the shaping die or gun, maintain the material at the plastic temperature with heat transfer oil or electrical element control led heat.

d. Direct fire heat transfer will not be allowed.

6. The application equipment shall be so constructed as to insure continuous uniformity in the dimensions of the stripe.

   a. The applicator shall provide a means for cleanly cutting of square stripe ends and shall provide a method of applying "skip" lines.

   b. The use of pans, aprons, or similar appliances, which the die overruns, will not be permitted.

7. Glass spheres applied to the surface of the completed stripe shall be applied by an automatic bead dispenser attached to the striping machine in such a manner that the beads are dispensed almost instantaneously upon the installed line.

8. Special kettle(s) shall be provided for melting and heating the thermoplastic material.

   a. The kettle(s) shall be equipped with automatic thermostatic control devices in order to provide uniform temperature control and prevent overheating of the material.

   b. The applicator and kettle(s) must be so equipped and arranged as to satisfy the requirements of the National Fire Underwriters, the State of Florida and Okeechobee County.

9. Applicators shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

   a. The applicator equipment to be used on roadway installations shall consist of either hand equipment or truck mounted units depending on the type of marking required.

10. The hand applicator equipment shall be insulated and shall have sufficient capacity to hold one hundred and fifty (150) pounds of molten material and shall be sufficiently maneuverable to install crosswalks; lane, edge and center lines; arrows and legends.

    a. The truck mounted unit for lane, edge, and center lines shall consist of a mobile self contained unit carrying its own material capable of operating at a minimum speed of five (5) miles per hour while installing striping.

11. Application time, weather limitations and surface preparation shall be in accordance with D.O.T. Specifications, Sections 710-4, 710-5 and 710-8.

12. The material, when formed into traffic stripes or other markings must be readily renewable by placing an overlay of new material directly over an old line of compatible material in such a manner that no splitting or separation takes place.

13. The application temperature shall be within the range specified by the manufacturer of the thermoplastic compound being used.

14. All pavement edge lines, gore, island and diagonal strip markings, bike lane symbols and messages, wherever located, shall have a minimum thickness of 0.060 inch at the edges and a maximum thickness of 0.120 inch at the center.

    a. A minimum average film thickness of 0.060 inch shall be maintained.

    b. Lane lines, center lines, transverse markings (except shoulder markings), and pavement markings within traffic wearing area (such as dotted turning guide lines) shall have a minimum thickness of 0.090 inch at the edges and a maximum thickness of 0.188 inch at the center.

    c. A minimum average film thickness of 0.090 shall be maintained.

    d. Thickness measurements shall be an average in over a three (3) foot length.

15. The glass sphere top coating shall be applied by a type of glass sphere dispenser or gun, which will embed the spheres into the line surface to at least one-half their diameter.

    a. The glass sphere top coating shall not incur more than a ten (10) percent loss during the first thirty (30) days of traffic exposure.

**END OF SECTION**

# SECTION 02769

# REFLECTIVE PAVEMENT MARKERS

## PART 1 GENERAL

1.01 SUMMARY

A. Furnish labor, equipment, and material for installation of reflectorized pavement markers and removing pavement markers at locations designated in the Drawings.

B. The work shall be done in accordance with the contract Specifications and Drawings.

1.02 DEFINITIONS

A. Type 1 Markers shall have amber bi-directional reflective faces.

B. Type 2 Markers shall have bi-directional reflective faces with one face colorless and the other face colored red.

C. Type 3 Markers shall have bi-directional reflective faces with one face colored red and the other face colored amber.

D. Type 4 Markers shall have an amber mono-directional reflective face.

E. Type 5 Markers shall have a colorless mono-directional reflective face.

F. Class A Markers shall meet the specific intensity requirements of 706-2.3.2. without the reflective face treatment.

G. Class B Markers shall meet the specific intensity requirements, 706-2.3.2, after the reflective face has been treated as specified in 706-2.3.3(a).

H. Horizontal entrance angle - the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the marker.

I. Observation angle - the angle at the reflector between the observer’s line of sight and the direction of the light incident on the reflector.

J. Specific intensity - candlepower of the returned light at the chosen observation and entrance angles for each foot-candle of illumination at the reflector on a plane perpendicular to the incident light.

1.03 METHOD OF MEASUREMENT

A. The contract unit price for markers furnished and installed shall include equipment, labor, and material necessary to make a complete and accepted installation.

B. The contract unit price for marker removal shall consist of equipment, material, and labor necessary to remove, pick up and dispose of the marker.

1.04 BASIS OF PAYMENT

A. The contract unit price each for Reflective Pavement Marker and the contract unit price each for Removal of Existing Pavement Markers shall be full compensation for work specified under these items.

1.05 RELATED SECTIONS

A. Submittals - Division 1

**PART 2 PRODUCTS**

2.01 MATERIALS

A. REFLECTIVE MARKERS

1. The marker shall consist of a molded methyl methacrylate or an acrylonitrile butadine styrene (ABS) shell filled with a mixture of an inert thermostatting compound and filler material.

   a. Methyl methacrylate shall conform to the requirements of Federal Specification L-P380C, Type 1, Class 3.

2. The marker shall have a maximum width of five (5) inches and a maximum height of three quarters of an (0.75) inch.

3. The minimum area of each reflective face shall be one and a half (1.50) square inches.

4. The outer surface shall be smooth and corners and edges exposed to traffic shall be rounded.

5. The base shall be substantially free of glass or substances that may reduce their bond to adhesive.

6. Strength Requirements:

   a. Marker General Strength

      1) The marker shall support a minimum load of 2,000 pounds when tested in accordance with a manufacturer-developed test approved by the Department.

      2) Failure shall constitute either breakage or significant deformation of the marker at loads less than or equal to 2,000 pounds.

      3) Should the marker fail, four (4) additional markers shall be tested.

      4) The failure of one of the four (4) markers shall be cause for rejection of the entire lot.

      5) Only Class B Markers shall be subjected to the face strength test.

6) The red reflective face of Type 2 and Type 3 Class B Markers shall not be subjected to the face strength test.

b. Reflective Face Strength:

1) The marker shall be placed in a convection oven at 130°F for one hour.

2) While at the elevated temperature, the face shall be impacted by a 0.2-pound dart fitted with a 0.25-inch radius spherical head falling perpendicularly onto the surface from a height of six (6) inches.

3) The impact area shall exhibit only concentric cracks.

4) Failure shall constitute radial cracks along the area.

7. Optical Requirements:

a. Specific Intensity:

1) The specific intensity of each colorless reflective face of the marker at 0.2 degree observation angle shall not be less than the following when:

a) The incident light is parallel to the base of the marker,

b) The reflective face has been subjected to the optical testing procedure specified

| Horizontal Entrance Angle | Specific Intensity |
|---|---|
| 0 Degree | 3.0 |
| 20 Degree | 1.2 |

2) The specific intensity of amber reflective faces shall be equal to or greater than sixty (60) percent of the value for colorless faces.

3) The specific intensity of red reflective faces shall be equal to or greater than twenty (20) percent of the value for colorless faces.

4) The specific intensity of blue reflective faces shall be equal to or greater than Ten (10) percent of the value for colorless faces.

c. Optical Testing Procedure*:*

1) Reflective Face Treatment for Class B Markers:

a) The reflective face of Class B Markers shall be prepared in accordance with the following procedure prior to measuring the specific intensity.

(1) A pad one (1) inch in diameter shall be formed from No. 3 coarse steel wool, which conforms with Federal Specification FF-W-1825.

(2) The steel wool pad shall be placed on the reflective face.

(3) The entire reflective face shall be rubbed 100 times with an applied load of 50 pounds.

b) For Type 2 and 3 Markers, the red reflective faces shall not be subjected to the testing preparation procedure.

d. Optical Measurements:

1) The markers to be tested shall be located with the center of the reflecting face at a distance of five feet from a uniformly bright source having an effective diameter of 0.2 inch.

2) The photocell width shall be 0.5 inch.

3) It shall be shielded to eliminate stray light.

4) The distance from light source center to the photocell center shall be 0.21 inch.

5) If a test distance other than five (5) feet is used, the source and receiver dimensions and the distance between source and receiver shall be modified in the same proportion as the test distance.

6) A random sample of five (5) markers will constitute a representative sample for a lot.

7) If more than one marker fails the initial test, a new sample (five (5) markers) may be tested.

8) Failure of more than one marker in the retest shall be cause for rejection of the entire lot.

B. ADHESIVE

1. General Requirements:

a. Bituminous adhesive as recommended by the marker manufacturer shall be used for bonding the markers to the pavement.

b. The adhesive used shall be one of the products included on the Qualified Products List, current at the time of the adhesive proposal for use.

2. Specific Requirements for Bituminous Adhesive:

a. The adhesive shall be material suitable for bonding pavement markers to portland cement concrete pavement, not to be used with bituminous

pavement and chip-sealed surfaces when the road surface and marker temperatures are in the range of 50°F to 160°F.

b. The composition of the adhesive must not deteriorate when heated to and applied at temperatures up to 425°F using either air or oil-jacketed melters.

c. The adhesive shall be packaged in self-releasing cardboard containers with essentially flat and parallel top and bottom surfaces allowing the packages to be stack properly.

d. Each package shall have a net weight of either fifty (50) or sixty (60) pounds and shall weigh within two (2) pounds of the stated quantity.

e. Self-releasing cardboard dividers which will separate each package into sections weighing no more than fifteen (15) pounds each shall be part of the packaging.

f. Each package shall show the manufacturer's name, net weight, and lot or batch number and shall be printed with "Bituminous Adhesive for Pavement Markers" or similar wording identifying the contents.

g. The adhesive will be tentatively accepted by a manufacturer's certified test report.

h. The certified test report shall show the test results and shall state that the adhesive represented by the test results meets the requirements of the specifications and has the properties and characteristics as herein specified.

i. Furnish six copies of the test report to the State Materials ENGINEER.

j. Each certification shall also contain a Material Safety Data Sheet.

k. Standard Type:

1) The asphaltic material and mineral filler shall comply with the following requirements:

2) Adhesive Properties:

| | Minimum | Maximum | Method |
|---|---|---|---|
| Softening Point, °F | 200 | - | ASTM D 36 |
| Penetration | 10 | 20 | ASTM D 5 |
| Flow, inches | - | 0.2 | ASTM D 3407 |
| Viscosity, 400°F, Poises | - | 75 | ASTM D 2669 |
| Flash Point, C. O. C., °F | 550 | - | ASTM D 92 |

3) Asphalt properties determined on the filler-free material derived from the extraction and Abson recovery process as explained in Test Methods.

| | Minimum | Maximum | Method Penetration, 100 g |
|---|---|---|---|
| 5 Second, 77°F | 25 | - | ASTM D 5 |
| Viscosity, 275°F, Poises | 12 | - | ASTM D 2171 |

4) Filler properties determined using the filler separation technique described in test methods.

| | Minimum | Maximum | Method |
|---|---|---|---|
| Filler Content, Percent by Weight | 50 | 75 | 5) |
| Filler Fineness Percent passing: | | | ASTM C430 |
| Sieve No.100 | 100 | | |
| Sieve No.200 | 95 | | |
| Sieve No.325 | 75 | | |

5) Filler material:

a) Shall be separated from the asphalt to determine filler content and filler fineness.

b) The portion of the adhesive insoluble in 1,1,1-trichloroethane shall be considered the filler content.

c) Filler content shall be determined by weighing 10.00 $\pm$ 0.01 grams of solid adhesive into centrifuge flask with approximately one hundred (100) ml volume as specified in ASTM D 1796.

d) Add fifty (50) ml of 1,1,1-trichloroethane to the adhesive, which should be broken up into small pieces in order to speed the dissolution process.

e) Swirl or stir with a fine rod, taking care not to lose solids.

f) Place the sample flask in a balanced centrifuge and spin using a minimum relative centrifugal force of one hundred and fifty (150) (as determined in Section 6 of ASTM D 1796) for ten (10) minutes.

g) Remove the sample flask and decant the solvent, taking care not to lose solids.

h) Repeat the application of solvent and centrifuging until the solvent becomes clear and the filler is visually free of asphalt.

i) Dry the filler at 160 ± 5°F to remove solvent and weigh the resulting filler.

j) Filtration of the decanted solvent may be performed to verify there is no loss of filler.

k) Percent filler content is calculated as follows:

$$\text{FILLER CONTENT (Percent by Weight)} = \frac{\text{FILLER WEIGHT (grams)} * 100}{\text{ORIGINAL ADHESIVE WEIGHT (grams)}}$$

3. Flexible Adhesive:

a. The hot applied flexible pavement marker adhesive shall be a hot melt thermoplastic material capable of bonding the marker without excessive marker movement at hot summer temperatures and remain flexible at winter temperatures.

b. The adhesive shall comply with the following physical requirements when melted in accordance with ASTM D 3407 and poured into suitable test molds:

| | |
|---|---|
| Penetration, 77°F (ASTM D 5) | 25 Max. |
| Softening Point (ASTM D 2398). | 200°F Min. |
| Brookfield Viscosity, 400°F (ASTM D 3236) | 10,000 cp Max. |
| Ductility at 77°F, 5 cm/min (ASTM D 113) | 15 cm Min. |
| Ductility at 39.2°F, 1 cm/min (ASTM D 3407) | 5 cm Min. |
| Asphalt Compatibility (ASTM D 3407) | Pass |

c. Thermoplastic striping materials are not suitable for this specification.

## PART 3 EXECUTION

3.01 INSTALLATION

A. Placement of the markers shall be in accordance with the Traffic Operations Standards unless otherwise specified.

B. The portion of the pavement surface or thermoplastic marking to which the marker is attached by the adhesive shall be cleaned of dirt, curing compound, grease, oil, moisture, loose or unsound pavement and other material which would adversely affect the adhesive.

C. Reflective markers shall be installed in a manner that the reflective face of the marker is perpendicular to a line parallel to the roadway centerline.

D. No markers shall be installed over longitudinal or transverse joints of the pavement surface.

E. The adhesive shall be spread on the bonding surface (not the marker) so that 100 percent of the bonding area of the marker will be covered.

F. The adhesive application shall be of sufficient thickness so that when the marker is pressed into the adhesive, excess adhesive shall be forced out around the entire perimeter of the marker.

G. Excessive adhesive shall be removed from in front of the reflective faces.

H. If adhesive or foreign matter adheres to the reflective face of the marker, the marker shall be replaced.

I. The marker shall be protected against impact until the adhesive has hardened.

J. The ENGINEER shall determine the minimum time necessary to cure the adhesive for sufficient set to bear traffic.

K. Specific Installation Requirements Utilizing Bituminous Adhesive:

1. The markers may be cemented to the pavement with a bituminous adhesive conforming to this specification.

2. The markers shall be installed when the pavement is dry and the pavement temperature is no less than fifty (50°) F, and no more than one hundred and sixty (160°) F.

3. The portion of the highway surface to which the marker is to be bonded by the adhesive shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint or other material which would adversely affect the bond of the adhesive.

4. Cleaning shall be done by blast cleaning on portland cement concrete and old bituminous pavements.

5. New bituminous pavement that is clean need not be blast-cleaned unless the surface contains an abnormal amount of asphalt or the surface is contaminated with dirt, grease, paint, oil or other material which would adversely affect the bond of the adhesive.

6. The bituminous adhesive shall be melted and heated in either thermostatically controlled double boiler type units utilizing heat transfer oil or thermostatically controlled electric heating pots.

7. Direct flame melting units shall not be used with flexible adhesives, but may be used with standard adhesive in accordance with manufacturer's recommendations.

8. The melter/applicator unit shall be suited for both melting and pumping application through heated applicator hoses.

9. The adhesive shall be heated to between 375 and 425°F and applied directly to the pavement surface from the melter/applicator by either pumping or pouring.

10. It is important that application temperature be maintained between 375 and 425°F as lower temperatures may result in decreased adhesion while higher temperatures may damage the adhesive.

11. Sufficient adhesive shall be used to insure total contact with the bottom of the marker.

12. Markers shall be applied to the adhesive immediately (within ten (10) seconds) to assure bonding.
13. The marker shall be placed in position by applying downward pressure until the marker is firmly seated with the required adhesive thickness and squeeze out.

14. Excessive adhesive squeeze out shall be removed from the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed.

15. Soft rags moistened with mineral spirits conforming to Federal Specifications TT-T-291 or kerosene may be used if necessary, to remove adhesive from exposed faces of pavement markers.

16. No other solvent may be used.

17. The adhesive may be reheated and reused.

18. The pot life at application temperatures shall not exceed manufacturer's recommendations.

19. Clean out of equipment and tanks may be performed using petroleum solvents as diesel fuel or similar materials.

20. Solvent must be removed from the equipment tanks and lines before the next use of the melter.

3.02 FIELD QUALITY CONTROL

A. In the event that more than two (2%) percent of the markers fail in adhesion within the first forty-five (45) days under the traffic, replace failed markers at CONTRACTOR'S expense.

B. If more than five percent of the markers fail in adhesion during the initial forty-five (45) day period, the replacement period shall be extended an additional forty-five (45) days from the date that replacement markers have been installed.

C. If, at the end of the additional forty-five (45) day period, more than two percent of markers (initial installation and forty-five (45) day replacements combined) fail in adhesion, replace failed markers at CONTRACTOR'S expense.

**END OF SECTION**

# SECTION 02773

# CEMENT CONCRETE GUTTERS AND CURBS

## PART 1 GENERAL

1.01 SUMMARY

A. Furnish labor, equipment, and material required for cutting, removing, protecting, and replacing existing concrete curb and gutter of the various types encountered, removed or damaged under this Contract.

B. Provide damage protection for adjacent concrete driveways, sidewalks and curb and gutter within the work area.

1.02 PAYMENT

A. If payment items have not been established in the Proposal for the removal and replacement of concrete curb and gutter, the cost for this work shall be included in the overall Project cost bid.

B. No other compensation will be provided.

1.03 RELATED SECTIONS

A. Concrete Division - 3

B. Reinforced Cement Concrete Pavement Division - 2

## PART 2 PRODUCTS

2.01 CONCRETE

A. Concrete shall conform to the applicable provisions specified in Division 3 of these Contract Documents.

## PART 3 EXECUTION

3.01 CURB AND GUTTER

A. Restore curb and gutter in lengths equal to trench width plus two (2) feet (shoulders), or ten (10) feet, whichever is greater, unless otherwise permitted or ordered by the ENGINEER.

B. Removal of existing curb and gutter, installation of forms, preparation of subgrade, and perform the final finish as specified for driveways.

C. Match the shape and final finish of the existing curb and gutter.

**END OF SECTION**

SECTION 02821

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SUMMARY

A. Furnish and install fencing indicated on the Contract Drawings.

B. Temporary installation and removal of fencing as required for the construction performed under this Contract.

1.02 SUBMITTALS

A. Furnish shop drawings for the materials, construction and installation of the fence in accordance with the Special Conditions.

1.03 RELATED SECTIONS

A. Cast-in-Place Concrete Division - 3

1.04 REFERENCES

A. ASTM A 491

B. ASTM A 153

C. ASTM C 150

D. ASTM C 33

PART 2 PRODUCTS

2.01 MATERIALS

A. Fabric

1. Use galvanized steel fabric No. 9 gauge wire woven in a two (2) inch mesh.

2. Provide fabric conforming to ASTM A 491.

B. Framework

1. Provide hot dipped galvanized steel posts and other appurtenances used in the construction of fence with a minimum of 1.8 ounces per square foot of surface.

2. Sizes referred to are nominal O. D. as commonly used in the trade.

C. Line Posts

1. Provide 2 1/2 inch O. D., hot dipped galvanized steel, and weight 3.65 pounds per lineal foot Intermediate line posts.

2. Crown posts without arms to shed water.

D. Terminal Posts

1. Provide 3 inch O. D, hot dipped galvanized steel, and weight 5.79 pounds per lineal foot end and corner posts.

2. Crown posts without arms to shed water.

E. Swing Gate Posts

1. Provide 4 inch O. D., hot dipped galvanized steel, and weight 9.1 pounds per lineal foot swing gate posts.

F. Bottom Wire

1. Provide seven (7) gauge coil spring galvanized steel bottom tension wire.

2. Stretch tension wire taut from terminal to terminal post and securely fastened to each inter-mediate post six (6) inches above the grade line.

3. Attach tension wire to the fence fabric with galvanized steel hog rings every twelve (12) inches.

G. Line and Corner Post Arms

1. Equip line and corner posts with outside drive on type heavy galvanized malleable iron 45 degree barb wire arms with set screw to exclude moisture.

2. Intermediate line post tops to be one piece galvanized steel, outside sleeve type, and to facilitate passage of top rail through same.

H. Top Rail

1. Provide 1 5/8 inch O. D., hot dipped galvanized steel, and weight 2.27 pounds per lineal foot rails.

2. Provide outside type six (6) inch long couplings and joined at approximate twenty (20) feet intervals top rails.

3. The top rail is to pass through line post tops to form a continuous brace end to end of each stretch of fence.

I. Braces

1. Make brace pipe the same as top rail and install midway between the top rail and ground and extend from the terminal post to the first adjacent line post.

2. Securely fastened brace pipe to posts with malleable iron rail end cap and have beveled edge pressed steel brace band with bolt, then trussed from line post to base of terminal post with a 3/8 inch truss rod and tightener.

3. On runs of fence requiring two (2) line post or less, omit truss rod assembly and install a continuous center brace rail.

J. Miscellaneous Hardware

1. Provide steel, malleable iron, or ductile iron: stops, latches, keepers, post caps, barb wire supporting arms, fasteners, and hardware.

2. Provide hot dip galvanizing after fabrication, using zinc grade E, in accordance with Federal Specification QQ-2-Z-51 with a minimum of 1.2 ounces of zinc per square foot of surface.

K. Gate Hardware

1. Provide galvanized finish conforming to ASTM A 153.

2. Size hinges and the material must suit the gate size, non-lift-off type, offset to permit 180 degree gate opening; 1-1/2 pairs.

3. Use forked type or plunger-bar type latch to permit operation from either side of the gate, with padlock eye as an integral part of the latch.

4. Use mushroom type gate stops flush plates with anchors, set in concrete, and designed to engage center drop rod or plunger-bar.

    a. Include locking device and padlock eyes as an integral part of the latch, permitting both gate leaves to be locked with a single padlock.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Evenly space posts in the line of fence at a maximum of ten (10) feet on center.

B. Provide professional installation with skilled mechanics experienced in erection of this type of fence.

C. Erect the fence on line and to grade as shown in the Drawings.

D. Set posts in concrete foundations in the ground to a minimum of four (4) times the diameter of the post.

E. Provide Portland cement, ASTM C 150, aggregates ASTM C 33, Cast-In Place Concrete.

1. Mix material to obtain concrete with a minimum twenty-eight (28) day compressive strength of 2500 psi.

2. Use at least four (4) sacks of cement per cubic yard, one (1) inch maximum aggregate size, and clean water.

2. Achieve a maximum three (3) inch slump and two (2) to four (4) percent entrained air.

3. The exposed surface of the concrete shall be crowned to shed water.

### 3.02 FABRIC FASTENING

A. Fabric to be stretched taut from terminal to terminal and secured to same with a heavy galvanized 3/4-inch tension bar and heavy beveled edge tension band with bolts, one (1) band less than the height of fence.

B. Fasten chain link fabric to rails, intermediate posts with a No. 6 gauge galvanized steel tie a maximum of fourteen (14) inch on center.

C. The tie ends to be wrapped on it's own end a minimum of two (2) times and turned in to eliminate hazardous condition.

3.03 REMOVAL OF EXISTING FENCING

A. Remove existing fencing as shown in the Drawings.

B. Removed fencing shall remain property of the OWNER, unless otherwise noted.

3.04 CLEANUP

A. Upon completion of the installation, remove debris created by the installation from the premises of the OWNER or disposed of as directed by the OWNER.

END OF SECTION

SECTION 02916

MULCHING

PART 1 GENERAL

1.01 SUMMARY

A. Furnishing labor, equipment, and material needed to provide finished grass ground cover by the placing and spreading of mulching.

1.02 RELATED SECTIONS

A. Clearing and Grubbing - Division 2.

B. Topsoil - Division 2.

C. Earthwork - Division 2.

D. Seeding and Supplements - Division 2.

1.03 REFERENCES

A. Standards - Federal Specifications (FS) 0-F-241C.

B. Testing Agency - Independent testing laboratory.

C. Requirements of Regulating Agencies - Comply with requirements of the State Department of Agriculture.

D. Source Quality Control - Producer's tests for purity and germination of seed, dated within nine months of sowing.

E. Cost of Testing - The testing is at expense of the CONTRACTOR.

1.04 SUBMITTALS

A. Test Report - Results of seed purity and germination tests.

B. Certificates - Manufacturer's certification that materials meet specification requirements.

1.05 MEASUREMENT AND PAYMENT

A. Payment for mulching shall be for areas of completed grass cover that have been accepted by the ENGINEER as field measured.

B. Payment will be made at the unit price bid for mulching, which price and payment shall constitute full compensation for furnishing materials and performing work in connection therewith and incidental thereto.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 CONDITIONS

A. Check that preceding work affecting ground surface is completed.

B. Do not start work until conditions are satisfactory.

3.02 APPLICATION

A. See seeding and soil supplements - Division 2.

END OF SECTION

SECTION 02919

TOPSOIL

PART 1 GENERAL

1.01 SUMMARY

A. The work covered by this section consists of furnishing labor, equipment, and material needed to provide finished grass ground cover by the placing and spreading of topsoil.

1.02 RELATED SECTIONS

A. Clearing and Grubbing - Division 2.

B. Mulching - Division 2.

C. Earthwork - Division 2.

D. Seeding and Soil Supplements - Division 2.

1.03 REFERENCES

A. Standards - Federal Specifications (FS) 0-F-241C.

B. Testing Agency - Independent testing laboratory.

C. Requirements of Regulating Agencies - Comply with requirements of the State Department of Agriculture.

D. Cost of Testing - The testing is at expense of the CONTRACTOR.

1.04 SUBMITTALS

A. Test Report - Results of seed purity and germination tests.

B. Certificates - Manufacturer's certification that materials meet specification requirements.

1.05 MEASUREMENT AND PAYMENT

A. Payment will be made at the unit price bid for topsoil, which price and payment shall constitute full compensation for furnishing materials and performing work in connection therewith and incidental thereto.

## PART 2 PRODUCTS

### 2.01 WATER

A. Free or matter harmful to plant growth.

### 2.02 TOPSOIL

A. Material used for topsoil shall be material supplied by CONTRACTOR from off-site sources or from excavated pond bottom area if suitable for this use.

B. Topsoil mixture shall be suitable for plant growth and free from hard clods, stiff clay, hardpan, gravel, brush, large roots, refuse or other deleterious material, and shall be of reasonably uniform quality.

C. Rocks larger than 1 inch in diameter shall be removed.

D. Organic content as determined in accordance with AASHTOT 194 shall be at least five percent (5%) and the pH shall be between 5.0 and 7.0.

## PART 3 EXECUTION

### 3.01 CONDITIONS

A. Check that preceding work affecting ground surface is completed.

B. Do not start work until conditions are satisfactory.

### 3.02 PREPARATION

A. Stockpiled topsoil shall be spread to a thickness of two (2) inches over areas to be seeded.

1. The resulting ground elevation shall be the proposed finished grade shown in the Drawing.

B. Till fertilizer into top two (2) inches of soil at rate of 12-lbs/1000 sq. ft.

C. Water dry topsoil to depth of five (5) inches at least forty eight (48) hours prior to seeding to obtain a loose friable seed bed.

END OF SECTION

SECTION 02923

SEEDING AND SOIL SUPPLEMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Furnishing labor, equipment, and material needed to provide finished grass ground cover by the placing and spreading of seeding.

1.02 RELATED SECTIONS

A. Clearing and Grubbing - Division 2.

B. Mulching - Division 2.

C. Earthwork - Section 2.

D. Top Soil - Division 2.

1.03 REFERENCES

A. Standards - Federal Specifications (FS) 0-F-241C.

B. Testing Agency - Independent testing laboratory.

C. Requirements of Regulating Agencies - Comply with requirements of the State Department of Agriculture.

D. Source Quality Control - Producer's tests for purity and germination of seed, dated within nine months of sowing.

E. Cost of Testing - The testing is at expense of the CONTRACTOR.

F. Fertilizers - Mixed, Commercial.

1.04 SUBMITTALS

A. Test Report - Results of seed purity and germination tests.

B. Certificates - Manufacturer's certification that materials meet specification requirements.

1.05 MEASUREMENT AND PAYMENT

A. Payment for seeding shall be for areas of completed grass cover that have been accepted by the ENGINEER as field measured.

B. Payment will be made at the unit price bid for seeding, which price and payment shall constitute full compensation for furnishing materials and performing work in connection therewith and incidental thereto.

PART 2 PRODUCTS

2.01 SEED

A. Species - Equal parts of Pensacola Bahia and Gulf improved rye.

B. Clean, dry, new crop seed, dry remixed immediately prior to sowing.

2.02 WATER

A. Free or matter harmful to plant growth.

2.03 SOIL STERILIZERS

A. As recommended by State and Local Agricultural Agencies.

2.04 FERTILIZER

A. FS O-F-241, Type 1, Grade A or B.

B. The chemical designation shall be 12-8-8, with at least fifty percent (50%) of the nitrogen from a non-water soluble organic source.

PART 3 EXECUTION

3.01 CONDITIONS

A. Check that preceding work affecting ground surface is completed.

B. Do not start work until conditions are satisfactory.

C. Do not perform seeding when wind exceeds fifteen (15) mph.

D. Seed during times acceptable to the ENGINEER.

3.02 PREPARATION

A. Apply a soil sterilizer to topsoil per manufacturer's direction.

1. Seeding shall not commence until after the proper time recommended by the manufacturer.

B. Till fertilizer into top two (2) inches of soil at rate of 12-lbs/1000 sq. ft.

C. Water dry topsoil to depth of five (5) inches at least forty eight (48) hours prior to seeding to obtain a loose friable seed bed.

3.03 APPLICATION

A. Broadcast half of seed with mechanical seeder.

B. Broadcast remaining half of seed at right angles to first seeding pattern, using same broadcast method.

C. Apply seed at 10-lbs./1000 sq. ft.

D. Cover seed to depth of one-eighth (1/8) inch by racking, harrowing, and cultivating.

E. Roll seeded area with roller weighing maximum of 150 lbs./ft. of width.

1. Make two (2) passes.

F. Spread mulch uniformly to completely cover seeded area.

G. Water seeded areas to depth of six (6) inches immediately after seeding/rolling operations.

3.04 PROTECTION

A. Immediately after seeding, erect barricades and warning signs as necessary to protect seeded areas from foot and vehicular traffic until grass is established.

3.05 ESTABLISHMENT

A. Watering

1. Keep soil moist during seed germination period.

2. Supplement rainfall to produce total of two (2) inches per week after germination.

B. Reseed and mulch spots larger than one (1) sq. ft. not having uniform stand of grass.

C. Establishment period to extend until acceptance by the OWNER.

3.06 CLEAN-UP

A. Remove trash and excess materials from project site.

B. Maintain paved areas in clean condition.

C. Remove barriers and signs from project site at termination of establishment period.

3.07 FINAL INSPECTION AND ACCEPTANCE

A. Request final inspection as the area is completed and grass is established.

B. Reseed rejected grass area within two (2) weeks after the inspection or as otherwise directed by the ENGINEER.

END OF SECTION

SECTION 02924

SODDING

PART 1 GENERAL

1.01 SUMMARY

A. Repair lawns and grassed rights of way damaged or removed during the construction of the pump station.

1.02 RELATED WORK

A. Clearing and Grubbing - Division 2.

B. Earthwork - Section 2.

C. Top Soil - Division 2.

1.03 REFERENCES

A. Federal Specification (FS) 0-F-241q (1), Fertilizer Mixed, Commercial.

B. Materials shall conform to the requirements established by the State Department of Agriculture.

1.04 SUBMITTALS

A. Growers Certification:

1. Grass species.

2. Compliance with State and Federal quarantine restrictions.

B. Manufacturer’s certification of fertilizer and herbicide composition and application rates.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver sod on pallets.

B. Protect roots from exposure to wind and sun.

C. Protect sod against dehydration, contamination and heating during transportation and delivery.

D. Do not deliver more sod than can be installed within twenty-four (24) hours.

E. Keep stored sod moist and under shade or covered with moistened burlap.

F. Do not stack sod more than two (2) feet deep.

G. Do not tear, stretch, or drop sod.

1.07 WARRANTY

A. Guarantee sod for period of three (3) months after date of substantial completion.

B. Repair damage to other plants during sod replacement at no cost to the OWNER.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sod

1. Grass Species is to be Stenotaphrum secundatum - St. Augustine “Floratam”, or approved equal.

2. American Sod Producers Association (ASPA) Grade

   a. Use nursery grown or approved equal sod.

3. Furnish sod in pads of the following dimensions:

   a. Length: twenty-four (24) inches plus or minus five (5) percent

   b. Width: sixteen (16) inches plus or minus five (5) percent

   c. Thickness: 1-1/2 inches excluding top growth and thatch.

4. Grow sod in organic “muck” soil, with minimum 1-inch soil intact on roots.

5. Mow sod to a uniform height of 2- 1/2 inches, when harvested.

6. Thatch: Maximum 1/2-inches uncompressed.

7. Use diseases free sod: entomologist of the State Department of Agriculture must inspect for nematodes, pests, and pest larvae.

8. Weeds: Free of Bermuda grass, nut grass, and other objectionable plant and material.

9. Uniform in color, leaf texture and density.

B. WATER

1. Free of substances harmful to plant growth. Free from chemicals or minerals that stain or discolor.

C. FERTILIZER

1. Federal Specification (FS) O-F-241 c (1), Grade A or 8.

2. The chemical designation shall be 16-4-8, with at least fifty (50) percent of the nitrogen from a non-water-soluble organic source.

D. HERBICIDES

1. As approved by the State of Department of Agriculture.

E. TOPSOIL

1. Topsoil mixture shall be suitable for plant growth.

2. Topsoil mixture shall be free from hard clods, stiff clay, hardpan, gravel, brush, large roots, refuse, or other deleterious material and of reasonable uniform quality.

3. Maximum Soluble Salts: 550 ppm

4. Top soil mixture shall be free of weeds, plants, seeds, insects, and undesirable materials, before delivery to the site.

a. Sterilization of topsoil shall not affect viability of new plant growth in treated topsoil.

## PART 3 EXECUTION

### 3.01 SURFACE PREPARATION

A. Wet surface to a uniform depth of two (2) to three (3) inches or until upper surface is reasonable wet and compacted before installing sod.

B. Roll soil with 100 lb. roller; make two (2) passes.

### 3.02 INSTALLATION

A. Verify topsoil placement.

B. Install sod species as specified herein.

C. Locate trees and palms and paint a forty-eight (48) inch diameter circle on the soil around the trunk of each species planted in sodded areas.

    1. Do not install sod within painted circle.

D. Begin sodding at bottom of slopes and install parallel to contours.

E. Lay first row of sod in straight line with long dimension of pads parallel to slope contours; continue laying sod accordingly.

F. Butt side and end joints flush and tight.

    1. Do not allow ends to curl or break.

G. Stagger end joints in adjacent rows.

    1. Do not stretch or overlap sod.

H. Peg sod on slopes with a ratio of 1:3 (rise:run) or greater using a minimum of two stakes per square yard, using six (6) inches minimum nursery grade bamboo stakes.

I. Sod installed adjacent to planting beds should be a minimum distance from the first row of shrubs, equal half the spacing of the shrubs (Example: shrubs spaced eighteen (18) inches on center - sod should be nine (9) inches from center of shrub).

J. Trim sod to provide clean edges for trees and planting beds; sod should follow planting beds to provide clean, smooth, and flowing lines.

K. Water sod immediately after transplanting.

L. Roll sod, except on pegged areas, with roller weighing not more than 100 lbs. per foot of roller width; make two (2) passes.

M. Water sod and soil to depth of six (6) inches within four (4) hours after rolling.

N. Cut a forty-eight (48) inch diameter, clean round saucer around each tree or palm planted in sodded areas to provide for mulch.

    1. Do not injure root ball or cut sprinkler or utility lines.

3.03 SOD ESTABLISHMENT

A. Watering:

1. Keep sod moist during first week after planting.

2. After first week, supplement rainfall to produce total of one (1) inch per day until sod has acclimated.

B. Weed Eradication: maintain grass in a weed free condition until OWNER acceptance.

C. Fertilizer: Apply fertilizer uniformly at manufacturer's recommended rate, two weeks after sod installation.

1. Fertilizer should be dispensed using lightweight spreaders.

D. Maintenance period to extend until acceptance of the OWNER.

3.04 CLEANING

A. Immediately clean spills from paved and finished surface areas.

B. Remove debris and excess materials from project site.

3.05 FINAL INSPECTIONS

A. Project final payment approval determines OWNER acceptance.

B. Replace rejected sod areas with acceptable sod within two weeks after the inspection.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK AND ACCESSORIES

## Part 1 GENERAL

### 1.01 SUMMARY

A. Furnish equipment, materials, and labor required for construction and removal of forms for the containment of concrete to be cast in place, as shown in the Drawings or as required for the completion of the project.

B. Provide equipment, materials, and labor required for joints in concrete, chamfer strips, and accessories as required for a complete installation as indicated in the Drawings and Specifications.

### 1.02 RELATED SECTION

A. General Conditions - Bidding and Contract Requirement

B. Site Work - Division 2.

C. Submittals - Division 2.

### 1.03 REFERENCES

A. The following codes and standards shall govern workmanship and materials unless modified more stringently in the Drawings and Specifications.

1. The Florida Building Code (latest edition).

2. ACI - 301 "Specifications for Structural Concrete for Buildings" (latest edition) is part of these specifications.

## PART 2 PRODUCTS

### 2.01 WOOD FORM MATERIAL

A. Formwork shall conform to standards of ACI 301 and 347, unless otherwise noted.

B. Lumber shall have a minimum moisture content of nineteen (19%) percent.

C. Members that have bows, twists, knots, or other defects, which make it unsuitable for the intended purpose, shall be rejected.

1. Plywood shall be exterior DFPA, three-quarter (3/4) inch minimum thickness, with faces in good condition.

2. Lumber shall be #2 short leaf Southern Pine.

    a. Beam bottom forms shall be one and one-half (1-1/2) inch minimum thickness.

3. Rough hardware shall be galvanized including bolts, anchors, nails, plates, and inserts.

    a. Bolts shall be of this size and length as detailed and shall be three quarter (3/4) inch minimum diameter where not detailed.

    b. Bolts shall be provided with washers.

4. Ties shall be "snap" type, or threaded end, completely removable or other approved type.

2.02 FORM ACCESSORIES

A. Form accessories shall be of a commercially manufactured type.

1. Form ties shall be so constructed that the ends, or end fasteners, can be removed without causing appreciable spalling at the faces of the concrete.

2. After ends, or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 inches from the formed face of the concrete that is exposed to wastewater or closed surfaces above the wastewater and not less that 3/4 inch from the formed face of other concrete.

3. Form ties in walls designed to retain liquids shall be provided with a water seal at mid-thickness of the wall.

2.03 CHAMFER STRIPS

A. Chamfer strips shall be polyvinyl strips designed to be nailed in the forms to provide a 3/4-inch chamfer at exposed edges of beams and interior rectilinear structural columns.

1. Chamfer strips shall not be used at corners of walls.

2.04 EXPANSION JOINT MATERIAL

A. Expansion joint filler shall be of closed cell Neoprene type, conforming to ASTM 1056, Type 1040 as manufactured by Williams Products, Inc., Troy, Michigan, or equal.

2.05 FORM COATING

A. Form coating shall be a coating that will effectively prevent absorption of moisture and prevent bond with concrete and will not stain concrete surfaces and shall be compatible with paint systems specified in Paint - Division 9.

2.06 WATERSTOPS

A. All joints subject to, or likely to be subject to internal or external liquid pressure shall have waterstops installed.

1. Plastic waterstops shall be manufactured from virgin polyvinyl chloride and shall not contain scrap or reclaimed material.

2. Properties of the PVC used shall conform to U.S. Army Corps of Engineers Specification CRD C572.

3. Waterstops shall be serrated type with a center hollow bulb.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. Forms shall be installed true to line and dimensions with snap ties and supports to maintain them in position, without bows or bulging during pouring, vibrating, and curing the concrete.

B. Dimensional tolerances of formwork shall be designed and installed assuring that the finished concrete will comply with dimensional tolerances of ACI 301 and the required tolerances to properly accommodate the equipment installation as verified from the manufacturer's shop drawings.

1. Embedded or cast-in anchors or inserts required for the performance of the work shall be furnished and the location carefully supervised.

2. No lumber shall be stored closer than four (4) inches to grade of floors.

a. Lumber stored outside shall be covered with visqueen or other suitable protection on top and sides.

b. Stack so as to allow proper air circulation.

3. Brace, plumb, and level members and secure with sufficient nails, spikes, and bolts to insure rigidity and safety under concrete placement.

    a. No metal to remain within one (1) inch of the surface of the concrete after removal.

    b. Wire ties are not permitted.

4. Unless otherwise indicated in the Drawings, exposed foundation sides and grade beams shall be formed.

    a. Forms shall be properly constructed, correctly aligned and of sufficient strength to retain wet concrete without excessive leaking, deflection or distortion.

    b. Temporary openings shall be provided for cleaning and inspection of the base of vertical forms and other places where necessary.

    c. Where required wood inserts, nailing blocks or other wood to be set in the forms shall be installed in an approved manner.

    d. The inside of the forms shall be coated with an approved form oil, and dampened before the concrete is poured.

5. Wood or metal forms will be required on sides of foundations, walls, and walks.

    a. Joist forms shall be accurately laid out and securely anchored, and shall be carefully handled to insure continued true and accurate pours.

6. Provide and maintain forms and shoring, and apply all applicable safety practices required for their proper use and removal.

7. Concrete on which forms have given way will be replaced or repaired at the discretion of the ENGINEER as soon as forms are removed.

8. The ENGINEER shall be notified at least twenty four (24) hours prior to placing concrete in order that forms and reinforcing steel may be inspected.

9. Masonry installed after concrete - Anchor exterior wall masonry, which is installed after concrete is poured, in one of the two following methods:

    a. Provide one (1) inch deep by three (3) inch wide concrete lugs around perimeter.

b. Provide continuous perimeter dovetail anchor slots for example H + B #305 galvanized steel with matching #303 by five and one-half (5-1/2) inch crimped twelve (12) gauge galvanized steel brick anchors.

1) Anchors shall be spaced not over sixteen (16) inch on-center vertically and forty-eight (48) inch on-center horizontally.

2) These dovetail anchors shall also be used wherever masonry passes in front of concrete columns or beams (interior and exterior).

3) Nail-on anchors will not be accepted.

4) No anchors are required where concrete is poured after masonry.

10. Remove forms and shoring in a manner as to insure the safety of the structure and personnel.

a. No forms or shoring shall be removed until members supported have acquired sufficient strength to support their weights and loads to be imposed thereon, and in no case earlier than seven (7) days

b. Removal of forms - Pinch bars, wrecking bars or other metal tools shall not be placed against as cast concrete finish surfaces to wedge forms loose, only wooden wedges shall be used.

1) Wedging shall be done carefully and gradually.

2) Driving accomplished only by light tapping.

3.02 WATERSTOPS

A. Waterstops shall be continuous PVC waterstops and shall be joined by heating the ends with a thermostatically controlled electric splicing iron as recommended by the manufacturer.

B. The position and shape of the waterstop shall be maintained unchanged before, during, and after the concrete placing operation.

3.03 CONSTRUCTION JOINT

A. The pacing of concrete shall be carried on continuous between construction joints and the work shall be executed so that these joints will occur in the locations designed in the Drawings.

1. If the CONTRACTOR proposes different locations, or additional intermediate construction joints, the CONTRACTOR shall submit to the ENGINEER marked up prints of the CONTRACTOR Drawings showing location, extent, and type of joints proposed.

2. These submittals shall be made well in advance of construction, and the proposed joints shall be incorporated in the work only if the changes are acceptable to the ENGINEER.

3. Submit drawings in accordance with the Special Conditions.

4. Installation of additional intermediate joints shall not relieve the CONTRACTOR of the CONTRACTOR's responsibilities to produce a watertight and/or structurally adequate component.

3.04 EXPANSION JOINTS

A. Reinforcement or other fixed items embedded or bonded into the concrete shall not be run continuously through expansion joins.

1. A neat chamfered edging shall be provided to finish edges around expansion joints.

B. Thoroughly clean expansion joints shall be located a minimum distance of five feet from the corner of intersecting walls, including corners, unless specific requests are formally made and accepted by the ENGINEER.

END OF SECTION

SECTION 03210

REINFORCING STEEL

## PART 1 GENERAL

### 1.01 SUMMARY

A. Furnish equipment, materials, and labor required for the supply, forming, and placement of reinforcing steel as specified in the Drawings or as required for the project.

### 1.02 RELATED SECTIONS

A. General Conditions - Bidding and Contract Requirement

B. General Requirements - Division 1

C. Site Conditions - Division 1

D. Submittals - Division 1

E. Concrete Form Work and Accessories - Division 3

F. Cast in Place Concrete - Division 3

### 1.03 REFERENCES

A. The following codes and standards shall govern workmanship and materials unless modified more stringently in the Drawings and Specifications.

1. The Florida Building Code (latest edition).

2. ACI - 301 "Specifications for Structural Concrete for Buildings" (latest edition) is part of these specifications.

3. Reinforcing shall conform to the requirements of ACI - 301, 315, 80, and 318 (latest editions).

4. Welding certificate conforming to AWS D1.4 - 79.

### 1.04 SUBMITTALS

A. Submit reinforcing steel shop drawings to the ENGINEER for approval.

1. Check and approve steel shop drawings prior to submittal to the ENGINEER.

2. The CONTRACTOR's stamp and signature is required on shop drawings prior to submittal.

1.05 MEASUREMENT AND PAYMENT

A. Measurement and payment will be included in the lump sum prices for the appropriate work items, as shown in the Bid Schedule, as required for those items which price and payment shall constitute full compensation for furnishing materials and performing work in connection herewith and as specified in the scope of work under this section.

1.06 TESTS AND CERTIFICATES

A. The cost of the initial steel testing and subsequent tests during the progress of the work ordered by the ENGINEER shall be paid for by the CONTRACTOR, including retesting of rejected material.

PART 2 PRODUCTS

A. Reinforcing steel shall conform to ASTM A-615 New Domestic Billet, Grade 60.

B. Steel shall have a 305 deformation.

C. Provide clean steel free from loose scale of flake rust or coating that destroys or reduces the bond to the concrete.

1. Keep steel clean until used or wire brushed before placing.

D. Welded Wire Mesh Reinforcement shall be ASTM Specification A-185 and A-82 hot dipped galvanized wire.

E. Metal Accessories - Spacers, ties, chairs, and devices necessary for proper placing, spacing, supporting, and fastening or reinforcement shall be supplied and placed as required by the Manual of Standard Practice for Detailing Concrete Structures (ACI 315-80).

1. Provide plastic coated feet on chairs, spacers, and bolsters.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. Bars shall be accurately fabricated, carefully placed as indicated in the Drawings, securely supported and fastened to prevent movement or displacement during the pouring of the concrete.

B. Placement of reinforcing shall conform to the requirements of "CRSI Recommended Practice for Placing of Reinforcing Bars".

C. Splices shall be in accordance with ACI Code, except liquid retention structures shall conform to requirements shown in the Drawings.

1. Securely wire wall dowels at foundations to the footing steel.

2. Where stub columns are poured (as in the case of stem walls) the dowels shall be of a length sufficient to satisfy requirements of ACI Code and to provide a minimum distance of 36-diameter lap where the main column is joined to the stub column.

3. Place and support mesh by means of chairs or other approved devices, so that it maintains its proper position in the slab during the pouring operations.

D. Size stirrups and column ties for bars designated in the Drawings and fabricate to provide a clearance of 1 1/2 inches between the outside of the tie and the surface of the concrete.

E. Unless shown otherwise in the Drawings, maintain the following minimum concrete cover:

1. Bottom of suspended slabs: 3/4-inch

2. Top of slabs: 1-inch

3. Walls, beams and columns: 2-inches

4. Formed concrete contacting soil: 2-inches

5. Concrete placed against soil: 3-inches

F. See Drawings for special requirements for liquid retention structures.

G. Support column and beam reinforcing from formwork with plastic accessories.

H. Support slab reinforcing on non-metallic slab bolsters.

## 3.02 INSPECTION

A. Notify the ENGINEER of the time when steel will be ready for inspection at least 24 hours in advance.

   1. Allow sufficient time for necessary correction before scheduled pour.

B. Correct incorrect or improperly placed steel and re-inspect by the ENGINEER prior to placing concrete.

C. Place no concrete except where the ENGINEER has inspected and approved the reinforcing steel.

   1. Cost of reinspection shall be paid by the CONTRACTOR.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

## PART 1 GENERAL

### 1.01 SUMMARY

A. Furnish equipment, materials, and labor required for the supply, casting, finishing, curing, and testing of cast-in-place concrete, as specified in the Drawings and Specifications, or as required for the complete project.

### 1.02 RELATED SECTIONS

A. General Conditions - Bidding and Contract Requirement

B. Summary of Work - Division 1

C. Site Conditions - Division 2

D. Concrete Formwork and Accessories - Division 3

E. Reinforcing Steel - Division 3

F. Submittals - Division 1

G. Guarantees - Division 1

### 1.03 REFERENCES

A. The latest edition of the following codes and standards shall govern workmanship and materials, unless modified more stringently herein.

1. The Florida Building Code.

2. ACI 301 "Specifications for Structural Concrete for Buildings" is part of these specifications, except as modified here in or in the Drawings.

    a. Construct concrete decks with a maximum of 1/8-inch deviation using a 10-foot long straightedge placed in any direction on the surface.

3. ACI 211.1, 308, 309, 318, and 347.

    a. The Florida Building Code shall govern where provisions of the ACI conflict.

4. ASTM C33, C94, C143, C150, D544 and D1190-52T.

1.04 MEASUREMENT AND PAYMENT

A. Measurement and payment will be included in the lump sum prices for the appropriate work items, as shown in the Bid Schedule, as required for those items which price and payment shall constitute full compensation for furnishing materials and performing work in connection herewith and as specified in the scope of work under this section.

1.05 TESTS AND CERTIFICATES

A. TESTS

1. Make tests in accordance with the recommendations of ASTM.

    a. Do not exceed maximum concrete slumps as specified above.

    b. Make five cylinders for each test required.

    c. Take samples for the test from the mixer at the 1/4 and 3/4 points in the load.

2. The ENGINEER may order core borings or other special tests during the progress of the work.

3. Removed and replaced at no cost to the CITY concrete failing indicated tests.

4. CONTRACTOR to pay the cost of testing.

    a. Propose a testing agency for approval by the ENGINEER.

B. SLUMP TESTS

1. Perform slump tests in accordance with ASTM C143 (latest edition) by testing agency.

    a. Make tests for each 10 cubic yards, or fraction thereof, of each batch.

    b. In the event the slump exceeds the specified requirements, the batch shall be rejected.

C. AIR TESTS

1. Testing agency shall test the air content of the freshly mixed concrete in accordance with ASTM C231 or C173 (latest edition) for each 10 cubic yards, or fraction thereof, of each batch.

a. In the event the percentage of air content is not within the limits in the specifications for entrained air content, the batch shall be rejected.

D. STRENGTH TESTS

1. Testing agency shall mold 5 specimens for each increment of 50 yards or less of each day's concrete placement, or as directed by the ENGINEER.

a. Maintain records for each specimen as to location, batch, and date.

b. Test specimens - one at 3 days, one at 7 days, two at 28 days, and one at 45 days, if the 28-day tests fail to meet the specified strengths.

2. Cooperate with the ENGINEER or persons employed by the testing agency for testing in making, storing and curing of the test cylinders.

## PART 2 PRODUCTS

### 2.01 CEMENT

A. Use Domestic Portland cement conforming to ASTM C150 (latest edition), Type I, except Type II shall be used for liquid retention structures.

1. Only one domestic brand shall be used throughout the duration of the project.

### 2.02 AGGREGATES

A. Aggregates shall meet the requirements of ASTM C33.

1. Do not use aggregates taken from salt water.

B. Provide clean, hard, sharp, natural sand having a fineness modulus between 2.5 and 3.0 as fine aggregate.

C. Provide clean gravel of crushed stone, graduation no. 57 as coarse aggregates.

### 2.03 WATER

A. Provide potable water, free from deleterious amounts of oils, acids, alkalis, organic matter, or other harmful matter.

## 2.04 EXPANSION MATERIALS

A. Pre-molded joint fillers shall conform to ASTM D544 Type V, equal to Celete 2 "Flexcell", 1/2 inch thick (or as shown in the Drawings), by width as indicated in the details.

B. Cast-in-place expansion materials shall conform to ASTM D1190-52T, equal to Servicised Products Corp., hot-poured Para-Plastic.

## 2.05 SLEEVES, HANGERS AND INSERTS

A. Inserts, hangers, sleeves, anchors, ties, bolts, dowels, thimbles, nailers, ground, or other devices required for the attachment or passage of other work shall be located by the CONTRACTOR from the Drawings in confirmation with the shop drawings or as approved by the ENGINEER.

B. BOLTS

1. Install stainless steel bolts of size and length specified as indicated in the Drawings.

2. Use 3/4-inch minimum size, with washers on both ends, where not indicated.

C. CHASES

1. Form chases with wood or metal forms or sleeves.

2. Remove wood.

3. Provide galvanized metal sleeves, if sleeves will not be removed.

4. Provide cast iron caulking sleeves where plumbing sleeves passes through exterior walls, slabs, or foundations.

D. OTHERS

1. Anchor bolts, ringlets, and inserts shall be of type, size, and spacing as required by the trades involved.

2. Use stainless steel on submerged applications and/or where corrosive environments exist as determined by the ENGINEER.

## 2.06 CURING COMPOUNDS

A. Do not use compound, which will interfere with adhesion or cause other deleterious reaction with indicated finish.

B. Provide curing compounds containing fugitive dye, fading not sooner than 7 days.

C. Use Castle Chemical Corp., Demicon Cure-Hard, Clear-Spread at 400 square feet per gallon or approved equal for slabs not receiving additional topping or finish.

D. Other Concrete - Use Lambert Corp. #64 Resin Base Clear; Master Builders Co. "Masterkure"; Sonneborn Chemical and Refining Corp., "Hydrocide Curing Compound Resin X Clear"; Guardian Chemical Co. "Clear Bond"; Karl E. Reynolds Curing Compound for curing, hardening, and sealing.

2.07 CONCRETE ADMIXTURES

A. Admixtures for concrete structures with liquid retention are listed below:

1. Air entrainment per ASTM C-260 6, plus or minus 1 percent.

2. Retarder per ASTM C-494 type D.

2.08 MISCELLANEOUS

A. Provide 0.006-inch polyethylene film vapor barrier.

B. Provide Wheeling galvanized Tensilform, or equal, by Granco or U.S. Steel for Metal decking.

PART 3 EXECUTION

3.01 PROPORTIONING AND MIXING

A. Use "ready-mixed" concrete in accordance with ASTM C-94.

B. Submit the proposed mix, as a shop drawing, together with slump and cylinder tests for approval.

C. Mix tests shall be by an independent testing laboratory.

D. Clearly indicate the proposed location in the project for each mix submitted.

1. See Submittals Division - 1.

E. Mixes for liquid retention structures shall have a minimum 28-day strength of 4,000 psi.

1. Other mixes shall be 3,000 psi, unless otherwise noted.
2. Minimum cement content shall be 5.5 sacks per cubic yard for 4,000 psi and 5.0 sacks per cubic yard for 3,000 psi.

3. Maximum slumps shall be:

   a. Footings: 3 inches

   b. Slabs, Beams: 4 inches

   c. Columns, Walls: 4 inches

4. Concrete placements that involve two specified slumps shall be governed by the lesser slump.

5. Maximum water/cement ratio for liquid retention structures shall be 0.41.

6. Place concrete within 1-1/2 hours after introduction of water to the mix. Under no conditions may additional water be added.

3.02 PLACING

A. Place concrete expeditiously in clean, damp forms that are not oily to the touch.

B. Spray forms with water immediately prior to placing concrete.

C. Secure reinforcement in position, have it inspected, and obtain approval before placing concrete.

D. Do not rest runways for transporting concrete on reinforcing steel.

E. Concrete placement time shall be in strict accordance with ACI standards, latest edition.

F. Do not place concrete under water

G. Place concrete during the daylight hours, unless approved by the ENGINEER.

H. After the concrete placement is completed, remove any excess or spilled concrete on all adjacent reinforcing steel that is located above the freshly placed concrete.

I. SPECIAL

1. Flat, true surfaces are essential on concrete pours for floors.

2. A ten foot (10') straight edge placed in any position on the floor shall contact the floor in its entire length with a tolerance of 1/8 inch.
3. Provide smooth finished floor throughout with no discernible waves.

4. Grind down concrete not meeting these requirements, until they are acceptable.

5. Existing conditions do not relieve the CONTRACTOR from meeting these requirements.

J RECESSES

1. Lay out and form, as required, recesses for door operators, closer hardware, sensor plates, mats, and equipment.

K. BONDING AGENTS

1. A two-part epoxy bonding agent, approved by the ENGINEER, shall be used wherever a topping or other concrete placement of less than 1-1/2 inches thickness is required.

2. Do not use bonding agents for liquid retention structures slabs where grout is to be the "topping."

3. Clean existing slabs prior to the topping concrete to assure a proper bond.

4. Use steam and/or solvents if required.

5. This requirement also applies to grout addition in liquid retention structures.

L. COMPACTION

1. Place concrete, except for footings, in layers not over 12 inches deep until compacted by internal vibrating equipment, supplemented by hand rodding and tamping as required.

   a. Do not use vibrators to move concrete laterally inside the forms.

   b. Internal vibrators shall maintain a speed of at least 5,000 impulses per minute when submerged in concrete.

   c. Maintain at least one spare vibrator, in working condition, at the site.

   d. Limit the duration of vibration to the time necessary to produce satisfactory consolidation without causing segregation but in no case less

than 20 seconds per square foot of exposed surface.

e. Move the vibrator constantly and place in each specific spot only once.

f. Provide consolidation methods and equipment conforming to ACI-309.

M. COLUMNS/WALLS

1. Place concrete in columns forms before the beam and slab steel is in place.

2. Place column/wall concrete without dropping more than 8 feet.

N. SLABS AND BEAMS

1. Clean slab and beam forms after placing wall concrete.

2. Do not place concrete in roof and wall beams, or slabs, until concrete in walls has been in place a minimum of four hours.

3. Place concrete for slabs and beams continuously and arrange work to assure joints will be located at the points specified.

4. Slope floor slabs with floor drains uniformly to the floor drain.

5. Place slabs on fill carefully to avoid damage to vapor barriers.

O. CONSTRUCTION JOINTS

1. Locate keyed construction joints, as shown, or near points of maximum potential movement and shear, subject to approval by the ENGINEER.

2. Locate construction joints at the underside of floor and roof members, tops of foundations and near the quarter point or third point of the span in slabs, beams or girders.

3. Locate construction joints for liquid retention structures as shown in the Drawings.

4. Install keyed construction joints, straight and smooth, in slabs on fill, at wall centerlines.

5. Cure keyed construction joints a minimum of 24 hours before fresh concrete is deposited.

6. Expansion joints in walkways on grade shall not exceed 20 feet on centers, unless otherwise noted, and at changes in directions.

7. Mark walks in 5'-0" sections, unless otherwise shown in the Drawings.

8. Mark and tool the walks before concrete has become set.

9. Make minimum walk thickness 4 inches.

3.03 FINISHING

A. Provide finishes for concrete surfaces as indicated below:

1. Smooth, double trowel floors and bottom slabs of liquid retention structures.

2. Broom finish exterior slabs and walkways, edges and joints tooled.

3. Smooth rub finish walls, columns, and beams of liquid retention structures

3.04 CURING

A. Water cure liquid retention structures in accordance with ACI-308 for a period of 14 days after concrete placement.

B. Cure other concrete by application of curing compounds as specified herein, applied in strict accordance with the manufacturer's recommendations.

1. Curing shall start as soon as possible after concrete placement.

3.05 TIME BETWEEN PLACING CONCRETE

A. At least two hours shall elapse after placing concrete in long or high columns, heavy walls, beams, girders, or slabs supported thereon.

1. For short columns and low height walls, 10 feet or less, waiting time shall be at least 45 minutes prior to placing concrete in beams, girders, brackets, column capitals, or slabs supported thereon.

2. Consider beams, girders, brackets, column capitals, and haunches as part of the floor or roof system and place concrete monolithically.

3.06 VAPOR BARRIER

A. Use vapor barriers under slabs on grade utilizing maximum reasonable widths.

1. Lap joints a minimum of 6 inches and seal penetrations with pressure sensitive tape.

2. Do not apply vapor barriers under liquid retention structures.

3.07 INSPECTION

A. Obtain approval from the ENGINEER for each day’s concrete placement limits, prior to starting the work.

B. Do not cover reinforcing steel with concrete until the ENGINEER has given approval to start concrete placement for the limits of the day.

3.08 CONSTRUCTION AND EXPANSION JOINTS

A. Locate joints where shown in the Drawings.

1. Make column joints horizontal and true.

2. Form beam joints with plywood and slope from the vertical 12 inches to 1 inches away from the beam center at the top.

B. Make expansion joints straight and true and to details shown in the Drawings.

1. Securely place and located moisture stops and inserts for cover plates.

C. When construction joints become necessary at locations other than those shown in the Drawings, the ENGINEER's approval shall be obtained prior to installation of the joints or concrete placement.

D. For walls of liquid retention structures, 14 days shall elapse prior to placing concrete adjacent to existing hardened concrete at vertical construction joints, so initial drying shrinkage can occur with minimal restraint.

END OF SECTION

SECTION 03480

PRECAST CONCRETE MANHOLES, VAULTS, AND CHAMBERS

## PART 1 GENERAL

### 1.01 SUMMARY

A. Furnish materials and precast concrete manholes as shown in the Drawings and as required for a complete installation.

B. Wet wells shall be precast concrete manholes with water-stops, sleeves and openings as noted in the Drawings.

C. Box outs for wall pipes shall conform accurately to the sizes and elevations of the adjoining pipes.

D. The structures shall be watertight.

### 1.02 RELATED SECTIONS

A. Paints and Coatings - Division 9.

## PART 2 PRODUCTS

### 2.01 Precast Wet Wells

A. Precast wetwells shall conform to the requirements of ASTM C 478 with reinforcement of ASTM A 615, Grade 60 bars and the following modifications thereto:

1. The minimum wall thickness shall be 8 inches.

2. Cement to be used in precast manholes and grout shall be ASTM C 150, Type II.

3. The date and name of manufacturer shall be marked inside each precast sections.

4. No more than 2 lift holes may be cast or drilled in each section.

## PART 3 EXECUTION

### 3.01 SETTING PRECAST SECTIONS

A. Precast reinforced concrete sections shall be set so as to be vertical and with sections in true alignment.

B. Holes in sections; used for their handling, shall be thoroughly plugged with mortar. The mortar shall be one (1) part cement to one and one-half (1 1/2) parts sand; mixed slightly damp to the touch (just short of "balling"); hammered into the holes until it is dense and an excess of paste appears on the surface; and then finished smooth and flush with the adjoining surfaces.

3.02 FINISH

A. The inside and the outside-of the manholes and wetwells shall be finished as shown and noted in the Contract Drawings.

END OF SECTION

SECTION 04064

MORTAR FOR ENGINEERED MASONRY

## PART 1 GENERAL

### 1.01 SUMMARY

A. Furnish labor, materials, equipment, and incidentals required to install mortar adhered products.

## PART 2 PRODUCTS

### 2.01 MORTAR

A. Provide type “M” mortar with average compressive strength at 28 days of 2,500 psi, Florida Portland cement or Lehigh Portland cement masonry cement interground mixture of Portland cement clinker and limestone, or equal.

B. Dry mix the mortar to laboratory established proportions with only as much water added as required to produce workability.

### 2.02 SAND

A. Sand shall be clean, durable particles, free from injurious amount of organic matter.

B. Provide sand conforming to the limits of ASTM C 144.

C. Provide sand for grout conforming to ASTM C 144 or C 33 as required.

### 2.03 WATER

A. Use water from a potable source, suitable for domestic consumption.

### 2.04 HYDRATED LIME

A. Provide hydrated lime conforming to requirements of Federal Specification SS-L-351, Type “M”, domestic manufactured.

### 2.05 GROUT

A. Mix grout for C. M. U. cores containing reinforcement for wind load resistance, and for setting bearing plates or machinery according to the approved recommendations of the manufacturer to give the necessary consistency for placing and to give a minimum compressive strength of 3,000 psi in 3 days.

2.06 NON-SHRINK GROUT

A. Use Embeco Aggregate in non-shrink grout, as manufactured by the Master Builders Company, Ferrolith by Sonneborn, or equal and be proportioned with sand in strict accordance with the manufacturer's instructions for the use intended.

PART 3 EXECUTION

3.01 SHIPPING, HANDLING AND STORAGE

A. Deliver, store, and handle mortar materials so as to prevent damage, deterioration, or contamination.

B. Store materials under cover in a dry place and in the original packaging.

3.02 PROPORTIONING AND MIXING

A. Control and accurately maintain specified proportions measurement.

1. Workability of consistency of mortar on the board shall be sufficiently wet to be worked under the trowel.

2. Make water for tempering available on the scaffold.

3. Discard mortar, which has begun to "set" after initial mixing.

4. Retemper mortar that has stiffened due to evaporation to restore its workability.

5. Do not re-temper the mortar at the mixer.

B. Machine mix mortar in a type of mixer acceptable to the ENGINEER in which the quantity of water can be accurately and uniformly controlled.

1. The mixing time shall not be less than 5 minutes, approximately 2 minutes of which shall be for mixing the dry materials and not less than 3 minutes for continuing the mixing after the water has been added.

2. Where hydrated lime is used for mortar requiring a lime content, the CONTRACTOR will have the option of using the dry-mix method for first converting the hydrated lime into a putty.

3. Where the dry-mix method is employed, the materials for each batch shall be well turned over together until the even color of the mixed, dry materials indicates that the cementitious materials has been thoroughly distributed throughout the mass, after which the water shall be gradually added until a thoroughly mixed mortar.

3.03 CLEANING

A. Clean out mortar boxes at the end of each day's work, and keep tools clean.

END OF SECTION

SECTION 04070

MASONRY GROUT

## PART 1 GENERAL

### 1.01 DESCRIPTION

A. Scope of Work: The work included in this Section consists of grouting the various items listed hereinafter and indicated in the Drawings.

B. Related Work Described Elsewhere:

1. Sanitary Sewer System, Division 2

2. Precast Concrete Manholes, Division 3

### 1.02 SUBMITTALS

A. Materials and shop drawings:

1. See Division 1 for submittal requirements.

B. Submit manufacturer's literature for review on non-shrink grout data including grout properties, mixing, surface preparation, and installation instructions.

### 1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver grouting materials and store in unbroken containers with seals and labels intact as packaged by the manufacturer.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Non-shrink, Non-metallic Grout: Sauereisen F-100 Level Fill, Master Builders Masterflow 713, Burke Non-Ferrous, Non-Shrink Grout or equal pre-mixed type.

B. Non-shrink Metallic Grout: Master Builders Embeco 636 Grout pre-mixed type.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean bonding surfaces of dust and oil.

3.02 INSTALLATION

A. Non-shrink Grout:

1. Use non-shrink, non-metallic grout for grouting column base plates, anchor bolts, reinforcing bars, pipe sleeves, machinery supports, and pump base plates.

2. Mix and place non-shrink grout as recommended by the manufacturer.

3. Mix grout as close to the work area as possible and transported quickly to its final position in a manner that will not permit segregation of materials.

4. Cure non-shrink grout with water saturated burlap for at least 3 days.

5. Do not operate machinery set on grout pads until the grout has cured for at least 36 hours.

3.03 MEASUREMENT AND PAYMENT

A. No additional payment shall be made for the work previously specified.

B. The CONTRACTOR’s Lump Sum Bid as set forth in the Proposal shall continue full compensation for the work involved in this section.

END SECTION

SECTION 04200

UNIT MASONRY

## PART 1 GENERAL

### 1.01 SUMMARY

A. Furnish labor, materials, and equipment and perform functions required in the installation and maintenance of the work covered by this Section.

1. This work includes:

a. Unit masonry work.

b. Angles, sleeves, anchors, inserts, and ties required to be built into masonry work.

### 1.02 RELATED SECTIONS

A. Steel reinforcement: Division - 3

B. Concrete: Division - 3

C. Mortar for Engineered Masonry: Division - 4

### 1.03 REFERENCES

A. ACI 530, “Specifications for Masonry Structures”

B. National Concrete Masonry Association: Standard Specifications for the Design and Construction of Load Bearing Concrete Masonry, NCMA TR-75B.

C. Standard Building Code, latest edition.

### 1.04 QUALITY ASSURANCE

A. Allowable Tolerances:

1. Plumb: ± 1/8 inch in 5’-0”, non-cumulative.

2. Horizontal Warp: ± 1/8 inch in 5’-0”, non-cumulative.

3. Level Courses in Wall Panels: ± 1/4 inch.

1.05 SUBMITTALS

A. Manufacturer's product data indicating compliance with specified requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C150-84, Type I, white or gray, as required.

B. Masonry Cement: ASTM C91-83a, Type II.

C. Sand: 100 percent passing a #8 sieve, and not more than 15 percent passing a #100 sieve, ASTM C144-81.

D. Water: City potable water.

E. Wall Reinforcement: Truss type welded wire masonry reinforcement, every second course, 9 gauge deformed wire, minimum weight for 8 inch wall 187lbs. per 1000 lineal feet, .048 sq. in. effective cross sectional steel area sized for width of block.

1. Comply with material requirements of ASTM Standard A 82 for high tensile steel.

F. Anchors: Galvanized steel, minimum 12 inch long.

G. Waterproofing: SEC #1, manufactured by SEC Manufacturing Co., or equivalent approved by Architect/ENGINEER.

H. Concrete Block: Hollow load-bearing blocks, ASTM C-90, Grade N, Type I, moisture content requirements as stipulated in the guide specifications of the Florida Concrete and Products Assoc., Inc., weight of concrete more than 100 lbs. per cubic foot, compressive strength minimum 2000 p. s. i., nominal 8 inches by 8 inches by 16 inches.

1. Use standard blocks specially designed for use at jambs, beams, as required.

PART 3 EXECUTION

3.01 MORTAR

A. ASTM C270, Type S, with compressive strength of 1800 p. s. i. at twenty-eight (28) days, except that Type M with 2500 p. s. i. shall be used for reinforced masonry, when required by code and where indicated in the Drawings.

1. Ingredients:

a. Portland cement, sand, hydrated lime and water, or masonry cement, sand, and water, with waterproofing added in accordance with the manufacturer's recommendations in mortar for exterior work.

B. Mix mortar with minimum amount of water for satisfactory workability, and only in quantity needed for immediate use.

1. The mason may adjust the consistency.

2. Do not use mortar after the cement has begun its initial set.

3. Re-tempering will not be permitted.

C. Pointing and Cleaning: On completion, point up exposed masonry, including joints at concrete columns and beams.

1. Fill holes and joints, remove loose mortar, cut out defective joints, and re-point only where necessary.

2. Masonry surfaces which are to be exposed, either painted or unpainted, shall be thoroughly cleaned free of mortar and stains and the joints pointed to obtain a level, smooth surface.

3.02 ERECTION

A. Protect masonry work from damage, both in appearance and structural stability.

1. When rain is imminent and the work discontinued, cover the top of exposed masonry with a strong waterproof membrane, well secured in place.

2. Replace walls damaged during construction by wind action or failure to provide adequate protection and bracing, at no expense to the OWNER.

B. Lay masonry in a common running bond, with vertical joints centered over masonry units below.

C. Do not step back unfinished work for joining with new work.

1. Complete the last course laid between columns or walls before interrupting the day's work.

2. Toothing may be restored to only when specifically approved by the ENGINEER.

3. Remove loose mortar before new work is started, and wet the exposed joint thoroughly before laying new work.

D. Built-In metal frames, vent blocks, access doors, and anchor bolts required by other trades as the work progresses.

1. Check with other trades for these items.

E. Bed each course solidly in mortar, under face shells and webs, with vertical joints, slushed full and breaking halfway over units in the course next below, unless stacked bond is specified or noted in the Drawings.

1. Terminate walls under soffits of existing beams or slab construction slightly below the soffit and fill the remaining space with mortar after roof dead loads have been brought to bear on the structure.

2. Fill cavities with mortar in walls or partitions supporting plumbing fixtures or other items, voids at door jambs, and other spaces requiring grout fill, so that anchoring devices are in a solid field not less than 8 inches in every direction from their center.

3. Reinforce exterior walls by placing wall reinforcement as indicated in the Drawings.

4. Lap reinforcing sufficiently at splices (24 inches min.) to ensure continuity.

F. Where block walls abut the vertical surface of a concrete member, provide cast-in-place recessed reglets for dovetail, corrugated, galvanized, 1 inch wide by 1/8-inch thick anchors at the end of each wall reinforcement run.

1. Where new block walls abut existing or previously erected concrete or masonry walls, secure anchors to existing wall by breaking through the block or chipping a recess in concrete and filling the space with grout, to prevent horizontal movement.

G. Where walls with concrete filled voids are indicated, use regular concrete with pea rock aggregate and a compressive strength of 3000 psi at twenty-eight (28) days.

1. Comply with the requirements of Division 3.

H. Do not wet concrete masonry units before laying.

1. Erect masonry plumb, true to line, level, and accurately spaced, with each course breaking joints with course next below, unless a stacked pattern is indicated in the Drawings.

2. Keep bond pattern plumb throughout, and corners and reveals plumb and true.

3. Use power drills and saws for penetration of plumbing and other pipes in exposed locations.

4. Fill chases and knockouts after other work is installed in them to restore the integrity of the wall.

I. For Exposed Masonry Finishes

1. Do not use cracked, spalled, or chipped blocks.

2. Use extra care to set blocks plumb, with even, uniform tooled joints, and to keep mortar smears from the face of the block.

3. Set courses level and line up the face of the units to provide a flat surface without warpage or breaks at the joints.

4. Strike the excess mortar from the joints with a trowel run parallel to the joint to avoid smearing the block face.

5. Joint thickness: 3/8-inch.

6. Keep setting mortar from the face of the block and wipe excess away before it sets.

    a. The blocks will remain exposed and painted in the finished condition.

    b. Replace blocks defaced by excessive mortar smears that interfere with the uniform texture and color of the wall.

END OF SECTION

SECTION 04220

CONCRETE MASONRY UNITS

PART 1 GENERAL

1.01 SUMMARY

A. Provide materials, equipment, and labor required to complete the concrete masonry work in accordance with the Drawings and Specifications.

B. Coordinate work with that of other trades.

1.02 STORAGE

A. Store materials under cover, in dry place, and in a manner to prevent damage or straining.

B. Deliver blocks to site dry in compliance with specification limitation for moisture and kept dry by storing off ground and under cover.

C. Remove blocks from site, that have become wet.

1.03 CERTIFICATION

A. Furnish certificates from manufacturer in triplicate prior to delivery of concrete masonry units to the job site.

1. Include on each certificate signature of an authorized officer of the manufacturing company, CONTRACTOR's name and address, project location, quantities, and date of shipment.

2. Certify units for compliance with these Specifications.

1.04 SAMPLES

A. Submit to the OWNER for approval in accordance with the Special Conditions, two (2) samples each of proposed masonry units, reinforcements, ties, control joint material and fillers.

B. Re-submit as required until approved.

## PART 2 PRODUCTS

### 2.01 CONCRETE MASONRY UNITS

A. Concrete masonry units (C. M. U.) are load-bearing blocks conforming to ASTM C 90, Grade N-1.

1. Obtain units from one manufacturer to insure even color and texture.

2. Provide nominal face dimensions of eight (8) inches by sixteen (16) inches.

### 2.02 SHAPES

A. Provide special shapes as required to complete concrete masonry work.

### 2.03 MORTAR

A. Provide mortar as specified under Division 4 for the specific installation required.

## PART 3 EXECUTION

### 3.01 JOB LAYOUTS

A. Lay out coursing horizontally and vertically as shown in the Drawings.

1. Avoid block cuts less than four (4) inches wide.

2. Provide eight (8) inches vertical coursing.

3. Provide 3/8-inch thick joints.

4. Bed joints shall be indicated to receive masonry joint reinforcing, ties, and/or anchors.

### 3.02 WORKMANSHIP

A. Lay masonry plumb and true to line.

1. Keep bond plumb throughout.

2. Avoid over plumbing and pounding of corners and jambs to fit stretcher units after they are set in position.

3. Remove and replace hardened mortar where adjustment must be made after mortar has started to set.

4. Use concrete brick to course out walls concealed in the finished work.

5. Cut masonry units dry.

6. Use a masonry saws for cuts exposed to the finished work.

B. Clean equipment used in placing, moving, and storing mortar, at end of each day's work.

1. Immediately before placing metal reinforcing, anchors, and ties, remove loose rust, tie wires and tags and other foreign matter that will degrade the bond.

3.03 REINFORCING

A. Reinforce horizontal joints continuously with ends lapped six (6) inches and laps staggered vertically.

B. Provide prefabricated corners and tee at intersection walls.

C. Reinforce above and below openings in the bed joint immediately above and below.

D. Extend reinforcing two (2) feet behind jambs.

E. Space horizontal reinforcing at sixteen (16) inches on-center vertically.

3.04 ANCHORS AND TIES

A. Place anchors and ties a minimum of sixteen (16) inches vertically and twenty-four (24) inches horizontally, unless otherwise indicated.

B. Make anchors and ties for masonry into adjacent concrete walls at the specified spacing.

3.05 BOND

A. Lay masonry units in running bond by lapping unit in successive courses a distance of one-half (1/2) a unit.

1. Level courses with joints of uniform width.

2. Finish joints flush.

3. Units shall have full mortar coverage of the face shells in both the horizontal and vertical joints.

4. Point joints solid with mortar on both sides and wall.

5. Firmly compact joints in exposed work, with a pointing tool when partially set.

3.06 MORTARING

A. Lay courses in a full bed of mortar.

1. Lay units with mortar applied to face shell of block previously laid as well as to block to be laid to insure well-filled joints.

B. Join new masonry to existing or partially set work by first cleaning loose mortar and joints.

1. When it is necessary to stop a horizontal run, rack back one-half (1/2) block length in each course; toothing shall not be permitted.

C. Strike joints flush in block in unexposed spaces.

1. Strike joints of block exposed in the finished work and tool when partially set with a glass or steel, twenty-four (24) inch long tool.

2. Use a tool approximately twice the size of the joint.

D. Fill solidly hollow metal frames, mullions and spaces around built-in items with grout.

E. Provide eight (8) inch minimum of solid end bearing the full height of wall for lintels.

F. Cut and patch finished masonry to accommodate work of other trades in a manner that will not damage or mar appearance of adjoining masonry.

G. Point holes in masonry.

1. Cut out and point up defective joints.

3.07 CONTROL JOINTS

A. Install control joints as detailed and located as shown in the Drawings.

B. Locate joints only as directed with a maximum length, horizontally, between vertical control joints of thirty (30) feet.

C. Make joints equal in width to the standard mortar joint.

D. Provide discontinuous horizontal joint enforcing at control joints.

3.08 CHASES

A. Construct masonry slots, chases, or openings required for the proper installation of the work of other Sections as indicated in the Drawings or in accordance with information furnished before the work is started at the points affected.

B. Do not cut chase into a wall constructed of hollow units after it is built, except as directed and approved by the OWNER.

3.09 PROTECTED

A. Brush surfaces as work progresses and maintained as clean as it is practicable.

B. Rake back unfinished work where possible, and toothed only where absolutely necessary.

C. Cover and protect walls, before leaving fresh or unfinished work, against damage by means of waterproof paper, tarpaulins, boards, or other means.

3.10 CLEANUP

A. Clean mortar and grout drippings from exposed masonry and adjacent surfaces as soon as possible to prevent surfaces from being permanently stained.

B. Remove drippings and smears before mortar or grout sets or hardens.

C. Remove mortar extruded beyond face of walls or partitions.

3.11 HOT WEATHER CONSTRUCTION

A. Provide masonry construction in hot weather conforming to the applicable requirements of the Florida Building Code, latest edition, unless otherwise specified herein.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

## PART 1 GENERAL

### 1.01 SUMMARY

A. Furnish equipment, materials, and labor for fabrication, erection and finish structural steel for the project.

B. Any lists of equipment and/or materials set forth herein shall not be taken to exclude other incidentals necessary to complete the project for its intended use.

C. Submit structural steel and/or its fabrication not covered by these specifications to the ENGINEER for approval prior to its acquisition or fabrication.

### 1.02 RELATED SECTIONS

A. General Conditions - Bidding and Contractor Requirement

B. General Requirements - Division 1

C. Site Conditions - Division 1

D. Cast-in-Place Concrete - Division 3

E. Finishes - Division 9

F. Miscellaneous Metals - Division 5

G. Mechanical - Division 15

H. Electrical - Division 16

### 1.03 STANDARDS AND REGULATIONS

A. The latest revision of the following codes and standards shall govern materials and workmanship unless modified more stringently herein.

B. The Standard Building Code.

C. The American Institute for Steel Construction (AISC).

1. Manual of Steel Construction, 8th Edition

D. The Steel Joist Institute.

E. The American Society for Testing Materials (ASTM).

F. The American Welding Society (AWS).

G. Florida Building Code, latest edition.

1.04 SUBMITTALS

A. Submit shop drawings as required by the General Conditions for structural steel.

B. Do no fabricate steel until shop drawings are approved.

C. Show members sizes, shapes, connections, joints, erection details, copes, holes, bolts, shim plates, shop and field welds, and other related details on Drawings, as required to show conditions.

1.05 MEASUREMENT AND PAYMENT

A. Measurement and payment will be included in the unit or lump sum prices for the appropriate work items, as shown in the Bid Schedule, as required for those items which price, and payment shall constitute full compensation for furnishing materials and performing work in connection herewith and as specified in the Summary under this section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide new materials, well formed to shape and size with sharp lines and angles, and provide clean, free from rust, scale, grease, and other coatings which may prevent proper bonding.

B. Rolled Sections - ASTM Specifications A - 36.

C. Steel Joists - provide joists conforming to the latest standard specification of the Steel Joist Institute, regular and high strength, long span and short span as scheduled.

D. Expanding grout - Por-rock cap with cement at areas subject to water, Embeco, Ferrolith, or Irontox grout at other areas.

E. Tubular Sections

1. Rectangular tubular sections - provide 46-ksi steel or steel conforming to ASTM A 500 Grade “B”.

2. Round tubular sections - provide steel conforming to ASTM A501 and A53 Type E or S Grade “B” open hearth or basic oxygen steel with maximum sulfur content of 0.05 percent.

F. Bolts, nuts, and washers - free from visible defects.

1. Provide anchor bolts conforming to ASTM A - 307.

2. Provide high strength anchor bolts conforming to ASTM A - 449.

3. Provide high strength connection bolts conforming to ASTM A - 325N and AISC details.

## PART 3 EXECUTION

### 3.01 STRUCTURAL

A. Design vertical steel bulkheads to withstand full hydrostatic forces from either side of the bulkhead or wall.

1. The design of the walls shall allow isolated compartments to be individually dewatered.

2. Provide a minimum one-quarter inch (1/4”) wall thickness.

3. Perform computations and supply structural drawings to the OWNER, and signed both sealed by a Florida Professional Engineer by the CONTRACTOR.

4. The Professional Engineer shall assume full responsibility for the structural integrity of the system design and construction.

B. Reinforce bulkheads and designed as partially fixed connections at the inner and outer walls.

1. Provide reinforcing structural members at the top of the section in bulkheads and walls.

2. Design these members to maintain the required shape of the item while under any combination of load applications that may be encountered under actual field conditions.

C. Remove shop welds having burrs and/or spatters prior to blasting.

1. Caulk chain or skip welds on surfaces above water level or on an outer surface prior to painting.

3.02 FABRICATION AND WORKMANSHIP

A. Provide fabrication and workmanship in accordance with SFBC, AISC, and Steel Joist Specifications.

B. Provide welding conforming to the requirements of the American Welding Society and performed by certified welders.

1. Present certification to the ENGINEER or OWNER's representative and approved by the ENGINEER prior to welding being performed.

2. Grind welds to a neat finish on joists to be left exposed.

C. Leave clean, true lines and surfaces when shearing, punching, and cutting.

D. Weld or bolt permanent connections as detailed on shop drawings.

1. Provide full strength butt or fillet welds for welded joints.

E. Provide anchors, inserts, and bearings as detailed.

F. Set bearing plates on mortar consisting of one part Portland cement and two parts sand, unless otherwise detailed.

G. Provide adequate substantial braces and stays to hold structural steel in position until permanently anchored.

H. Anchor bolts, inserts, and other miscellaneous items of structural steel required to be cast or built-in shall be furnished to the proper trades in sufficient time to avoid delay of their work.

1. Provide necessary supervision, templates, and spaces, as required for proper installation.

I. Provide plumb, properly spaced, true to line, and dimension erection of structural steel conforming to the requirements of the A. I. S. C. and the Steel Joint Institute.

1. Remove and replace or relocate work not conforming to these requirements.

J. Provide Joist bridging conforming to Steel Joint Institute and shall be sizes and types as shown in the Drawings.

1. Install bridging immediately after joist erection and before loads are applied to the joists.

K. Carefully do the bridging of exposed joists with members in alignment, carefully cut and fitted, and welding neatly done.

L. Provide galvanized bolts for exterior work-plain steel for interior work.

M. Perform field installation in strict accordance with the manufacturer's recommendations.

N. Remove weld spatter and burrs by chipping and grinding from field welding accomplished on surfaces down to a point two feet below the top of the plant.

O. Field painting of the plant and accessories mounted on or attached to the exterior of the tank shall include masking of galvanized and aluminum surfaces.

3.03 PROTECTION

A. Protect structural steel items from weather properly stored off the floor and grade in a manner satisfactory to the ENGINEER.

B. Protect structural steel items from corrosion.

3.04 PAINTING

A. Remove rust, mill scale, and weld slag from steel surfaces using commercial blast in accordance with SSPC-SP-6-63.

1. Remove weld splatter and surface roughness by chipping and grinding smooth.

2. Perform blasting indoors to produce a mil profile for optimum adhesion of the primer.

3. Sand blasting shall be accepted.

B. Prepared surfaces shall be thoroughly dry and free from preparation dust and foreign matter prior to the application of coating.

1. Craftsmen applying protective coatings shall be thoroughly familiar with the application guidelines and preparation requirements of the product to be applied.

2. Evenly apply coating materials and shall be free from obvious defects.

C. Protective coatings shall not be applied to improperly prepared surfaces or during conditions considered to be not conducive to sound painting practices or in fog, rain, snow, mist or when the surface temperature is less than 40 degrees Fahrenheit or the humidity exceeds 85%.

D. Immediately after surface preparation, a rust inhibitive epoxy primer coat shall be applied.

1. No discoloration of the cleaned areas shall occur prior to the application of the prime coat.

2. Steel surfaces shall receive a 3-mil dry film thickness of this protective coating.

E. Touch-up shop coats which are damaged with the same paint as soon as steel is erected.

F. Mechanically wire brush field welds and marred areas to remove weld slag and surface impurities.

1. Apply, immediately after surface preparation, a 3-mil dry film thickness topcoat.

2. Provide a self-priming, high-solids epoxy coating of the color specified top coating.

G. Dry film thickness of coats shall be determined by employing standard calibrated dry film thickness gauges.

3.05 TESTING

A. The requirements for testing are as outlined in Paragraph 1.7 of Section 11374, Surge Tank and Aeration Basin.

1. Failure or excessive deflection shall be remedied and costs shall be borne by the CONTRACTOR.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

## PART 1 GENERAL

### 1.01 SUMMARY

A. Miscellaneous metals necessary for a complete installation, not specified herein, shall be equal in quality to the specified material suitable for the intended use, and shall conform to the details and notes shown in the Drawings.

B. Install minor items implied, usually included or required for the construction of a complete operating system, whether specified or shown in the Drawings, or not.

C. Furnish and install miscellaneous metal as shown in the Drawings, required by specification, or necessary for complete installation.

D. Perform work in conformance with requirements and recommendations of the standards listed in the Special Conditions.

### 1.03 SHOP DRAWINGS

A. Submit shop drawings for review in accordance with the Contract Document.

1. Do not start fabrication until shop drawings have been approved by the OWNER.

2. Make drawings in conformity with standard practice and indicate: fabrication, assembly and erection details, size of member, profiles, fastenings, supports and anchors, patterns, clearances and connection to other work.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Provide best quality materials entirely suited for the particular service.

B. Provide metals free from defects and with structural properties to safely render required service.

C. Provide non-corrosive, non-staining, and concealed fastenings.

1. Grind exposed welds smooth to form a neat uniform fillet without weakening base metal.

2. Remove slag from unexposed welds before applying shop coating.

3. Form molded, bent, or shaped members with clean, sharp rises, without dents, scratches, cracks, or other defects.

4. Provide anchors, bolts, shims, and accessory items as required for building into or fastening to adjacent work.

5. Galvanize ferrous metals, except as otherwise specified.

D. Unless otherwise specified the miscellaneous metal work shall be equal to or exceed the requirements of the following standards:

| | Carbon and Low Alloy Steel | ASTM Designation |
|---|---|---|
| 1. Plates and Structural Fabrication | A 36, A 529 or A 283 | Grade C |
| 2. Sheet Steel | A 570 | Grade C |
| 3. Bars and Rods | A 36 or A 306 | Grade 60 |
| 4. Pipe | | |
| a. General use process pipe | A 53 or A 120 Schedule 40 | |
| b. Process pipe | A 524 Grade | |
| 5.Fasteners | | |
| a. Standard Strength Bolts | A 307 Grade A | |
| b. High Strength Bolts | A 325 | |
| c. Eye bolts | A 489 | |
| 6.Steel Coatings | | |
| a. Zinc - Electrodeposited | A 164 | |
| b. Hot Dipped | A 123 and A 386 | |
| c. Cadmium | A 165 | |
| 7.Stainless Steel | | |
| a. Plate and Steel | A 167 Type 304 | |
| b. Bars and Shapes | A 276 Type 304 | |
| c. Fasteners | A 167 and A 276 Type 316 | |
| 8.Cast Iron | | |
| a. Gray | A 48 Class 30 B | |
| b. Malleable | A 47 | |
| c. Ductile | A 536 Grade 60-40-18 | |

| | Carbon and Low Alloy Steel | ASTM Designation |
|---|---|---|
| 9. Wrought Iron | | |
| a. Plates | A 42 | |
| b. Sheets | A 162 | |
| c. Shapes and Bars | A 207 | |
| d. Pipe | A 72 | |
| 10. Bronze | | |
| a. Rods, Bars, and Shapes | B 138 Alloy B Soft | |
| 11. Fasteners | | |
| a. Yellow Brass Cap Screws and Other Small Fasteners | B 16, B 36, or B 134 | |
| b. Silicon Bronze Bolts | B 97, B 98, B 99, and B 124 | |
| 12. Aluminum | | |
| a. Structure Shapes | B 308 Alloy 6061-T6 | |
| b. Castings | B 26, B 85, and B 108 | |
| c. Extruded Bars, Rods, and Tubes | B 221 Bars - Alloy 6061 Other - Alloy 6063 | |
| d. Plates and Sheet | B 209 Plates - Alloy 6061 Sheets - Alloy 3003 | |

D. Materials with more than one specification or grade listed shall conform to specification or grade providing the highest strength and appropriated mechanical properties for the fabrication technique used.

2.02 PROTECTIVE COATING

A. Clean ferrous metal, except stainless steel and galvanized surfaces and given one shop coat of primer compatible with the coating system specified in Division 9.

B. Shop prime metal work to be encased in concrete unless specified to be stainless steel or galvanized.

C. Clean castings that are to be left unpainted and coated with a coal-tar-pitch varnish.

D. Perform hot-dip galvanizing or zinc coatings applied on products fabricated from rolled, pressed or forged steel shapes, plated, bars conforming to ASTM A 123.

1. Perform hot-dip galvanizing or zinc coatings on assembled steel products conforming to ASTM A 386.

2. The weight of coatings is designated in Table 1 for the class and thickness of material to be coated.

E. Chemically treat galvanized surfaces for which a shop coat of paint is specified to provide a bond for the paint.

1. Perform galvanizing after fabrication, except for bolts and nuts.

F. Protect aluminum to be placed adjacent to masonry or dissimilar metals with an isolating coating of bitumastic and/or felt.

2.03 MANHOLE FRAME AND COVER SETS

A. Machine bearing surface of the frames and covers so that cover seats firmly into the frame without rocking.

2.04 STEEL PIPE GUARDS

A. Make pipe for guards from galvanized steel, schedule 40 pipe conforming to ASTM A 53.

B. Provide painting conforming to Section 9.

2.05 STRUCTURAL AND MISCELLANEOUS ALUMINUM

A. Provide structural and miscellaneous aluminum shapes, bars, and plates conforming to Alloy 6061-T6.

B. Protect fasteners for aluminum to be placed adjacent to concrete, masonry, or dissimilar metals with one (1) coat of bitumastic paint.

2.06 SAFETY CHAINS

A. Provide safety chains conforming to 316 stainless steel proof coil chain.

1. Provide chains straight link style, 3/16-inch diameter, with at least twelve (12) links per foot, and with snap hooks on each end.

2. Provide stainless steel boat type snap hooks and eye bolts for attachment of chains: 3/8 inch bolt with 3/4 inch eye diameter, anchored as required.

3. Supply two (2) chains four (4) inches longer than the anchorage spacing for each guarded area.

2.07 ALUMINUM BAR GRATING

A. Provide aluminum gratings consisting of extruded bearing I bars positioned and locked by cross bars with exposed ends of bearing bars and cut outs banded with a bar of the same depth and thickness as the main bearing bars.

1. Weld each cut bar to the band.
2. Provide reversible gratings with fluted non-skid surfaced bearing bars as manufactured by Borden, Gary, Irving, or equal.

B. Provide bearing and cross bars conforming to 6063-T6 aluminum alloy.

1. Grating I bar section, depth and spacing shall be based upon a uniformly applied load of one hundred fifty (150) pounds per square foot over the full span unless a greater loading is noted in the Drawings.

2. The maximum deflection of L/240, but not more than 1/4 inch, shall be based on an allowable fiber stress of twelve thousand (12,000) pounds per square inch.

3. Provide a minimum grating depth one and one half (1 1/2) inches thick.

C. Fabricate gratings into easily removable sections and fastened at each corner.

1. Do not use fasteners projecting above the walking surface.

2. Provide stainless steel clamps and bolts used for attaching the grating to supporting member.

3. Provide manufacturer recommended Clamps.

2.08 ALUMINUM RAILING SYSTEM

A. Provide pipe handrails as required by the Uniform Building Code and OSHA whether indicated in the Drawings or not.

B. Provide built-in pipe sleeves where vertical pipe supports to be set in concrete, or concrete may be cored, minimum 5-inches in length as indicated in the Drawings.

1. Provide sleeves for removable posts.

2. Cement the joint between upright and sleeve with grout.

C. Design wall brackets for handrail as indicated in the Drawings and as manufactured by Julius Blum & Company, J.G. Braun Company, Fulton Metal Products Company, or equal.

1. Fabricate wall brackets of metal compatible with handrail.

2. Metal end wall mounted railings at the line of the first nosing.

D. Shop weld connections between vertical posts and horizontal railing or between sections of horizontal railings continuous in as long of sections as practical.

1. Provide watertight welds and that are ground smooth.

2. Field assembly of welded sections may be made by mechanical fasteners.

3. Provide location and type of field connections for review by the ENGINEER.

4. Shop drill weep holes in vertical posts of external railing.

E. Design Load: Design components of the railings to resist the design loads of the Florida Building Code, latest edition.

1. Provide a maximum of six feet spacing of vertical pipe supports.

2. Note design loads in the shop drawing submittal.

F. Aluminum Railing: Provide aluminum pipe railings of nominal 1-1/2 inch diameter, Schedule 40 (minimum) aluminum alloy 6061-T6 with clear anodized finish.

1. Railing posts must be adequately reinforced to meet the specified design loads.

2. Provide a maximum of six feet spacing of vertical pipe supports.

3. Stainless steel railings may be used in lieu of aluminum railing at the CONTRACTOR'S option.

G. Kickplates: Furnished and installed kickplates where called for in the Drawings and typically at the edges of metal walkways and at other handrail installations.

1. Provide 1/4-inch thick kickplates, conforming to OSHA requirements, projecting 4-inches above walkway surface, not infringing on minimum required walkway width, and material must be the same as that of handrail construction.

2. Connect kickplates to handrail posts as detailed in the Drawings.

H. Aluminum Railings: Perform aluminum railing fabrication using craftsmen experienced in the fabrication of architectural metal work.

1. Exposed surfaces shall be free from defects or other surface blemishes.

2. Field-verify dimensions and conditions.

3. Precision fit joints, junctions, miters, and butting sections with no gaps occurring between sections, align assuring flush surfaces.

4. Provide electrolysis protection of materials.

## 2.09 FASTENERS

### A. MATERIALS

1. Provide bolts, screws, nuts, washers, anchors, and other fasteners conforming to the Specifications.

2. Furnish necessary bolts, anchor bolts, nuts, washers, plates, and bolt sleeves conforming to the Specifications.

3. Provide washer for anchor bolts and hexagonal nuts when necessary.

4. Provide raised letters or symbols on stainless steel and silicon bronze bolts indicating the manufacturer.

5. Provide drill-in type concrete and masonry inserts as manufactured by Phillips Drill Company, Michigan City, Indiana; Hilti, Tulsa, Oklahoma; or equal.

6. Unless specifically noted do not use powder or gun-driven, fiber and plastic inserts.

7. The use of these devises in the webs of prestressed concrete members is prohibited.

8. Provide bolts, anchor bolts, nuts, washers, plates, and bolt sleeves conforming to type A 316 stainless steel unless otherwise indicated or specified.

9. Zinc coated, after being threaded, galvanized bolts, anchor bolts, nuts, or washers, by the hot dip process conforming to ASTM A 123, or A 153, as appropriate.

### C. Concrete Insert

1. Design concrete inserts to support safely, in the concrete that is used, the maximum load that can be imposed by the bolts used in the inserts.

### D. Dissimilar Metal

1. Connect dissimilar metal with appropriate fasteners, and insulate with a dielectric or approved equal.

2. Fastened aluminum with Type 304 stainless steel bolts and insulate with micarta, nylon, rubber, or equal, unless otherwise specified.

E. Anchor Bolts

1. Set anchor bolts accurately and be carefully held in suitable templates of approved design.

2. Provide anchor bolts, where indicated in the Drawings, Specifications, or required, with square plates at least four (4) inches by 1/8 inch (4 inches by 1/8 inch) or provide square heads and washers and be set in the concrete forms with suitable pipe sleeves, or both.

3. Do not substitute drill-in type anchors for anchor bolts.

## PART 3 EXECUTION

### 3.01 CONSTRUCTION

A. Overview

1. Maintain first class workmanship and conforming to recognized and accepted best practice.

2. Straighten structural materials in the shop by methods that will not damage them before laying out and cutting is done upon them.

3. Provide straight finished members and free from open joints and distortions.

4. Finish shearing neatly.

5. Flame cutting may be used in the preparation of the various members provided a machine performs this operation.

6. Furnish necessary fillets, connections, brackets, posts, and other details not shown in the Drawings, but necessary for the work.

7. Provide welded fabrication except where riveted construction is specifically allowed in the Specifications.

B. Grating and Plates

1. Fabricate gratings, checkered plates, and other applicable items based on verified field measurements and examination of adjoining work and conditions.

C. Steel

1. Provide steel fabrication conforming to the AISC Specification for Design, Fabrication, and Erection of Structural Steel for Buildings.

D. Aluminum

1. Provide aluminum fabrication conforming to the Aluminum Construction Manual, Specifications for Aluminum Structures.

E. Welding

1. Provide welding conforming to the standards and recommendations of the American Welding Society.

    a. Produce complete fusion when welding joints with the parent metal.

    b. Do not use tack welding on exposed surfaces.

    c. Provide smooth finished welded joints free from grooves, depressions, or other irregularities.

    d. Correct other irregularities by welding and/or grinding.

    e. Remove scale or flux after each pass.

    f. Weld bronze by either the inert gas shielded arc method or by brazing with the proper flux and filler metal.

    g. Ground smooth flush welds of butt joints where exposed to view.

## 3.02 INSTALLATION

A. Install miscellaneous items in conformance with Specifications and details as shown in the Drawings or approved shop drawings.

B. Install and erect in conformance with the best practice with each item set plumb, level, true to line and securely anchored in its proper place.

END OF SECTION

SECTION 07920

JOINT SEALANTS

## PART 1 GENERAL

### 1.01 SUMMARY

A. Provide labor, materials, and installation required to complete the Project.

### 1.02 RELATED SECTIONS

A. General Conditions

B. Supplementary Conditions

C. Special Conditions

### 1.03 STANDARDS AND REGULATIONS

A. The following codes and standards shall govern workmanship and materials unless modified more stringently hereinafter.

1. Standard Building Code (SBC).

### 1.04 MEASUREMENT AND PAYMENT

A. Measurement and payment will be included in the lump sum and unit cost prices for the appropriate work items, as shown in the Bid Schedule as required for those items for the completion of the work which price and payment shall constitute full compensation for furnishing materials and performing work in connection herewith and as specified in the scope of work under this section.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Caulking Compounds - Silicone, polysulfide, and acrylic polymer sealants are optional, except where use of one or the other is specifically called for in these documents or where one or the other is not recommended for use by the manufacturer.

1. Silicone: Dow Corning 780, G.E. 1200 or 1300.

2. Polysulfide: Thiokol, Pecora, U.S. TT-S-00230.

3. Acrylic: Tremco, Pecora, U.S. TT-S-00230.

B. Sealant Backup - Polyethylene Foam - Dow Ethafoam S.B., Tremco, and Pecora.

C. Acoustical Caulking - Tremco "Acoustical Sealant", Presstite 57964, "miracle" sound control sealant #21.

## PART 3 EXECUTION

### 3.01 WORKMANSHIP AND INSTALLATION

A. Provide application conforming to the manufacturers recommendations.

1. Use sealant manufacturers primers, solvents, and thinners.

2. Clean and prepare surfaces as recommended.

3. Tool joints with OWNER selected color and remove excess sealant.

B. Provide caulking where indicated in the Drawings, Specifications, and as listed below:

1. Joints subject to weather and/or air infiltration.

2. At perimeter of items set in exterior walls.

3. At exposed surface joints of dissimilar materials and manufactured items permanently incorporated into the work.

a. This includes, but is not limited to, hollow metal frames, windows, stools, casework, plumbing fixtures, corner guards, and thresholds.

4. Where required for fire rating, such as the perimeter of partitions, and around pipe and duct penetrations in same.

5. Where required for sound control to maintain code required S.T.C. rating.

6. At building expansion joints.

7. At metal flashing.

8. At juncture between dissimilar materials, except concrete poured against block.

END OF SECTION

SECTION 09900

PAINTS AND COATINGS

## PART 1 GENERAL

### 1.01 SUMMARY

A. Furnish labor, equipment, materials, and appurtenances for preparing, priming, painting, and cleaning surfaces of structures, equipment, and exposed piping as shown in the Drawings and Specifications.

### 1.02 RELATED SECTIONS

A. Submittals Procedure - Division 1.

B. Quality Control - Division 1.

C. Cleaning - Division 1.

D. Shop Drawings, Product Data, and Samples - Division 1

### 1.03 REFERENCES

A. Applicable Standards

1. Steel Structures Painting Council (SSPC).

2. American National Standards Institute (ANSI).

3. American Society of Testing and Materials (ASTM).

4. National Association of Corrosion Engineers (NACE).

B. Provide paint materials for surfaces in contact with water conforming to Local and State Health Department and U.S. Environmental Protection Agency standards for potable water supplies.

### 1.04 SUBMITTALS

A. Submit to the ENGINEER for approval complete lists of the paints proposed for parts of the work, including their generic type and the manufacturer's catalog description of each.

1. Accompany this list with other pertinent descriptive literature relative to each coating proposed to be used and a sample panel of the colors chosen.

B. Provide minimum 1-year guarantee on materials and workmanship.

1.05 MEASUREMENT AND PAYMENT

A. Measurement and payment will be included in the LUMP SUM prices for the appropriate work items as shown in the Bid Schedule, as required for those items which price and payment shall constitute full compensation for furnishing materials and performing work in connection herewith and as specified in the scope of work under this section.

PART 2 PRODUCTS

2.01 MATERIALS

A. The paints and paint products manufactured by Tnemec Company, Inc. are used in these specifications as standard of quality, and to indicate coating system to be used for each class of work.

1. Provide products of the Xypex Chemical Corporation, or Chemprobe Technologies, Inc. as alternate materials.

2.02 DELIVERY AND STORAGE

A. Deliver materials to the jobsite in original unbroken containers as packaged and labeled by the approved Manufacturer.

B. Suitably stored painting materials at the site and store together only paint or ingredients that are to be used on this work.

1. Keep the storage space clean and take every precaution to avoid fire hazards and spillage.

2. Provide a paint storage area with an impervious bottom preventing paint accidentally spilled from leaking onto the ground

3. Provide a containment area with sufficient volume to prevent spillage if the largest container is spilled.

PART 3 EXECUTION

3.01 PAINTING PROCEDURES

A. Paint Application

1. Apply paint in conformance to the Manufacturers instructions and recommendation and as received form the Manufacturer without addition of a drier or thinner except as specified or as approved by the ENGINEER.

2. Wherever possible, successive coats of paint shall be of sufficiently different color to facilitate inspection of the same as a safeguard against "holidays" and pinholes.

3. Clean surfaces to be given protective coatings, refinish scratches and abrasions on equipment that has been shop coated.

    a. Perform painting as a continuous and orderly operation to facilitate adequate inspection, prime coat materials subject to weathering or corrosion as quickly as practicable.

    b. At no cost to the OWNER: remove, clean, prepare, prime, and paint surfaces of exposed inaccessible members, and replace to the original position and condition.

4. Protect areas under and adjacent to painted work with drop cloths or other approved means, and dripped or spattered paint shall be promptly removed.

5. Apply no paint until the undercoat has cured as specified by the paint manufacturer.

6. Paint the tops and bottoms of doors after they have been fitted and before permanent installation with the same paint as door surface.

7. Remove switch plates finish hardware, and the like before painting and replace after painting.

    a. Remove name and date plates on equipment or kept free from paint by suitable means.

8. Apply no paint to sliding contacts, and the like of operating units.

    a. Paint access doors, plates, panel boxes, and the like with the adjoining surfaces paint on which they occur, using the same kind of paint, number of coats, color, and finish.

9. Protect form damage mechanical equipment, including but not limited to; pumps, motors, gear drives, and the like due to sandblasting and painting operations.

    a. Assume responsibility for equipment, which is damaged due to these operations.

10. Employ whatever means are necessary to prevent drift of sandblast dust and paint to the adjacent treatment units and filters remaining in service.

    a. Do not sand blast or paint on days, which are windy enough to cause dust, or over spray problems.

11. Painting inspection will be performed by the ENGINEER and is required.

    a. Inspections will be required after surface preparation has been completed, prior to the application of the first coat of primer or paint, and after each coat thereafter, prior to the application of the following coat.

    b. Notify the ENGINEER at least 48 hours before beginning painting and at least 24 hours before requiring inspection on each and every phase.

12. Apply no paint when the following conditions exist or are expected within 18 hours:

    a. The ambient shaded air temperature is below 40° F.

    b. The receiving surface temperature is below 35° F.

    c. The receiving surface is wet or damp.

    d. During rain, fog, mist, or when the relative humidity exceeds 85 percent.

B. Field Painting of Shop Primed Metal

1. Clean surfaces of foreign matter as described and spot prime where marred.

2. Smooth rough surfaces with sand paper.

3.02 SURFACE PREPARATION

A. The surface shall be cleaned as specified for the paint system being used. All cleaning shall be outlined in the Steel Structures Painting Council's Surface Preparation Specification (SSPC), unless otherwise noted. If surfaces are subject to contamination, other than mill scale or normal atmospheric rusting, the surfaces shall be pressure washed, and acid or caustic pH residues neutralized, in addition to the specified surface preparation.

B. Standards for Surface Preparation

1. SSPC-SP1, Chemical and/or Solvent Cleaning

    a. Remove all grease, oil, salt, acid, alkali, dirt, dust, wax, fat, foreign matter, and contaminants, etc. by one of the following methods: steam cleaning, alkaline cleaning, or volatile solvent cleaning.

2. SSPC-SP2, Hand Tool Cleaning

    a. Removal of loose rust, loose mill scale, and loose paint to a clean sound substrate by hand chipping, scraping, sanding, and wire brushing.

3. SSPC-SP3, Power Tool Cleaning

    a. Removal of loose rust, loose mill scale, and loose paint to a clean sound substrate by power tool chipping, descaling, sanding, wire brushing, and grinding.

4. SSPC-SP4, Flame Cleaning

    a. Dehydrating and removal of rust, loose mill scale, and some light mill scale by use of flame, followed by wire brushing.

5. SSPC-SP5 (NACE-1), White Metal Blast Cleaning

    a. Complete removal of all mill scale, rust, rust scale, previous coating, etc., leaving the surface a uniform gray-white color.

6. SSPC-SP6 (NACE-3), Commercial Grade Blast Cleaning

    a. Complete removal of all dirt, rust scale, mill scale, foreign matter, and previous coatings, etc., leaving only shadows and/or streaks caused by rust stain and mill scale oxides. At least 66% of each square inch of surface area is to be free of all visible residues, except slight discoloration.

7. SSPC-SP7 (NACE-4), Brush-Off Blast Cleaning

    a. Removal of rust scale, loose mill scale, loose rust, and loose coatings, leaving tightly-bonded mill scale, rust and previous coatings. On concrete surfaces, brush-off blast cleaning shall remove all laitance, form oils, and solid contaminants. Blasting should be performed sufficiently close to the surface so as to open up surface voids, bug holes, air pockets, and other subsurface irregularities, but so as not to expose underlying aggregate.

8. SSPC-SP8, Pickling

a. Complete removal of rust and mill scale by acid pickling, duplex pickling or electrolytic pickling (may reduce the resistance of the surface to corrosion, if not to be primed immediately).

9. SSPC-SP10 (NACE-2), Near-White Blast Cleaning

a. Removal of all rust scale, mill scale, previous coating, etc., leaving only light stains from rust, mill scale, and small specks of previous coating. At least 95% of each square inch of surface area is to be free of all visible residues and the remainder shall be limited to slight discoloration.

10. SSPC-SP11-87, Power Tool Cleaning to Bare Metal

a. Complete removal of rust, rust scale, mill scale, foreign matter, and previous coatings, etc., to a standard as specified on a Commercial Grade Blast Cleaning (SSPC-SP6, NACE-3) by means of power tools that will provide the proper degree of cleaning and surface profile.

C. SSPC-VIS-1, Visual Standards

1. (Swedish SIS OS 5900), “Pictorial Surface Preparation Standards for Painting Steel Surfaces,” and the National Association of Corrosion Engineers, “Blasting Cleaning Visual Standards” TM-01-70 and TM-01-75 shall be considered as standards for proper surface preparation.

D. Oil, grease, soil, dust, etc., deposited on the surface preparation that has been completed shall be removed prior to painting according to SSPC-SP1 Solvent Cleaning.

E. Weld flux, weld spatter and excessive rust scale shall be removed by Power Tool Cleaning, as per SSPC-SP11-87T.

F. All weld seams, sharp protrusions, and edges shall be ground smooth prior to surface preparation or application of any coatings.

G. All areas requiring field welding shall be masked off prior to shop coating, unless waived by the Engineer.

H. All areas that require field touch-up after erection, such as welds, burnbacks, and mechanically damaged areas, shall be cleaned by thorough Power Tool as specified in SSPC-SP11-87T.

I. “Touch-up systems will be the same as original specification except that approved manufacturer’s organic zinc-rich shall be used in lieu of inorganic zinc where this system was originally used. Also, strict adherence to manufacturer’s complete touch-up recommendations shall be followed. Any questions relative to compatibility of products shall be brought to the Engineer’s attention; otherwise, Contractor assumes full responsibility.

3.03 PRETREATMENTS

A. When specified, the surface shall be pretreated in accordance with the specified pretreatment prior to application of the prime coat of paint.

3.04 STORAGE

A. Materials shall be delivered to the job site in the original packages with seals unbroken and with legible labels attached. Packages shall not be opened until they are inspected by the Engineer and required for use. All painting materials shall be stored in a clean, dry, well-ventilated place, protected from sparks, flame, the direct rays of the sun, or from excessive heat. Paint susceptible to damage from low temperatures shall be kept in a heated storage space when necessary. The Contractor shall be solely responsible for the protection of the materials stored by him at the job site. Empty coating cans shall be required to be neatly stacked in an areas designated by the Engineer and removed from the job site on a schedule determined by the Engineer. Engineer may request a notarized statement from contractor detailing all materials used on the project.

3.05 PREPARATION OF MATERIALS

A. Mechanical mixers, capable of thoroughly mixing the pigment and vehicle together, shall mix the paint prior to use where required by manufacturer’s instructions; thorough hand-mixing will be allowed for small amounts up to one gallon. Pressure pots shall be equipped with mechanical mixers to keep the pigment in suspension, when required by manufacturer’s instructions. Otherwise, intermittent hand mixing shall be done to assure that no separation occurs. All mixing shall be done in accordance with SSPC Vol. 1, Chapter 4, “Practical Aspects, Use and Application of Paints” and/or with manufacturer’s recommendations.

B. Catalysts or thinners shall be as recommended by the manufacturer and shall be added or discarded strictly in accordance with the manufacturer’s instruction.

3.06 APPLICATION

A. Paint shall be applied only on thoroughly dry surfaces and during periods of favorable weather, unless otherwise allowed by the paint manufacturer. Except as provided below, painting shall not be permitted when the atmospheric temperature is below 50° F, or when freshly painted surfaces may be damaged by rain, fog, dust, or condensation, and/or when it can be anticipated that these conditions will prevail during the drying period.

B. No coatings shall be applied unless surface temperature is a minimum of 5° above dew point; temperature must be maintained during curing.

3.07 DEW POINT CALCULATION CHART

DEW POINT CALCULATION CHART

Ambient Air Temperature – Fahrenheit

| Relative Humidity | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 90% | 18 | 28 | 37 | 47 | 57 | 67 | 77 | 87 | 97 | 107 | 117 |
| 85% | 17 | 26 | 36 | 45 | 55 | 65 | 76 | 84 | 95 | 103 | 113 |
| 80% | 16 | 25 | 34 | 44 | 54 | 63 | 73 | 82 | 93 | 102 | 108 |
| 75% | 15 | 24 | 33 | 42 | 52 | 62 | 71 | 80 | 91 | 100 | 108 |
| 70% | 13 | 22 | 31 | 40 | 50 | 60 | 68 | 78 | 88 | 96 | 105 |
| 65% | 12 | 20 | 29 | 38 | 47 | 57 | 66 | 76 | 85 | 93 | 103 |
| 60% | 11 | 29 | 27 | 36 | 45 | 55 | 64 | 73 | 83 | 92 | 101 |
| 55% | 9 | 17 | 25 | 34 | 43 | 53 | 61 | 70 | 80 | 89 | 98 |
| 50% | 6 | 15 | 23 | 31 | 40 | 50 | 59 | 67 | 77 | 86 | 94 |
| 45% | 4 | 13 | 21 | 29 | 37 | 47 | 56 | 64 | 73 | 82 | 91 |
| 40% | 1 | 11 | 18 | 26 | 35 | 43 | 52 | 61 | 69 | 78 | 87 |
| 35% | -2 | 8 | 16 | 23 | 31 | 40 | 48 | 57 | 65 | 74 | 83 |
| 30% | -6 | 4 | 13 | 20 | 28 | 36 | 44 | 52 | 61 | 69 | 77 |

SURFACE TEMPERATURE AT WHICH CONDENSATION OCCURS

3.08 DEW POINT

A. Temperature at which moisture will condense on surface. No coatings should be applied unless surface temperature is a minimum of 5° above this point. Temperature must be maintained during curing.

3.09 EXAMPLE

A. If air temperature is 70° F and relative humidity is 65%, the dew point is 57° F. No coating should be applied unless surface temperature is 62° F minimum.

B. No coatings shall be applied unless the relative humidity is below 85%.

C. Suitable enclosures to permit painting during inclement weather may be used if provisions are made to control atmospheric conditions artificially inside the enclosure, within limits suitable for painting throughout the painting operations.

D. Field Painting in the immediate vicinity of, or on, energized electrical and rotating equipment, and equipment and/or pipes in service shall not be performed without the approval of the Engineer.

E. Extreme care shall be exercised in the painting of all operable equipment, such as valves, electric motors, etc., so that the proper functioning of the equipment will not be affected.

F. The Contractor's scaffolding shall be erected, maintained, and dismantled without damage to structures, machinery, equipment or pipe. Drop cloths shall be used where required to protect buildings and equipment. All surfaces required to be clear for visual observations shall be cleaned immediately after paint application

G. Painting shall not be performed on insulated pipe within three (3) feet of insulation operations or on insulation who's covering and surface coat have not had time to set and dry. Painting shall not be performed on uninsulated pipe within one (1) foot of any type of connection until the connection has been made, except as directed by the Engineer.

H. The prime coat shall be applied immediately following surface preparation and in no case later than the same working day. All paint shall be applied by brushing, paint mitt and roller, conventional spraying, or airless spraying, using equipment approved by the paint manufacturer.

I. Each coat of paint shall be recoated as per manufacturer's instructions. Paint shall be considered recoatable when an additional coat can be applied without any detrimental film irregularities such as lifting or loss of adhesion.

J. Surfaces that will be inaccessible after assembly shall receive either the full specified paint system or three shop coats of the specified primer before assembly.

K. Finish colors shall be in accordance with the COLOR SCHEDULE and shall be factory mixed (i.e., there shall be no tinting by the Contractor, unless authorized by the Engineer).

L. All edges and weld seams in immersion service shall receive a “stripe coat” (applied by brush) of the 1st coat prior to application of the full 1st coat.

M. All open seams in the roof area of tanks shall be filled after application of the topcoat with a flexible caulking such as Sika Flex 1A.

3.10 WORKMANSHIP

A. The Contractor must show proof that all employees associated with this project shall have been employed by the Contractor for a period not less than six (6) months.

B. Painting shall be performed by experienced painters in accordance with the recommendations of the paint manufacturer. All paint shall be uniformly applied without sags, runs, spots, or other blemishes. Work that shows carelessness, lack of skill, or is defective in the opinion of the Engineer, shall be corrected at the expense of the Contractor.

C. The Contractor shall provide the names of at least 6 other projects of similar size and scope that they have successfully completed under their current company name.

3.11 APPLICATION OF PAINT

A. BRUSH AND/OR ROLLERS

1. Top quality, properly styled brushes and rollers shall be used. Rollers with a baked phenol core shall be utilized.

2. The brushing or rolling shall be done so that a smooth coat as nearly uniform in thickness as possible is obtained. Brush or roller strokes shall be made to smooth the film without leaving deep or detrimental marks.

3. Surfaces not accessible to brushes or rollers may be painted by spray, by dauber or sheepskins, and paint mitt.

4. It may require 2 coats to achieve the specified dry film thickness if application is by brush and roller.

B. AIR, AIRLESS, OR HOT SPRAY

1. The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied and shall be equipped with suitable pressure regulators and gauges.

2. Paint shall be applied in a uniform layer, with a 50% overlap pattern. All runs and sags should be brushed out immediately or the paint shall be removed and the surface resprayed.

3. High build coatings should be applied by a crosshatch method of spray application to ensure proper film thickness of the coating.

4. Areas inaccessible to spray shall be brushed; if also inaccessible to brush, daubs or sheepskins shall be used, as authorized by the manufacturer.

5. Special care shall be taken with thinners and paint temperatures so that paint of the correct formula reaches the receiving surface.

6. Nozzles, tips, etc., shall be of sizes and designs as recommended by the manufacturer of the paint being sprayed.

7. The first coat on concrete surfaces in immersion service should be sprayed and backrolled.

3.12 PROTECTION AND CLEAN-UP

A. It shall be the responsibility of the Contractor to protect at all times, in areas where painting is being done, floors, materials of other crafts, equipment, vehicles, fixtures, and finished surfaces adjacent to paint work. The Contractor shall over all electric plates, surface hardware, nameplates, gauge glasses, etc., before starting painting work.

B. At the option of the Engineer during the course of this project, the Contractor will contain all pent abrasives, old paint chips, paint overspray and debris by means suitable to the Engineer, including but not limited to, full shrouding of the area.

C. If shrouding is required, the Contractor must provide a complete design of the intended shroud or cover. Care must be taken not to modify or damage the structure during the use of the shroud. If damage should occur, the Contractor is held responsible for all repairs.

D. At completion of the work, remove all paint where spilled, splashed, splattered, sprayed or smeared on all surfaces, including glass, light fixtures, hardware, equipment, painted, and unpainted surfaces.

E. After completion of all painting, the Contractor shall remove from job site all painting equipment, surplus materials, and debris resulting from this work.

F. The Contractor is responsible for the removal and proper disposal of all hazardous materials from the jobsite in accordance with Local, State, and Federal requirements as outlined by the Environmental Protection Agency.

G. A notarized statement shall be presented to the Engineer that all hazardous materials have been disposed of properly including but not limited to: name of disposal company, disposal site, listing of hazardous materials, weights of all materials, cost per pound and EPA registration number.

3.13 TOUCH-UP MATERIALS

A. The Contractor shall provide at the end of the project at least one (1) gallon of each topcoat in each color as specified by the Engineer for future touch-up. Two gallons may be required for (2) component materials.

3.14 ON-SITE INSPECTION

A. During the course of this project the Engineer will reserve the option of incorporating the services of a qualified inspection service. The inspection service will be responsible for assuring the proper execution of this specification by the successful contractor.

3.15 COATING SYSTEM SCHEDULE

3.15.1 STEEL – STRUCTURAL, TANKS, PIPES, AND EQUIPMENT

A. EXTERIOR EXPOSURE (NON-IMMERSION)

A.1 System No. 73-1 Epoxy/High Build Urethane

Surface Preparation: SSPC-SP6 Commercial Blast Cleaning

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 66-1255 Epoxoline Primer | 3.0 – 4.0 |
| 2nd Coat: | 66-Color Hi-Build Epoxoline | 2.0 – 3.0 |
| 3rd Coat: | 73-Endura-Shield III | 2.0 – 3.0 |
| | | 7.0 -10.0 |
| | | Minimum 8.0 Mils |

NOTE: This system is highly resistant to abrasion, wet conditions, corrosive fumes, and chemical contact. Provides 2-3 times the color and gloss retention of conventional paints. Second coat to be same color or close to finish color. Specify Series 74 Endura-Shield for a gloss finish. Specify Series 161 in lieu of the 66 for faster recoats.

A.2 System No. 73-2 High Build Urethane For Marginally Cleaned Surfaces or Top coating Existing Systems.

Surface Preparation: SSPC-SP6 Commercial Blast Cleaning or SSPC-SP3 Power Tool Cleaning

| | Dry Film-Mils |
|---|---|
| Shop Coat: Manufacturer Standard Primer (or existing coating) | 1.5 – 2.0 |
| 2nd Coat: N27 S.T. Typoxy | 3.0 – 5.0 |
| 3rd Coat: 73-Color Endura-Shield | 2.0 – 3.0 |
| | 6.5-10.0 |
| | Minimum 7.5 Mils |

NOTE: This system can be used over factory finish paint or over non-sandblasted steel and offer the high performance of a urethane coating. Specify Series 74 Endura-Shield for gloss finish. A test patch is always recommended to insure proper application.

A.3 System No. 23-1 Alkyd Enamel – Semi-Gloss

Surface Preparation: SSPC-SP6 Commercial Blast Cleaning

| | Dry Film-Mils |
|---|---|
| 1st Coat: 37H-77 Chem-Prime H.S. | 2.0 – 3.5 |
| 2nd Coat: 23-Color Enduratone | 1.5 – 2.5 |
| 3rd Coat: 23-Color Enduratone | 1.5 – 2.5 |
| | 5.0 – 8.5 |
| | Minimum 6.0 Mils |

A.4 System 90-97 Zinc/Epoxy/Urethane

Surface Preparation: SSPC-SP6 Commercial Blast Cleaning

| | Dry Film-Mils |
|---|---|
| Primer: 90-97 Tneme-Zinc | 2.5 – 3.5 |
| 2nd Coat: 66-Color Hi-Build Epoxoline | 2.0 – 3.0 |
| 3rd Coat: 73 Endura-Shield III | 2.0 – 3.0 |
| | 6.5 – 9.5 |
| | Minimum 8.0 Mils |

NOTE: This system offers the added corrosion protection of a zinc rich primer. Series 90-97 Tneme-Zinc is an organic zinc-rich primer that can be used for field touch up of a zinc primer or for touch up of galvanized surfaces that are damaged. You can substitute Series 91-$H_2O$ Hydrozinc for the 90-97. You can substitute Series 74 for the Series 73 if a gloss finish is desired.

A.5 System No. 30-1 DTM Acrylic Overcoat System

Surface Preparation: Pressure Clean @ 3500 PSI Spot SP2, 3, 7, or 6

| | | Dry Film-Mils |
|---|---|---|
| Spot Primer: | 30 Spra-Saf EN | 2.0 – 4.0 |
| 2nd Coat: | 30 Spra-Saf EN | 2.0 – 4.0 |
| 3rd Coat: | 30 Spra-Saf EN | 2.0 – 4.0 |
| | | 6.0 – 12.0 |
| | | Minimum 9.0 Mils |

NOTE: This is an excellent coating system to overcoat existing unknown coating systems with limited surface preparation, using a non-stressful coating with excellent color and gloss retention. This coating should be spray applied and has excellent dry fall properties.

B. INTERIOR EXPOSURE (NON-IMMERSION)

B.1 System No. 69-1 High Solids Epoxy

Surface Preparation: SSPC-SP6 Commercial Blast Cleaning

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 69-1211 Epoxoline Primer II | 4.0 – 6.0 |
| 2nd Coat: | 69-Color Hi-Build Epoxoline II | 4.0 – 6.0 |
| | | 8.0 –12.0 |
| | | Minimum 10.0 Mils |

NOTE: This coating will provide maximum protection. It offers chemical and corrosion resistance for long-term protection against salt spray, moisture, corrosive fumes, and chemical attack. Series 69 is a polyamidoamine-cured epoxy. Primer coat must be touched-up before 2nd coat is applied.

B.2 System No. 66-2 High Build Epoxy

Surface Preparation: SSPC-SP6 Commercial Blast Cleaning

| | | Dry Film-Mils |
|---|---|---|
| Shop Coat: | 66-1211 Epoxoline Primer | 3.0 – 5.0 |
| 2nd Coat: | 66-Color Hi-Build Epoxoline | 4.0 – 6.0 |
| | | 7.0 –11.0 |
| | | Minimum 9.0 Mils |

NOTE: This system will provide chemical and corrosion resistance against abrasion, moisture, corrosion fumes, chemical contact, and immersion in non-potable water. Primer coat must be touched-up before 2nd coat is applied. Substitute Series 161 for low temperature cure or quick recoats.

B.3 System No. 66-6 High Build Epoxy (Over OEM Finishes)

Surface Preparation: Spot SSPC-SP6 Commercial Blast Cleaning or SSPC-SP11 Power Tool Cleaning To Bare Metal

| | | Dry Film-Mils |
|---|---|---|
| Shop Coat: | Manufacturer's Standard (or existing coating) | 1.0 – 2.0 |
| 2nd Coat: | 27 S.T. Typoxy | 3.0 – 5.0 |
| 3rd Coat: | 66-Color Hi-Build Epoxoline | 3.0 – 5.0 |
| | | 6.0–10.0 |
| | | Minimum 7.0 Mils |

NOTE: This system is to be used over standard manufacturer's primer to offer a high performance epoxy finish. Excellent for areas of rust not able to be completely cleaned.

C. IMMERSION

C.1 System No. 69-2 High Solids Epoxy (Non-Potable Water)

Surface Preparation: SSPC-SP10 Near White Blast Cleaning

| | | Dry Film-Mils |
|---|---|---|
| Shop Coat: | 69-1211 Hi-Build Epoxoline II | 5.0 – 7.0 |
| 2nd Coat: | 69-Color Hi-Build Epoxoline II | 6.0 – 8.0 |
| | | 11.0 -15.0 |
| | | Minimum 12.0 Mils |

NOTE: This system provides maximum protection in immersion service. Scarify the surface before top coating if the Series 69 has been exterior-exposed for 90 days or longer. If primer coat is damaged, it must be touched-up before 2nd coat if applied.

C.2 System No. 66-2 High Build Epoxy (Non-Potable Water)

Surface Preparation: SSPC-SP10 Near White Blast Cleaning

| | | Dry Film-Mils |
|---|---|---|
| Shop Coat: | 66-1211 Epoxoline Primer | 3.0 – 5.0 |
| 2nd Coat: | 66-Color Hi-Build Epoxoline | 3.0 – 5.0 |
| 3rd Coat: | 66-Color Hi-Build Epoxoline | 3.0 – 5.0 |
| | | 1.0 –15.0 |
| | | Minimum 11.0 Mils |

NOTE: This system will provide chemical and corrosion resistance for protection against abrasion, moisture, corrosive fumes, chemical contact, and immersion. Primer coat must be touched-up before 2nd coat is applied. Scarify the surface before top coating if the Series 66 has been exterior-exposed for 60 days or longer. Substitute Series 161 for low temperature cure or quick recoats.

C.3 System No. 20-1 Epoxy-Polyamide (Potable Water)

Surface Preparation: SSPC-SP10 Near White Blast Cleaning

| | | | Dry Film-Mils |
|---|---|---|---|
| Shop Coat or | | | |
| 1st Coat: | 20-WH02 | Pota-Pox (Tank White) | 3.0 – 5.0 |
| 2nd Coat: | 20-1255 | Pota-Pox (Beige) | 4.0 – 6.0 |
| 3rd Coat: | 20-WH02 | Pota-Pox (Tank White) | 4.0 – 6.0 |
| | | | 11.0–17.0 |
| | | | Minimum 12.0 Mils |

NOTE: This system meets American Water Works Association AWWA D 102 Inside Paint System Number 1. Series 20 meets the new requirements of approval for potable water use as established by the National Sanitation Foundation Standard 61.

C.4 System No. 140 High Solids Epoxy (Potable Water)

Surface Preparation: SSPC-SP10 Near White Blast Cleaning

| | | | Dry Film-Mils |
|---|---|---|---|
| Shop Coat or | | | |
| 1st Coat: | 140-1255 | Pota-Pox II (Beige) | 6.0 – 8.0 |
| 2nd Coat: | 140-WH02 | Pota-Pox II (Tank White) | 6.0 – 8.0 |
| | | | 12.0-16.0 |
| | | | Minimum 14.0 Mils |

NOTE: Series 140 meets the new requirements of approval for potable water use as established by the National Sanitation Foundation Standard 61.

C.5 System No. 46-30 Coal Tar-Epoxy (Non-Potable Water)

Surface Preparation: SSPC-SP10 Near White Blast Cleaning*

| | | Dry Film-Mils |
|---|---|---|
| One Coat: | 46H-413 Hi-Build Tneme-Tar | 14.0 – 20.0 |

NOTE: May be applied in a two-coat application. Review critical recoat time if utilized.

*SSPC-SP6 Commercial Blast Cleaning may be used for non-immersion service.

C.6 System No. 91-$H_2O$ Zinc/Epoxy (Potable Water)

Surface Preparation: SSPC-SP10 Near White Metal Blast

Dry Film-Mils

| | | | |
|---|---|---|---|
| 1st Coat: | 91- $H_2O$ | Hydrozinc | 2.5 – 3.5 |
| 2nd Coat: | 20-1255 | Pota-Pox (Beige) | 4.0 – 6.0 |
| 3rd Coat: | 20-WH02 | Pota-Pox (Tank White) | 4.0 – 6.0 |
| | | | 10.5-15.5 |
| | | | Minimum 12.0 Mils |

NOTE: Can substitute Series 40, 140, or FC20 for Series 20 if preferred. Meets AWWA D102-97 Inside Coating System No. 3.

3.15.2 OVERHEAD METAL DECKING, JOIST

A. INTERIOR EXPOSURE

A.1 System No. 15-1 Uni-Bond

Surface Preparation: Surfaces must be dry, clean, and free of oil, grease, and other contaminants. Allow concrete to cure 28 days.

| | | Dry Film-Mils |
|---|---|---|
| Coating: | 15-Color Uni-Bond | 2.5 – 3.5 |

NOTE: This system should be used on ceiling areas where a one-coat system is desired. Can be applied over steel, galvanized, and aluminum decking, joist, beams, conduits, and concrete.

B. EXTERIOR EXPOSURE

B.1 System No. N27 S.T. Typoxy

Surface Preparation: Pressure clean to remove all dirt, oil, grease, chemicals, and foreign contaminants. Remove loose paint and all rust by hand and power tool cleaning (SSPC-SP 2 & 3),

| | | Dry Film-Mils |
|---|---|---|
| Coating: | N27-Color S.T. Typoxy | 3.0 – 5.0 |

NOTE: This system can be applied over a wide variety of coatings and factory finishes. It can also be applied direct to galvanized aluminum decking, joists, conduits, and tight rust.

3.15.3 MILL COATED STEEL PIPE

A. EXTERIOR/INTERIOR EXPOSURE (NON-IMMERSION)

A.1 System No. 66-3 Epoxy-Polyamide

Surface Preparation: Surface shall be clean and dry. Scarify by Brush Blasting if surface is hard and glossy.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 66-1211 Epoxoline Primer | 3.0 – 4.0 |
| 2nd Coat: | 66-Color Hi-Build Epoxoline | 4.0 – 6.0 |
| 3rd Coat: | (If required) | (4.0 – 6.0) |
| | | (11.0 –16.0) |
| | | Minimum 11.0 Mils |

NOTE: This system can be applied directly to mill coated steel pipe without sandblasting for use in non-immersion. There may be some bleed through with the 1st coat. Do not apply over glossy varnish type mill coatings.

3.15.4 GALVANIZED STEEL – PIPE AND MISCELLANEOUS FABRICATIONS

A. EXTERIOR/ (NON-IMMERSION)

A.1 System No. 73-2 Epoxy/High Build Urethane

Surface Preparation: SSPC-SP1 Solvent Cleaning and Scarify Brush Off Blasting or Hand Sanding

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 66-Color Hi-Build Epoxoline | 2.0 – 4.0 |
| 2nd Coat: | 73-Color Endura-Shield | 2.0 – 4.0 |
| | | 4.0 – 8.0 |
| | | Minimum 5.0 Mils |

NOTE: Series 66 has excellent adhesion to galvanized steel. This system is highly resistant to abrasion, wet conditions, corrosive fumes, and chemical contact. Provides 2-3 times the color and gloss retention of conventional paints. First coat to be same color as or close to the finish color. Specify Series 74 Endura-Shield for gloss finish.

B. INTERIOR EXPOSURE (NON IMMERSION)

B.1 System No. 66-6 Polyamide Epoxy

Surface Preparation: SSPC-SP1 Solvent Cleaning and Scarify by Brush Off Blasting or Hand Sanding

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 66-Color Hi-Build Epoxoline | 2.0 – 4.0 |
| 2nd Coat: | 66-Color Hi-Build Epoxoline | 2.0 – 4.0 |
| | | 4.0 – 8.0 |
| | | Minimum 5.0 Mils |

C. IMMERSION (POTABLE WATER)

C.1 System No. 20-1 Epoxy-Polyamide (Potable Water)

Surface Preparation: Solvent Clean Per SSPC-SP1 & Cleaning per SSPC-SP7

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 20-1255 Pota-Pox Primer | 4.0 – 6.0 |
| 2nd Coat: | 20-WH02 Pota-Pox Finish | 4.0 – 6.0 |
| | | 8.0–12.0 |
| | | Minimum 10.0 Mils |

NOTE: Series 20 meets the new requirements of approval for potable water use as established by the National Sanitation Foundation Standard 61.

3.15.5 CHAIN-LINK FENCES

A. GALVANIZED STEEL & NON-FERROUS METAL

A.1 System No. 6-2 Acrylic

Surface Preparation: Surface shall be clean and dry

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0 |
| 2nd Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0 |
| | | 4.0 – 6.0 |
| | | Minimum 5.0 Mils |

3.15.6 CONCRETE

A. EXTERIOR – ABOVE GRADE

A.1 System No. 180-1 High Build Acrylic Emulsion – Smooth

Surface Preparation: Surface shall be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 180-Color W.B. Tneme-Crete | 4.0 – 6.0 |
| 2nd Coat: | 180-Color W.B. Tneme-Crete | 4.0 – 6.0 |
| | | 8.0 –12.0 Mils |

NOTE: Series 180 is a high build decorative acrylic coating in a smooth finish. Substitute Series 181 if a sand texture finish if desired.

B. System No. 6-1 Acrylic Emulsion Low Sheen

Surface Preparation: Surface must be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0 |

| | | |
|---|---|---|
| 2nd Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0<br>4.0 – 6.0<br>Minimum 5.0 Mils |

NOTE: If semi-gloss finish is desired, use Series 7 Tneme-Cryl SG as the 2nd coat.

C. System No. 156-1 Modified Acrylic Elastomer

Surface Preparation: Surface must be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 156-Color Enviro-Crete | 4.0 – 8.0 |
| 2nd Coat: | 156-Color Enviro-Crete | 4.0 – 8.0<br>8.0 –16.0<br>Minimum 10.0 Mils |

NOTE: If texture is needed, use 157 Enviro-Crete TX (medium texture) or 159 Enviro-Crete XTX (coarse texture). For application over previously applied coatings, use TNEMEC Series 151 Elasto-Grip at 1.0 – 2.5 mils DFT prior to the application of Series 156 Enviro-Crete. Also use Series 151 for stucco surface.

D. EXTERIOR – BELOW GRADE

D.1 System No. 46-61 Coal Tar Pitch Solution

Surface Preparation: Surface must be clean and dry. Level all protrusions.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 46-465 H.B. Tnemecol | 8.0 –12.0 |
| 2nd Coat: | 46-465 H.B. Tnemecol | 8.0 –12.0<br>16.0 - 24.0<br>Minimum 16.0 Mils |

D.2 System No. 46-31 Coal Tar Epoxy

Surface Preparation: Surface shall be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| One Coat: | 46H-413 Hi-Build Tneme-Tar | 14.0-20.0 |

D.3 System No. 100-1 Crystalline Waterproofing

Surface Preparation: Surface to be clean and roughened by Brush Blasting or Acid Etching.

1st Coat: XYPEX Concentrate @ (1.5 #/SY)
2nd Coat: XYPEX Modified @ (1.5 #/SY)

NOTE: This system can be applied to concrete that is still wet or hasn't developed final cure. It can be used where wet surface conditions exist or where there is the potential for water intrusion due to hydrostatic pressure. Application shall be per XYPEX specification manual.

E. EXTERIOR/INTERIOR EXPOSURE (NON-IMMERSION)

E.1 System No. 6-1 Acrylic Emulsion, Low Sheen (Interior/Exterior)

Surface Preparation: Surface shall be clean and dry. Allow concrete to cure for 28 days.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0 |
| 2nd Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0 |
| | | 4.0 – 6.0 |
| | | Minimum 5.0 Mils |

NOTE: This system will provide a decorative coating with good exterior durability, color retention, and a high vapor transmission rate. For Semi-Gloss finish, use 7-Color Tneme-Cryl S/G.

E.2 System No. 66-4 Epoxy-Polyamide (Interior/Exterior)

Surface Preparation: Surfaces shall be clean and dry. Allow concrete to cure for 28 days. SSPC-SP7 Brush Off Blast Clean.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 66-Color Hi-Build Epoxoline | 3.0 – 5.0 |
| 2nd Coat: | 66-Color Hi-Build Epoxoline | 4.0 – 6.0 |
| | | 7.0–11.0 |
| | | Minimum 9.0 Mils |

E.3 System No. 83-1 High Solids Catalyzed Epoxy (Interior)

Surface Preparation: Surfaces shall be clean and dry. Allow concrete to cure for 28 days. SSPC-SP7 Brush Off Blast Clean. Concrete block surfaces: Allow to cure 28 days. Level fins, protrusion, and mortar splatter.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 83-Color Ceramlon II | 6.0 – 10.0 |
| 2nd Coat: | 83-Color Ceramlon II | 6.0 – 10.0 |
| | | 12.0 - 20.0 |
| | | Minimum 14.0 Mils |

F. IMMERSION – POTABLE & NON-POTABLE WATER

F.1 System No. 66-4 Epoxy-Polyamide (Non-Potable Water)

Surface Preparation: SSPC-SP7 Brush Off Blast Cleaning

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 66-Color Hi-Build Epoxoline | 4.0 – 6.0 |
| 2nd Coat: | 66-Color Hi-Build Epoxoline | 4.0 – 6.0 |
| | | 8.0 –12.0 |
| | | Minimum 10.0 Mils |

NOTE: Surface irregularities and bug holes should be filled to a smooth uniform appearance as required with TNEMEC Series 63-1500 Filler & Surfacer. First coat should be spray applied and backrolled.

F.2 System No. 104-5 High Solids Epoxy (Non-Potable Water)

Surface Preparation: SSPC-SP7 Brush Off Blast Cleaning

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 104-1255 H.S. Epoxy Primer | 6.0 – 10.0 |
| 2nd Coat: | 104-Color H.S. Epoxy | 6.0 – 10.0 |
| | | 12.0 - 20.0 |
| | | Minimum 10.0 Mils |

NOTE: Surface irregularities and bug holes should be filled to a smooth uniform appearance as required with TNEMEC Series 63-1500 Filler & Surfacer. First coat should be spray applied and backrolled.

F.3 System No. 46-31 Coal Tar-Epoxy (Non-Potable Water)

Surface Preparation: Brush Off Blasting Cleaning

| | | Dry Film-Mils |
|---|---|---|
| One Coat: | 46H-413 Hi-Build Tneme-Tar | 14.0 – 20.0 |

NOTE: May be applied in a two-coat application. Review critical recoat time if utilized. Surface irregularities and bug holes should be filled to a smooth uniform appearance as required with TNEMEC Series 63-1500 Filler & Surfacer.

F.4 System No. 20-2 Epoxy-Polyamide (Potable Water)

Surface Preparation: SSPC-SP10 Near White Blast Cleaning

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 20-1255 Pota-Pox | 4.0 – 6.0 |

| | | |
|---|---|---|
| 2nd Coat: | 20-WH02 Pota-Pox Finish | 4.0 – 6.0<br>8.0 –12.0<br>Minimum 10.0 Mils |

NOTE: This system meets American Water Works Association AWWA D 102 inside System No. 1. Series 20 meets the new requirements of approval for potable water use as established by the National Sanitation Foundation Standard 61. Surface irregularities and bug holes should be filled to a smooth uniform appearance as required with TNEMEC Series 63-1500 Filler & Surfacer. (NSF Standard 61 approved). Substitute Series FC20 for low temperature cure or quick recoats.

F.5 System No. 140-2 Epoxy-Polyamidoamine (Potable Water)

Surface Preparation: SSPC-SP10 Near White Blast Cleaning

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 140-1255 Pota-Pox Plus | 6.0 – 8.0 |
| 2nd Coat: | 140-WH02 Pota-Pox Plus | 6.0 – 8.0<br>12.0-16.0<br>Minimum 14.0 Mils |

NOTE: Series 140 meets the new requirements of approval for potable water use as established by the National Sanitation Foundation Standard 61. Surface irregularities and bug holes should be filled to a smooth uniform appearance as required with TNEMEC Series 63-1500 Filler & Surfacer. (NSF Standard 61 approved). First coat should be sprayed and backrolled.

F.6 System No. 264-1 Elastomeric Polyurethane

Surface Preparation: Surfaces shall be clean and dry. Allow new concrete to cure for 28 days. Abrasive blast clean per SSPC-SP7 (Brush Off Blast).

| | | Dry Film-Mils |
|---|---|---|
| Primer: | 20-WH02 (Tank White) | 5.0 Mils |
| Coating: | 264 Elasto-Shield (Black) | 60.0 Mils ±<br>Minimum 65.0 Mils |

NOTE: This system is NSF Certified for Potable Water. This flexible liner can be used to rehab tanks with leaks. Multiple passes may be required to achieve the desired thickness that can range from 50-100 mils. See Elasto-Shield Application Guide for detailed instructions.

G. INTERIOR EXPOSURE (NON-IMMERSION)

G.1 System No. 104-3 High Solids Epoxy

Surface Preparation: Surface to be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 104-Color H.S. Epoxy | 6.0 – 8.0 |
| 2nd Coat: | 104-Color H.S. Epoxy | 6.0 – 8.0 |
| | | 12.0 -16.0 |
| | | Minimum 14.0 Mils |

NOTE: This system will produce a slick, tile-like finish that has excellent chemical and water resistance. Surface will be easy to clean. First coat should be spray applied and backrolled.

G.2 System No. 113-1 Acrylic-Epoxy Semi-Gloss

Surface Preparation: Surface must be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 113-Color Tneme-Tufcoat | 4.0 – 6.0 |

NOTE: This system will provide high performance and can be applied directly over existing coatings without lifting. Can be used when low odor is required during application. Specify Series 114 Tneme-Tufcoat for Gloss Finish. Two coats will be required to achieve the specified film thickness if applied by roller.

3.15.7 CONCRETE FLOORS

A. EPOXY FLOOR COATING

A.1 System No. 66-1 Epoxy-Polyamide

Surface Preparation: Allow concrete to cure 28 days. Acid Etch or Brush Off Blast Cleaning

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 66-Color Hi-Build Epoxoline | 2.0 – 3.0 |
| 2nd Coat: | 66-Color Hi-Build Epoxoline | 2.0 – 3.0 |
| | | 4.0 – 6.0 |
| | | Minimum 5.0 Mils |

NOTE: This system will provide a durable, long-wearing coating that bonds tightly to concrete and stands up under heavy foot traffic, frequent cleaning, and spillage of water, oil, grease, or chemical.

A.2 System No. 287-1 Waterborne Epoxy-Amine

Surface Preparation: Allow concrete to cure 28 days. Acid Etch or Brush Off Blast Cleaning

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 287-Color Enviro-Tread | 2.0 – 4.0 |
| 2nd Coat: | 287-Color Enviro-Tread | 2.0 – 4.0 |
| | | 4.0 – 8.0 |
| | | Minimum 5.0 Mils |

NOTE: For a non-skid finish, add 287-300C skid-resistance sand into the first coat.

A.3 System No. 291-12 Epoxy/Urethane

Surface Preparation: Allow concrete to cure 28 days. Acid Etch or Brush Off Blast Cleaning

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 66-Color Hi-Build Epoxoline | 2.0 – 3.0 |
| 2nd Coat: | 66-Color Hi-Build Epoxoline | 2.0 – 3.0 |
| 3rd Coat: | 291-Color CRU | 2.0 – 3.0 |
| | | 6.0 – 9.0 |
| | | Minimum 7.0 Mils |

NOTE: This system offers a hard, chemically resistant floor coating with excellent flow properties and color and gloss retention.

A.4 System No. 281-1 High Build Polyamine-Epoxy Floor

Surface Preparation: Allow concrete to cure 28 days. Abrasive Blast Cleaning (Refer to Installation Guide of manufacturer.)

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 201 Epoxoprime | 6.0 – 8.0 |
| 2nd Coat: | 281 Tneme-Glaze | 6.0 – 8.0 |
| 3rd Coat: | 281 Tneme-Glaze | 6.0 – 8.0 |
| | | 18.0 –24.0 |
| | | Minimum 18 Mils |

Please refer to manufacturer's Installation Guide and Technical Data for proper installation.

A.5 System No. 221/281 Functional Flooring (Non-Slip)

Surface Preparation: Abrasive Blast Cleaning (Refer to Installation Guide of manufacturer.)

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 201 Epoxoprime | 6.0 – 8.0 |
| 2nd Coat: | 221 Lami-Tread | 1/8" (2 cts @ 1/16" each) |

| | | |
|---|---|---|
| 3rd Coat: | 281 Tneme-Glaze | 8.0 –12.0<br>Minimum ¼"+ |

Please refer to manufacturer's Installation Guide and Technical Data for proper installation.

3.15.8 POROUS MASONRY

A. EXTERIOR/INTERIOR EXPOSURE

A.1 System No. 180-2 Acrylic Emulsion – Smooth

Surface Preparation: Surface shall be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 180-Color W.B. Tneme-Crete | 6.0 – 8.0 |
| 2nd Coat: | 180-Color W.B. Tneme-Crete | 6.0 – 8.0 |
| | | 12.0-16.0 |

NOTE: First coat of Tneme-Crete will act as a filler coat while the second coat will completely seal and finish. Long-term life and high performance. Available in Series 181 in a sand finish.

A.2 System No. 6-2 Acrylic Emulsion, Low Sheen

Surface Preparation: Surface shall be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 54-562 Modified Epoxy | 80 SF Gal Masonry Filler |
| 2nd Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0 |
| 3rd Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0 |
| | | *4.0 – 6.0 |

*Total dry film thickness of topcoats only.

NOTE: This system will fill the block and provide a sealed surface. For semi-gloss finish, use 7-Color Tneme-Cryl S/G.

A.3 System No. 66-15 Epoxy-Polyamide (Interior)

Surface Preparation: Surface shall be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 54-660 Epoxy Masonry Filler | 100 SF Gal |
| 2nd Coat: | 66-Color Hi-Build Epoxoline | 4.0 – 6.0 |

| | | |
|---|---|---|
| 3rd Coat: | 66-Color Hi-Build Epoxoline | 4.0 – 6.0 |
| | | *8.0–12.0 |

*Total dry film thickness of topcoats only.

NOTE: Block filler is a modified epoxy designed for high moisture.

A.4 System No. 104-6 High Solids Epoxy (Interior Only)

Surface Preparation: Surface to be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 104-Color H.S. Epoxy | 6.0 – 10.0 |
| 2nd Coat: | 104-Color H.S. Epoxy | 6.0 – 10.0 |
| | | 12.0 – 20.0 |
| | | Minimum 14.0 Mils |

NOTE: This system will produce a film thickness of 16 mils. The surface will be tile-like for easy cleaning and will provide protection against chemical attack, corrosive fumes, high humidity and wash down. Backroll first coat to fill porosity.

A.5 System No. 113-1 Acrylic-Epoxy Semi-Gloss (Interior Only)

Surface Preparation: Surface must be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 130 Envirofill | 100 SF/Gal |
| 2nd Coat: | 113-Color Tneme-Tufcoat* | 4.0 – 6.0 |
| | | 4.0 – 6.0 |

*Two coats may be required if applied by roller

NOTE: Series 113 Tneme-Tufcoat has very low odor and can be used when painting in occupied areas. Specify Series 114 Tneme-Tufcoat for a gloss finish.

A.6 System No. 156-1 Modified Acrylic Elastomer

Surface Preparation: Surface must be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 130 Envirofill | 100 SF/Gal |
| 2nd Coat: | 156-Color Enviro-Crete | 4.0 – 8.0 |
| 3rd Coat: | 156-Color Enviro-Crete | 4.0 – 8.0 |
| | | 8.0–16.0 |
| | | Minimum 10.0 Mils |
| | | (For 2nd & 3rd Coats) |

NOTE: If texture is needed, use 157 Enviro-Crete TX (medium texture or 159 Enviro-Crete XTX – coarse texture). For application over previously applied coatings, use TNEMEC 151 Elasto-Grip at 1.0 – 2.5 mils DFT.

3.15.9 GYPSUM WALLBOARD

A. INTERIOR EXPOSURE

A.1 System No. 113-5 Acrylic-Epoxy

Surface Preparation: Surface must be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 51-792 PVA Sealer | 1.0 – 2.0 |
| 2nd Coat: | 113 H.B. Tneme-Tufcoat* | 4.0 – 5.0 |
| | | 5.0 – 7.0 |
| | | Minimum 6.0 Mils |

NOTE: *Two coats may be required if application is by brush and roller. Substitute Series 114 if a gloss finish is desired.

A.2 System No. 66-22 Hi-Build Epoxoline

Surface Preparation: Surface must be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 51-792 PVA Sealer | 1.0 – 2.0 |
| 2nd Coat: | 66-Color Hi-Build Epoxoline* | 4.0 – 6.0 |
| | | 5.0 – 8.0 |
| | | Minimum 5.0 Mils |

NOTES: *Two coats may be required if applied by roller.

A.3 System No. 6-1 Acrylic Emulsion, Low Sheen
(Interior / Exterior Exposure)

Surface Preparation: Surface must be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0 |
| 2nd Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0 |
| | | 4.0 – 6.0 |
| | | Minimum 5.0 Mils |

NOTE: This system is designed for mild use areas like office walls, laboratory ceilings, stairwells, etc. For semi-gloss finish, use 7-Color Tneme-Cryl S/G.

3.15.10 WOOD

A. EXTERIOR/INTERIOR EXPOSURE

A.1 System No. 23-4 Alkyd Semi-Gloss

Surface Preparation: Surface shall be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 36-603 Undercoater | 2.5 – 3.5 |
| 2nd Coat: | 23 Enduratone | 1.5 – 3.5 |
| 3rd Coat: | 23 Enduratone | 1.5 – 3.5 |
| | | 5.5–10.5 |
| | | Minimum 6.0 Mils |

NOTE: Specify Series 2H Hi-Build Tneme-Gloss for High Gloss finish.

A.2 System No. 6-5 Acrylic Latex

Surface Preparation: Surface shall be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 36 Undercoater | 2.0 – 3.5 |
| 2nd Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0 |
| 3rd Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0 |
| | | 6.0 – 9.5 |
| | | Minimum 7.5 Mils |

NOTE: Substitute Series 7 if semi-gloss finish is desired.

3.15.11 PVC PIPE

A. EXTERIOR OR INTERIOR

A.1 System No. 66-23 Epoxy-Polyamide

Surface Preparation: Surface shall be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| One Coat: | 66-Color Hi-Build Epoxoline | 4.0 – 6.0 |

NOTE: Optional topcoat of Series 73/74 Endura-Shield would give long-term color and gloss retention for exterior exposure.

3.15.12 INSULATED PIPE

A. INTERIOR EXPOSURE

A.1 System No. 6-1 Acrylic Emulsion, Low Sheen

Surface Preparation: Surface shall be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0 |
| 2nd Coat: | 6-Color Tneme-Cryl | 2.0 – 3.0 |
| | | 4.0 – 6.0 |
| | | Minimum 5.0 Mils |

NOTE: For semi-gloss finish, use 7-Color Tneme-Cryl S/G.

3.15.13 HIGH HEAT COATING

A. EXTERIOR/INTERIOR EXPOSURE

A.1 System No. 39-2 Silicone Aluminum (1200° F Maximum)

Surface Preparation: SSPC-SP10 Near White Blast Cleaning – 1.0 Mil Surface Profile

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 39-1261 Silicone Aluminum | 1.0 – 1.5 |
| 2nd Coat: | 39-1261 Silicone Aluminum | 1.0 – 1.5 |
| | | 2.0 – 3.0 |
| | | Minimum 2.0 Mils |

A.2 System No. 39-4 Silicone Aluminum (600° F Maximum)

Surface Preparation: SSPC-SP10 Near White Blast Cleaning 1.0 Mil Surface Profile

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 39-661 Silicone Aluminum | 1.0 – 1.5 |
| 2nd Coat: | 39-661 Silicone Aluminum | 1.0 – 1.5 |
| | | 2.0 – 3.0 |
| | | Minimum 2.0 Mils |

3.15.1 SURFACES EXPOSED TO $H_2S/H_2SO_4$ (SEVERE EXPOSURE/IMMERSION)

A. CEMENTITIOUS SURFACES

A.1 System No. 120-1 Vinyl Ester

Surface Preparation: Abrasive blast clean to remove all laitance, fines, and contamination.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 120-5002 Vinester | 6.0 – 10.0* |
| 2nd Coat: | 120-5003 Vinester F&S | As Required** |
| 3rd Coat: | 120-5002 Vinester | 12.0 – 18.0 |
| 4th Coat: | 120-5001 Vinester | 12.0 – 18.0 |
| | | 30.0 - 46.0 |
| | | Minimum 36.0 Mils + |

Notes:
*First coat to be applied by roller application or spray applied followed by backrolling.

**All surface voids, cracks, pinholes, and other defects must be filled flush with the adjacent surfaces by putty knife, trowel, float, squeegee, or other suitable method.

B. FERROUS METAL SURFACES

B.1 System No. 120-2 Vinyl Ester

Surface Preparation: SSPC-SP5 White Metal Blast Cleaning (3.0 Mil Profile)

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 120-5002 Vinester | 12.0 – 18.0 |
| 2nd Coat: | 120-5001 Vinester | 12.0 – 18.0 |
| | | 24.0 – 36.0 |
| | | Minimum 30.0 Mils |

3.15.15 EXTERIOR OF PRESTRESSED CONCRETE TANKS

A. System No. 156-3 New Tanks

Surface Preparation: Surface to be clean and dry.

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 156-Color Envirocrete | 4.0 – 6.0 |
| 2nd Coat: | 156-Color Envirocrete | 4.0 – 6.0 |
| | | 8.0–12.0 |
| | | Minimum 10.0 Mils |

A.1 System No. 156-4 Existing Tanks (Previously Painted)

Surface Preparation: Remove all dirt, oil, grease, chalk, and loose paint per High Pressure Water Blast (Min 3500 PSI).

| | | Dry Film-Mils |
|---|---|---|
| 1st Coat: | 151 Elasto-Grip | 1.0 – 2.5 |
| Stripe Coat: | Stripe all hairline cracks with a Brushed coat of Series 156 Envirocrete | 3.0 – 5.0 |
| Topcoat: | 156-Envirocrete | 4.0 – 6.0 |
| | (Cracks) | 8.0–13.5 |
| | (Other) | 5.0 – 8.5 |

3.15.16 SECONDARY CONTAINMENT AREAS

A. System No. 66-4 Epoxy Polyamide

Surface Preparation: Surface shall be clean and dry. Allow new concrete to cure for 28 days. Abrasive Blast Clean per SSPC-SP7 (Brush Off Blast).

| | | Dry Film-Thickness |
|---|---|---|
| Primer: | 66-Color Hi-Build Epoxoline | 4.0 – 6.0 |
| Topcoat: | 66-Color Hi-Build Epoxoline | 4.0 – 6.0 |
| | | 8.0–12.0 |
| | | Minimum 10.0 Mils |

NOTE: This system will provide excellent resistance to most chemicals including petrochemicals. Use Tnemec Series 63-1500 between coats as a filler and surfacer wherever it is required.

A.1 System No. 61-1 Amine Epoxy

Surface Preparation: Surfaces shall be clean and dry. Allow new concrete to cure for 28 days. Abrasive Blast Clean per SSPC-SP6 (Brush Off Blast).

| | | Dry Film-Thickness |
|---|---|---|
| Primer: | 61-5002 Tneme-Liner (Beige) | 8.0 – 12.0 |
| Topcoat: | 61-5001 Tneme-Liner (Gray) | 8.0 – 12.0 |
| | | 16.0 - 24.0 |

NOTE: This system offers superior chemical resistance to a wide range of chemicals. Use Tnemec Series 63-1500 between coats as a filler and surfacer wherever it is required.

A.2 System 262-1 Flexible Polyurethane

Surface Preparation: Surfaces shall be clean and dry. Allow new concrete to cure for 28 days. Abrasive Blast Clean per SSPC-SP7 (Brush Off Blast).

| | | Dry Film-Thickness |
|---|---|---|
| Primer: | 66 Hi-Build Epoxoline | 5 Mils |
| Coating: | 262 Elasto-Shield (Black) | 50Mils |

Total 55 Mils

NOTE: Multiple passes may be required to achieve recommended film thickness. See Elasto-Shield Application Guide for additional instructions. This product is only available in black

3.15.17 CLEAR WATER REPELLENT FOR CONCRETE, MASONRY & BRICK

A. Silane Sealer (Min 28% Solids)

Surface Preparation: Allow new concrete to cure 28 days. Clean surfaces to be sealed by abrasive blasting or waterblasting.

| | Coverage |
|---|---|
| Brick, Concrete: PRIME A PELL Plus | 125-200 SF/GAL |
| Porous Masonry: PRIME A PELL Plus | 65-100 SF/GAL |

3.15.18 MANHOLES, WET WELLS & LIFT STATIONS

A. System No. 120-1 Vinyl Ester

Surface Preparation: Abrasive blast clean to remove all laitance, fines, and contamination.

| | Dry Film-Thickness |
|---|---|
| 1st Coat: 120-5002 Vinester | 6.0 – 10.0* |
| 2nd Coat: 120-5003 Vinester F&S | As required** |
| 3rd Coat: 120-5002 Vinester | 12.0 – 18.0 |
| 4th Coat: 120-5001 Vinester | 12.0 – 18.0 |
| | 30.0 – 46.0 |
| | Minimum 36.0 Mils + |

*First coat to be applied by roller application or spray applied followed by backrolling.

**All surface voids, cracks, pinholes, and other defects must be filled flush with the adjacent surfaces by putty knife, trowel, float, squeegee, or other suitable method.

B. System No. 100-1 Crystalline Waterproofing

Surface Preparation: Surface to be clean and roughened by Brush Blasting, Acid Etching, or High Pressure Water Blasting (3500 PSI) with turbo tips.

1st Coat: XYPEX Concentrate @ (1.5#/SY) – 1/16"±
2nd Coat: XYPEX Modified @ (1.5#/SY) – 1/16"±

NOTE: This system can be applied to concrete that is still wet or hasn't developed final cure. It can be used where wet surface conditions exist or where there is the potential for water intrusion due to hydrostatic pressure.

3.15.19 CANAL PIPE CROSSINGS

A. System 90-97 Zinc/Epoxy/Urethane for New Pipe or Pipe Requiring Removal of Existing Coatings

Surface Preparation: SSPC-SP6 Commercial Blast Cleaning

| | | Dry Film-Thickness |
|---|---|---|
| Primer: | 90-97 Tneme-Zinc | 2.5 – 3.5 |
| 2nd Coat: | 66-Color Hi-Build Epoxoline | 2.0 – 3.0 |
| 3rd Coat: | 74-Color Endura-Shield | 2.0 – 3.0 |
| | | 6.5 – 9.5 |
| | | Minimum 8.0 Mils |

A.1 System No. 135-2 High Build, High Gloss Urethane for Marginally Cleaned. Surfaces or Topcoating Over Existing Systems

Surface Preparation: High Pressure Water Blast (Min 3500 PSI) or Solvent Clean (SSPC-SP1) and Spot Hand and Power Tool Clean (SSPC-SP2 & 3) or Brush Blast (SSPC-SP7). Existing coatings must be clean, dry, and tightly adhering prior to application of coatings.

| | | Dry Film-Thickness |
|---|---|---|
| 1st Coat: | N27 S.T. Typoxy | 3.0 – 4.0 |
| 2nd Coat: | 74-Color Endura-Shield | 2.0 – 3.0 |
| | | 5.0 – 7.0 |
| | | Minimum 5.0 Mils |

NOTE: A test Patch is always recommended to insure proper adhesion to existing coatings without lifting of existing coatings.

4.00 GENERAL STATEMENT

Manufacturer's Technical Data Sheets, Installation Instructions and Label Directions are considered to be part of this specification.

Systems not applicable to this project should be deleted.

Consult TNEMEC for additional systems needed to address surfaces not included within these specifications.

4.01 STEEL

A. EXTERIOR (NON-IMMERSION)

A.1 System No. 73-1 Epoxy/High Build Urethane
A.2 System No. 73-2 High Build Urethane
A.3 System No. 23-1 Alkyd Enamel
A.4 System 90-97 Zinc/Epoxy/Urethane
A.5 System 30-1 DTM Acrylic Overcoat

B. INTERIOR EXPOSURE (NON-IMMERSION)

B.1 System No. 69-1 High Solids Epoxy
B.2 System No. 66-2 High Build Epoxy
B.3 System No. 66-6 High Build Epoxy

C. IMMERSION

C.1 System No. 69-2 High Solids Epoxy (Non-Potable)
C.2 System No. 66-2 High Build Epoxy (Non-Potable)
C.3 System No. 20-1 Epoxy-Polyamide (Potable)
C.4 System No. 140 High Solids Epoxy (Potable Water)
C.5 System No. 46-30 High Build Coal Tar Epoxy (Non-Potable Only)
C.6 System No. 91-$H_2O$ Hydrozinc

D. OVERHEAD METAL DECKING, JOIST (INTERIOR EXPOSURE)

D.1 System No. 15-1 Uni-Bond

E. OVERHEAD METAL DECKING, JOIST (EXTERIOR EXPOSURE)

E.1 System No. N27 S.T. Typoxy

F. MILL COATED STEEL PIPE

F.1 System No. 66-3 Epoxy Polyamide

G. GALVANIZED STEEL-PIPE AND MISCELLANEOUS FABRIACATORS

G.1 System No. 73-2 Epoxy/High Build Urethane

H. GALVANIZED STEEL-INTERIOR EXPOSURE (NON-IMMERSION)

H.1 System No. 66-6 Polyamide Epoxy

I. GALVANIZED STEEL-IMMERSION (POTABLE WATER)

I.1 System No. 20-1 Epoxy Polyamide (Potable Water)

J. CHAIN LINK FENCES

J.1 System No. 6-2 Acrylic

4.02 CONCRETE

A. EXTERIOR-ABOVE GRADE

1. System No. 180 High Build Acrylic Emulsion – Smooth
2. System No. 6-1 Acrylic Emulsion Low Sheen
3. System No. 156-1 Modified Acrylic Elastomer

B. EXTERIOR-BELOW GRADE

1. System No. 46-61 Coal Tar Pitch Solution
2. System No. 46-31 Coal Tar Epoxy
3. System No. 100-1 Crystalline Waterproofing

C. EXTERIOR/INTERIOR EXPOSURE (NON-IMMERSION)

1. System No. 6-1 Acrylic Emulsion Low Sheen
2. System No. 66-4 Epoxy-Polyamide
3. System No. 83-1 High Solids Catalyzed Epoxy

D. IMMERSION (POTABLE & NON-POTABLE)

1. System No. 66-4 Epoxy-Polyamide (Non-Potable)
2. System No. 104-5 High Solids Epoxy (Non-Potable)
3. System No. 46-31 High Build Coal Tar Epoxy (Non-Potable Only)
4. System No. 20-2 Epoxy Polyamide (Potable)
5. System No. 140-2 Epoxy Polyamidoamine (Potable)
6. System No. 264-1 Elastomeric Polyurethane (Potable)

E. INTERIOR EXPOSURE (NON-IMMERSION)

1. System No. 104-3 High Solids Epoxy
2. System No. 113-1 Acrylic Epoxy Semi-Gloss

F. CONCRETE FLOORS

1. System No. 66-1 Epoxy-Polyamide
2. System No. 287-1 Waterborne Epoxy Amine
3. System No. 291-12 Epoxy/Urethane

4. System No. 281-1 High Build Polyamide-Epoxy Flooring
5. System No. 221/281 Functional Flooring (Non-Slip)

G. POROUS MASONRY-EXTERIOR/INTERIOR EXPOSURE

1. System No.180-2 High Build Acrylic Emulsion – Smooth
2. System No. 6-2 Acrylic Emulsion, Low Sheen
3. System No. 66-15 Epoxy-Polyamide (Interior)
4. System No. 104-6 High Solids Epoxy (Interior Only)
5. System No. 113-1 Acrylic Epoxy Semi-Gloss (Interior Only)
6. System No. 156-1 Modified Acrylic Elastomer

H. GYPSUM WALLBOARD

1. System No. 113-5 Acrylic Epoxy
2. System No. 66-22 Hi-Build Epoxoline
3. System No. 6-1 Acrylic Emulsion, Low Sheen

I. WOOD EXTERIOR/INTERIOR EXPOSURE

1. System No. 23-4 Alkyd Semi-Gloss
2. System No. 6-5 Acrylic Latex

J. PVC PIPE EXTERIOR/INTERIOR EXPOSURE

1. System No. 66-23 Epoxy-Polyamide

K. INSULATED PIPE-INTERIOR EXPOSURE

1. System No. 6-1 Acrylic Emulsion, Low Sheen

L. HIGH HEAT SURFACES – FERROUS METAL

1. System No. 39-2 Silicone Aluminum (1200° F Maximum)
2. System No. 39-4 Silicone Aluminum (600° F Maximum)

M. SURFACES EXPOSED TO $H_2S/H_2SO_4$ (SEVERE EXPOSURE/IMMERSION)

1. System No. 120-1 Vinyl Ester
2. System No. 120-2 Vinyl Ester

N. EXTERIOR OF PRESTRESSED CONCRETE TANKS

1. System No. 156-3 New Tanks
2. System No. 156-4 System 156-2 Existing Tanks (previously painted)

O. SECONDARY CONTAINMENT AREAS

1. System No. 66-4 Epoxy Polyamide
2. System No. 61-1 Amine Epoxy
3. System No. 262-1 Flexible Polyurethane

P. CLEAR WATER REPELLENT FOR CONCRETE, MASONRY, AND BRICK

1. Silane Sealer (Min 28% Solids)

Q. MANHOLES, WET WELLS, AND LIFT STATIONS

1. System No. 120-1 Vinyl Ester
2. System No. 100-1 Crystalline Waterproofing

R. CANAL PIPE CROSSINGS

1. System No. 90-97 Zinc/Epoxy/Urethane
2. System No. 135-2 High Build/High Gloss Urethane

4.03 COATING SCHEDULE

| | FINISH COLOR | SURFACE | EXPOSURE | COATING SYSTEM |
|---|---|---|---|---|
| 1. | As Directed by Engineer | Steel | Exterior (Non-Immersion) | 73-1 Epoxy/High Build Urethane |
| 2. | As Directed by Engineer | Steel | Interior Exposure (Non-Immersion) | 69-1 High Solids Epoxy |
| 3. | As Directed by Engineer | Steel | Immersion | 69-2 High Solids Epoxy |
| 4. | As Directed by Engineer | Concrete | Exterior-Above Grade | 180 High Build Acrylic |
| 5. | As Directed by Engineer | Concrete | Exterior-Below Grade | 46-61 Coal Tar Pitch Solution |
| 6. | As Directed by Engineer | Concrete | Porous Masonry-Exterior/Interior | 180-2 High Build Acrylic |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10. | | | | |

END OF SECTION

SECTION 07920

JOINT SEALANTS

## PART 1 GENERAL

### 1.01 SUMMARY

A. Provide labor, materials, and installation required to complete the Project.

### 1.02 RELATED SECTIONS

A. General Conditions

B. Supplementary Conditions

C. Special Conditions

### 1.03 STANDARDS AND REGULATIONS

A. The following codes and standards shall govern workmanship and materials unless modified more stringently hereinafter.

1. Standard Building Code (SBC).

### 1.04 MEASUREMENT AND PAYMENT

A. Measurement and payment will be included in the lump sum and unit cost prices for the appropriate work items, as shown in the Bid Schedule as required for those items for the completion of the work which price and payment shall constitute full compensation for furnishing materials and performing work in connection herewith and as specified in the scope of work under this section.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Caulking Compounds - Silicone, polysulfide, and acrylic polymer sealants are optional, except where use of one or the other is specifically called for in these documents or where one or the other is not recommended for use by the manufacturer.

1. Silicone: Dow Corning 780, G.E. 1200 or 1300.

2. Polysulfide: Thiokol, Pecora, U.S. TT-S-00230.

3. Acrylic: Tremco, Pecora, U.S. TT-S-00230.

B. Sealant Backup - Polyethylene Foam - Dow Ethafoam S.B., Tremco, and Pecora.

C. Acoustical Caulking - Tremco "Acoustical Sealant", Presstite 57964, "miracle" sound control sealant #21.

## PART 3 EXECUTION

### 3.01 WORKMANSHIP AND INSTALLATION

A. Provide application conforming to the manufacturers recommendations.

1. Use sealant manufacturers primers, solvents, and thinners.

2. Clean and prepare surfaces as recommended.

3. Tool joints with OWNER selected color and remove excess sealant.

B. Provide caulking where indicated in the Drawings, Specifications, and as listed below:

1. Joints subject to weather and/or air infiltration.

2. At perimeter of items set in exterior walls.

3. At exposed surface joints of dissimilar materials and manufactured items permanently incorporated into the work.

a. This includes, but is not limited to, hollow metal frames, windows, stools, casework, plumbing fixtures, corner guards, and thresholds.

4. Where required for fire rating, such as the perimeter of partitions, and around pipe and duct penetrations in same.

5. Where required for sound control to maintain code required S.T.C. rating.

6. At building expansion joints.

7. At metal flashing.

8. At juncture between dissimilar materials, except concrete poured against block.

END OF SECTION

**SECTION 11315 SUPPLEMENT**
**N 3171 SPECIFICATION**

## REQUIREMENTS

Furnish and install ___ submersible non-clog wastewater pump(s). Each pump shall be equipped with an ___ HP submersible electric motor, connected for operation on_____ volts, ____ phase, 60 hertz, _____ wire service, with____ feet of submersible cable (SUBCAB) suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards and also meet with P-MSHA Approval. The pump shall be supplied with a mating cast iron ___ inch discharge connection and be capable of delivering _____ GPM at _____ TDH. An additional point on the same curve shall be _____ GPM at ____ feet total head. Shut off head shall be feet (minimum). Each pump shall be fitted with _____ feet of _____ lifting chain or stainless steel cable. The working load of the lifting system shall be 50% greater than the pump unit weight.

## PUMP DESIGN CONFIGURATION (Wet pit installation)

The pump shall be supplied with a mating cast iron _____ inch discharge connection and be capable of delivering _____ GPM at _____ FT. TDH. The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor. Each pump shall be fitted with _____ feet of _____ lifting chain or stainless steel cable. The working load of the lifting system shall be 50% greater than the pump unit weight.

## PUMP CONSTRUCTION

Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. The lifting handle shall be of stainless steel. All exposed nuts or bolts shall be of stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

Sealing design shall incorporate **metal-to-metal contact** between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.

Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

## COOLING SYSTEM

Each unit shall be provided with an integral motor cooling system. A stainless steel motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F (40°C.). Operational restrictions at temperatures below

104°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.

**CABLE ENTRY SEAL**

The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered equal.

**MOTOR**

The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while handling pumped media of up to 104°F. The motor shall be capable of no less than 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel.
The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

**Optional Premium Efficiency Motor:**

In addition to the features specified under **MOTOR**, above, the premium efficiency motor rotor shall have end rings and rotor bars constructed of copper. The premium efficiency motor shall meet the efficiency levels specified in the IEC standard 60034-30 for international efficiency, Class IE3.

**Optional - Shielded Power Cable:**

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The power cable shall

be of a shielded design in which an overall tinned copper shield is included and each individual phase conductor is shielded with an aluminum coated foil wrap. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.
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**BEARINGS**

The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a two row angular contact ball bearing. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces. The minimum $L_{10}$ bearing life shall be 50,000 hours at any usable portion of the pump curve.

**MECHANICAL SEALS**

Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.

The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

**Seal lubricant shall be non-hazardous.**

**PUMP SHAFT**

The pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be stainless steel – ASTM A479 S43100-T. Shaft sleeves will not be acceptable.

**IMPELLER**

The impeller shall be of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

**VOLUTE / SUCTION COVER**

The pump volute shall be a single piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron) and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

**PROTECTION**

Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection.

The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump control panel.

**EXPLOSION-PROOF**

Electric Submersible Pumps must be approved by Factory Mutual Research (FM) as Explosion-proof. They must conform to the latest edition of the National Electrical Code (NEC), Articles 500, 501, 502, and 503 requirements as explosion proof and suitable for use in Class I, Division 1, Groups C and D, and dust ignition proof and suitable for use in Class II, Division 1, Groups E, F and G hazardous locations, and suitable for use in Class III, Division 1 hazardous locations. FM approval also meets OSHA (Occupational Safety and Health Administration) requirements.

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 SUMMARY

A. Furnish, install, and test equipment specified and indicated in the Contract Documents.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Equipment and Materials

1. Equipment and materials used in this installation shall be new, of the best quality and, unless otherwise noted, shall be standard catalog items of the various manufacturers.

B. Design

1. Equipment and appurtenances shall be designed in conformity with the USA, ASME, AIEE, NEMA and other generally accepted applicable standards and shall be of rugged construction and of sufficient strength to withstand stresses which may occur during fabrication testing, transportation, installation and conditions of operation.

2. Bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for an adequate lubrication by readily accessible devices.

3. Details shall be designed for appearance as well as utility.

4. Protruding members, joints, corners, and gear covers, shall be furnished in appearance.

5. Exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

C. Safety Requirements

1. In addition to the components specified and shown in the Drawings and necessary for the specified performance, incorporated in the design and show in the shop drawings, the safety features required by the current codes and regulations, including but not limited to those of the Occupational Safety and Health Act of 1970, and Amendments thereto.

D. Drives and Belt Guards

1. Provide for each V-belt drive or rotating shaft a protective guard that shall be constructed around an angle iron frame, security bolted to the floor or apparatus.

2. The guard shall completely enclose drives and pulleys and be constructed to comply with safety requirements.

3. Hinged access doors not less than six (6) inches x six (6) inches shall be provided for access to motor and fan shaft for test purposes.

4. For double inlet fans, the belt-guard shall be arranged so as not to restrict the airflow into the fan inlet.

5. Guards shall not interfere with lubrication of equipment.

E. Shop Tests

1. Equipment so noted in the detailed equipment specifications, shall be tested in the shop of the manufacturer in a manner that shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.

2. None of this equipment shall be shipped to the project until the OWNER has been furnished a certified copy of test results and has been furnished a certified copy of test results and has notified the CONTRACTOR, in writing, that the results of these tests are acceptable.

3. When called for in the detailed equipment specifications, arrangements shall be made for the OWNER to witness performance tests in the Manufacturer's shop.

4. Certified copies of the manufacturer's actual test data and interpreted results thereof, shall be submitted to the OWNER for review in accordance with the Special Conditions.

F. Space and Access

1. Equipment shall fit the allotted space and shall leave reasonable access for servicing and repairs.

G. Prevention of Electrolysis

1. Where the contract of dissimilar metals may cause electrolysis and where aluminum will contact concrete, mortar or plaster, the contact surface of the metals shall be separated using not less than one (1) coat off zinc chromate primer and one (1) heavy coat of aluminum pigmented asphalt paint on each surface; or where deemed necessary by the OWNER, not less than one (1) course of asphalt saturated cotton fabric cemented to both metals with flashing cement, shall be used.

2. Finished works shall be cleaned and excess cement removed.

H. Metal Fasteners

1. Metal fasteners and related parts shall be of aluminum or stainless steel and of adequate strength for the purpose intended.

I. Standardization of Grease Fittings

1. The grease fittings on mechanical equipment must be able to be serviced with a single type of grease gun.

2. Fittings shall be hydraulic type, Alemite, Lincoln, or equal.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Obtain written installation manuals from the equipment manufacturer prior to installation.

1. Equipment shall be installed strictly in accordance with recommendations of the manufacturer.

2. A copy of installation instructions shall be furnished the OWNER's field representative one (1) week prior to installation.

B. Have on hand sufficient proper construction equipment and machinery of ample capacity to facilitate the work and to handle emergencies normally encountered in work of this character.

C. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.

D. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown in the Drawings.

E. For pumping equipment units, which require field alignment and connections, provide the services of the manufacturer's qualified mechanic, millwright or machinist, to align the pump and motor prior to making piping connections or anchoring the pump base.

F. Assume responsibility for the exact alignment of equipment with associated piping and under no circumstances will pipe springing be permitted.

## 3.02 ANCHORS AND SUPPORTS

A. Furnish, install and protect necessary guides, bearing plates, anchor and attachment bolts, and other appurtenances required for the installation of the devices included in the equipment specified.

1. Drawings for installation shall be furnished by the equipment manufacturer, and suitable templates shall be used when required in the detailed equipment specifications.

B. Anchor bolts shall be of size, strength and material required for the purpose intended, and shall be in accordance with Division 5, Miscellaneous Metals, and the detailed equipment specifications.

C. Provide concrete pedestals required for equipment and supports, hangers, and racks for piping and duct systems and appurtenances.

D. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required.

1. Equipment shall be leveled by first using sitting nuts on the anchor bolts and then filling the space between the equipment base and concrete pedestal with non-shrink grout unless alternate methods are recommended by the manufacturer and approved by the OWNER (such as shim leveling).

## 3.03 EQUIPMENT IDENTIFICATION

A. Each piece of equipment shall be provided with a stainless steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, serial number and principal rating data, as specified.

END OF SECTION

SECTION 15105

PIPES AND TUBES

## PART 1 GENERAL

### 1.01 SUMMARY

A. Furnish, install, place in operation, and test specified piping complete with fittings, wall pipes, exterior wall sleeves, couplings, adapters, hanger supports and other appurtenances as shown in the Drawings and Specifications as required for a complete installation.

B. Pipe and fittings covered by these specifications shall be furnished by fully qualified manufacturers experienced in the fabrication, casting and manufacture of the pipe materials specified herein.

1. The pipe and fittings shall be designed, fabricated and installed in accordance with the best practice of the trade and the standards specified herein.

C. No material furnished under this specification shall be shipped to the job site until submittals have been reviewed.

D. Each submittal shall be identified as specified in the General Conditions.

### 1.02 RELATED SECTIONS

A. Clearing and Grubbing - Section 02231

B. Earthwork - Section 02300

C. Construction Photographs and Video Recordings - Section 01321

D. Valves - Section 15110

E. Submittal Procedures - Section 01330

F. Shop Drawings, Product Data, and Samples - Section 01334

### 1.03 SUBMITTALS

A. Submit Shop Drawings in accordance with the procedures and requirements set forth in the Specifications.

B. Each submittal shall be complete incorporating information and data listed

herein and additional information required to evaluate the proposed piping material's compliance with the Contract Documents.

1. Partial or incomplete submissions will be returned to the CONTRACTOR without review.

C. Data to be submitted shall include, but not be limited to:

1. Catalog Data consisting of specifications, illustrations and a parts schedule that identifies the materials to be used for the various piping components and accessories.

a. The illustrations shall be in sufficient detail to serve as a guide for assembly and disassembly.

2. Complete layout and installation drawings with clearly marked dimensions.

a. Piece numbers, which are coordinated with the tabulated pipe layout schedule, shall be clearly marked.

b. Scale and size of the drawings shall conform to the specifications in the General Conditions.

c. Piping layout drawings shall indicate the following information; pipe supports, location, support type, hanger rod size, insert type and the load on the hanger in pounds.

3. Weight of all component parts.

4. Design calculations where specified.

5. Tabulated pipe layout schedule that shall include the following information for pipe and fittings, restrained joints, service, pipe size, working pressure, wall thickness, and piece number.

1.04 Manufacturer’s Recommendations

A. Where installation procedures are required to be in conformance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the ENGINEER prior to the installation.

1.05 MEASUREMENT AND PAYMENT

A. Measurement and payment will be based upon work completed and accepted in accordance with the Drawings and Specifications.

1. No separate payment will be made for excavation, trenching, backfilling, leakage tests or other incidental items of work not shown in the BID SCHEDULE and authorized by the ENGINEER, in writing, as extra work.

1.06 GUARANTEE

A. Guarantee materials and equipment furnished and installed, and work performed for a period of one (1) year from the date of substantial completion.

1. The guarantee shall stipulate that the completed system is free from all defects due to faulty materials or workmanship and promptly make such corrections as may be necessary by reason of such defects including the repairs of any damage to other parts of the system resulting from such defects.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipe and fittings shall be marked with the manufacturer's name or trade mark, size, class or pressure rating, and the date of manufacture in accordance with the standards specified herein.

B. Bolts and nuts shall be hexagonal conforming to ANSI B18.2.

C. No raised face flanges in conformance with ANSI 816.5 class 150 will be acceptable.

1. Raised faces shall be milled flat.

2. The only exceptions to this rule are ANSI B16.5 class 300 pound flanges where specified and the lap joint flanges for the stainless steel pipe for low pressure air service and light wall stainless steel pipe.

D. Gasket shall be full-faced type conforming to ANSI B16.21 except for lap joints and 300 lb. flanges.

E. The equipment shall include, but not be limited to the following:

| Paragraph | Title |
|---|---|
| 2.02 | Ductile Iron Pipe (DIP) and Fittings |
| 2.03 | Polyvinylchloride (PVC) Pipe |
| 2.04 | Polyvinylchloride (PVC) Pressure Pipe |
| 2.05 | High Density Polyethylene (HDPE) Pipe |
| 2.06 | Sleeve Type Couplings |

2.07 Grooved Couplings
2.08 Flanged Adapters
2.09 Wall Sleeves, Pipes, and Castings
2.10 Wall Penetration Seal
2.11 Unions
2.12 Insulating Type Fittings

## 2.02 DUCTILE IRON PIPE (DIP) AND FITTINGS

A. Ductile iron pipe shall conform to the requirements of AWWA/ANSI C151/A21.51.

1. Provide pipe with a wall thickness for buried and encased piping conforming to the following:

| Size | Pressure Class |
|---|---|
| 4-inch through 6-inch | 350 |
| 8-inch through 20-inch | 250 |
| 24-inch | 200 |
| 30-inch through 64-inch | 150 |

2. Subject each ductile iron pipe to a hydrostatic test of at least 500 psi for 10 or more seconds.

a. Subject pipes of diameter 18 inches or larger to a continuing hydrostatic test in which the pressure is elevated from 500 psi to a peak pressure that induces a stress in the pipe wall equivalent to 75% of the minimum specified yield of ductile iron (42,000 psi) as calculated by:

$$P = \frac{2 \times f_s \times t}{d}$$ where:

**P** = peak hydrostatic pressure
$f_s$ = stress in pipe wall during hydrostatic test (0.75 times the minimum yield strength of the ductile iron in tension)
**t** = nominal wall thickness, inches
**d** = outside diameter, inches

B. The pressure classes indicated above are the minimum permitted unless noted elsewhere.

C. Fittings for use with the ductile iron pipe specified above shall be ductile iron.

1. Cast ductile-iron fittings shall be pressure rated at 250 psi, minimum.

2. Fittings with mechanical joints, flange joints and push-on joints shall conform

to AWWA/ANSI C153/A21.53.

3. In addition, fittings with mechanical joints and push-on joints shall conform to AWWA/ANSI C111/A21.11, except that neoprene gaskets shall be used for the joint.

D. Ductile iron pipe and fittings intended for interior use and for use above grade shall be flanged.

E. Ductile iron pipe for use below grade shall be push-on joint and thrust restrained, where necessary, as listed on the drawing details.

F. Ductile iron pipe for use below grade shall be thrust restrained mechanical joint, where indicated on the drawings or required for pipe crossing right-of-ways by their governing agencies.

G. Ductile iron pipe with threaded flanges shall be manufactured in accordance with AWWA/ANSI C115/A21.15, unless otherwise specified, and with the provisions contained herein for ductile iron pipe except that wall thickness shall not be less than Class 53 unless a higher class is noted.

H. Flanges shall be ANSI Standard Class 125, plain faced and drilled, in accordance with ANSI B16.1.

1. Flanges on ductile iron pipe and fittings shall be ductile iron and shall be provided by the pipe manufacturer.

2. Joint materials for flanged pipe and fittings shall be ANSI sized and approved and shall consist of hot dip galvanized bolts and nuts and 1/8 inch thick full-face neoprene gaskets.

I. Mechanical joint pipe and fittings shall be furnished with high strength cast iron or alloy steel tee head bolts and hex nuts, with composition, dimensions and threading in accordance with AWWA/ANSI C111/A21.11.

1. Segmented glands will not be acceptable.

2. Bolt holes for mechanical joints shall be equally spaced, and shall straddle the vertical centerline.

J. Thrust restrained mechanical joints for ductile iron pipe and fittings shall utilize a restraining follower gland, which when actuated imparts a multiple wedging action against the pipe, increasing its resistance as the pressure increases.

1. Glands shall be manufactured of ductile iron conforming to ASTM A536.

a. Restraining devices shall be of ductile iron heat treated to a minimum

hardness of 370 BHN.

1) Dimensions shall be such that the gland can be used with the standardized mechanical joint bell and tee head bolts.

b. Twist off nuts, sized same as tee head bolts, shall be used to insure proper actuating of restraining devices.

c. The mechanical joint shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1 and shall be MEGALUG Series 1100 as manufactured by EBAA Iron, Inc., or equal.

K. Alternatively, thrust restrained mechanical joints for ductile iron pipe and fittings may be TR-FLEX as manufactured by U.S. Pipe and Foundry, Lok-Ring by the American Ductile Iron Pipe Co., Locked Mechanical Joint F-127D or Super Lock Joint by the Clow Corporation.

1. The restraining components, when not cast integrally with the pipe and fittings, shall be ductile iron or a high strength non-corrosive alloy steel.

2. Tee head bolts and hexagonal nuts for restrained joints in pipe and fittings shall be of high strength cast iron or alloy steel, with composition, dimensions and threading as specified in AWWA/ANSI C111/A21.11, except that the length of the bolts shall meet the requirements for the restrained joint design.

3. For cut grooved retainers, the thickness of barrel left after grooving shall not be less than the nominal wall thickness of equal sized non-restrained pipe as specified here in above for the centrifugally cast ductile iron pipe.

4. The gasket and joint accessories shall be shipped in suitable protective containers.

5. Each restrained joint and the pipe and fitting of which it is a part, shall be designed to withstand the axial thrust from an internal pipeline pressure of at least 150 psi at bulkhead conditions without reduction because of its position in the pipeline nor from support by external thrust blocks.

6. Restrained joint pipe and fittings shall be capable of being deflected after assembly.

L. Provide cement-mortar coating for Water Main ductile-iron pipe and fittings in accordance with AWWA/ANSI C104/A21.4 and ANSI/NSF Standard 61 for potable water contact.

1. The interior of the pipe shall receive the standard thickness of the protective cement-mortar coating, unless otherwise specified.

2. The coating shall not be applied in the gasket grooves.

M. Provide ceramic epoxy coating for Sanitary Sewer Force main ductile-iron pipe and fittings in conform with Method A of ASTM E-96-66, Procedure A, ASTM D714-56, ASTM D 2794, and ASTM G 53-77.
   1. The interior of the pipe shall receive 40 mils dry film thickness of the protective ceramic epoxy coating.

   2. The coating shall not be applied in the gasket grooves.

      a. Special attention shall be given to the coating of fittings.

   3. Coating shall be applied to bare metal.

   4. Coating shall extend to the faces of flanges, to the end of spigots, or to the shoulder of hubs, as the case may be.

N. Asphaltic coating shall be applied to the exterior of ductile iron pipe and fittings intended for buried service and shall conform to AWWA/ANSI C151/ A21.51.

   1. Ductile iron pipe and fittings intended for interior use and for use above grade shall receive a prime coat compatible with the coating system specified in Paints and Coatings - 09900.

2.03 POLYVINYLCHLORIDE (PVC) PIPE

A. PVC pipe shall conform to ASTM D1785 and shall be made from a 12454B compound which is a Type 1, Grade 1 plastic as defined by ASTM D1784.

   1. Rerun or reclaimed materials will not be acceptable.

B. Pipe to be used for potable water applications shall comply with the National Sanitation Foundation Standard No. 14 and shall have markings on the pipe to indicate that it has been tested and is in compliance.

C. Wall Thickness shall be a minimum of Schedule 80, unless otherwise noted in Schedule 15D.

D. Pipe joints shall be provided as specified in the pipe schedule.

   1. Where required, socket type adapters and socket type flange adapters shall be provided.

E. PVC pipe intended for buried service shall be socket weld joint.

F. Socket type joints shall be made up in accordance with ASTM D2855 with a

PVC solvent cement complying with ASTM D2564.

1. The cement shall have a minimum viscosity of 2000 cps.

G. Where flanges are to be used, flanges shall be van stone type with full-faced vinyl gaskets.

H. Socket type pipe fittings for schedule 80 pipe shall conform to ASTM D2467.

I. Fittings shall have the same schedule designation, joint type and be made of the same PVC compound as the connecting pipe.

2.04 POLYVINYLCHLORIDE (PVC) PRESSURE PIPE

A. Joints shall be bell and spigot type using flexible elastomeric seals conforming to AWWA C900, DR 18 with ductile iron fittings.

B. Restraining PVC pipe to mechanical joint DIP fittings:

1. The mechanical joint restraint shall have working pressure of at least 150 psi with a minimum safety factor of 2:1.

2. Retainer glands shall consist of a plurality of individually activated gripping surfaces to maximize restraint capability. The glands shall have serrations on the I.D. sufficient to hold the working and test pressures.

3. Dimensions of the glands shall be such that it can be used with standardized mechanical joint bell and tee-head bolts conforming to AWWA/ANSI C111/A21.11 and AWWA/ANSI C153/A21.53.

4. Twist off nuts, sized same as tee-head bolts, shall be used to insure proper actuating of the restraining devices.

C. Retainer glands for 4 through 12-inch mechanical joint fittings shall be MEGALUG Series 2000 PV as manufactured by EBAA Iron, Inc., or approved equal.

D. Retainer glands for 14 through 30-inch mechanical joint fittings shall be MEGALUG Series 1000 PV as manufactured by EBAA Iron, Inc., or approved equal.

2.05 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

A. This specification covers high density polyethylene (PE 3408) pressure pipe primarily intended for transportation of potable water either buried or above grade.

B. Referenced Standards:

1. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, ½ inch through 3 inch For Water Services.

2. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 63 inch For Water Distribution.

3. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

4. ASTM B3261 - Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

5. ASTM D3350 - Standard Specification for Polyethylene Plastic Pipe Fittings Materials.

6. PPI TR-3 - Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

7. PPI TR-4 - Recommended Hydrostatic Strength and Design Stresses for Thermoplastic Pipe and Fittings Compounds.

8. NSF Standard # 14 - Plastic Piping Components and Related Materials.

C. Qualification of Manufacturers:

1. The Manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these specifications.

2. Given reasonable notice, the Manufacturer's production facilities shall be open for inspection by the CITY or an authorized representative.

3. Qualified manufacturers shall be approved by the ENGINEER.

4. Approved manufacturers include PLEXCO Performance Pipe Division - Chevron Chemical Company, or approved equal.

D. Material

1. Materials used for the manufacturing of polyethylene pipe and fittings shall be PE 3408 High Density Polyethylene (HDPE) meeting the ASTM D3350 cell classification of 345434C.

2. The material shall have a minimum Hydrostatic Design Basis (HDB) of 1600 psi at 73°F when tested in accordance with PPI TR-3 and shall be listed in

the name of the pipe and fitting manufacturer in PPI TR-4.

3. The material used in production of potable water pipe shall be approved by the National Sanitation Foundation (NSF).

4. The Manufacturer shall certify that the materials used to manufacture pipe and fittings meet the requirements of this specification.

E. Pipe:

1. Polyethylene pipe ½" through 3" shall be DR 11, iron pipe size (IPS), and manufactured in accordance with AWWA C901, unless otherwise noted.

2. Polyethylene pipe 4" though 12" shall be DR 17, ductile iron pipe size (DIPS), and in accordance with AWWA C906, unless otherwise noted.

2. Permanent identification of piping service shall be provided by co-extruding longitudinal blue stripes into the outside surface of the pipe.

   a. The striping material shall be the same material as the pipe material except for color.

   b. Stripes printed or painted on the pipe outside surfaces shall not be acceptable

F. Fittings:

1. Polyethylene fittings shall be made from material meeting the same requirements as the pipe.

   a. Polyethylene fittings shall be molded or fabricated by the manufacturer of the pipe.

2. Where applicable, fittings shall meet the requirements of AWWA C906.

3. Molded fittings shall be manufactured in accordance with either ASTM D2683 (socket fused) or ASTM D3261 (butt fused) and shall be so marked.

4. Mechanical Fittings used with polyethylene pipe shall be specifically designed for, or tested and found to be acceptable for use with polyethylene pipe.

   a. Mechanical Fittings designed for other materials shall not be used unless authorized by the Mechanical Fitting Manufacturer.

   b. Special precaution may exist with certain mechanical fittings or additional components may be required - consult the manufacturer of the fittings

prior to use.

G. Manufacturer's Quality Control

1. The pipe and fittings Manufacturer shall have an established quality control program responsible for inspecting incoming and outgoing materials.

   a. Incoming polyethylene materials shall be inspected for density, melt flow rate, and contamination.
   b. The cell classification properties of the material shall be certified by the supplier.

   c. Incoming materials shall be approved by Quality Control before processing into finished goods.

   d. Outgoing products shall be tested as required in AWWA C901 or C906.

2. The Manufacturer shall maintain permanent Quality Control (QC) and Quality Assurance (QA) records.

   a. Certification or copy of these records shall be made available to the purchaser on request.

## 2.06 SLEEVE TYPE COUPLINGS

A. Sleeve couplings shall be Style 38 for either steel, or ductile iron pipe as manufactured by Dresser Manufacturing Division or equivalent models by Smith Blair, Rockwell Industries, or equal.

1. Sleeve couplings shall be Style 62 for joining steel pipes to ductile iron pipe as manufactured by Dresser or equivalent models by Smith Blair, Rockwell Industries, or equal.

2. Applications with stainless steel pipe shall be fabricated of type 316 stainless steel for components except the gaskets.

3. Gasket material shall be compatible with the service application especially with respect to temperature requirements and chemical compatibility.

B. The interior of the middle ring shall be painted with two coats of asphaltic coating suitable for the service intended.

1. The middle ring shall not have a pipe stop.

## 2.07 GROOVED COUPLINGS

A. Grooved couplings shall be in accordance with AWWA C606.

B. For ductile iron pipe with nominal pipe sizes ranging from three (3) inches to twenty-four (24) inches, groove couplings shall be style 31 by Victualic, or equal.

1. The joint grooving dimensions shall be in conformance to the rigid joint specifications.

2. The gasket shall be a flush-seal type.

C. Pipe wall thickness for ductile iron pipe shall be in accordance with AWWA C606.

2.08 FLANGED ADAPTERS

A. Flanged adapters for ductile iron piping shall have either steel or gray iron bodies; models 912 or 913 as manufactured by Rockwell Industries, Styles 127 and 128 by Dresser Ind., Clow, or equal.

B. Flange adapters shall have a minimum rated working pressure of 175 psig for gray iron body types and 150 psig for steel body types, and shall conform to applicable requirements of AWWA/ANSI C115/A21.15 and AWWA/ANSI C111/A21.11.

1. Bolt hole and bolt patterns shall conform to the mating flange patterns as specified in the piping paragraphs.

2. Bolts, nuts and flange gaskets shall conform to the specifications for the adjacent piping.

C. Pipe shall be anchored by using anchor studs drilled into the coupling and connected pipe for nominal pipe sizes to twelve (12) inches.

1. For nominal pipe sizes above twelve (12) inches, pipe shall be restrained by harnesses.

2.09 WALL SLEEVES, PIPES, AND CASTINGS

A. Wall pipes or wall sleeves shall be provided in accordance with the following schedule, except where otherwise noted, when passing through new concrete or masonry structures:

| From | To | Fitting |
|---|---|---|
| Dry Interior | Dry Interior | Wall Sleeve with Penetration Seal |
| Dry Interior | Dry Exterior | Wall Pipe |
| Dry Interior | Wet Tank | Wall Pipe |

| | | |
|---|---|---|
| Dry Interior | Earth Exterior | Wall Pipe |
| Wet Tank | Earth Exterior | Wall Pipe |
| Wet Tank | Wet Tank | Wall Pipe |
| Wet Tank | Dry Exterior | Wall Pipe |

B. Transitions between interior piping materials and yard piping materials, which occur in the structural walls, shall be furnished in accordance with the details shown on the Drawings.

1. Special adapters or wall fittings shall be provided by the piping manufacturer.

C. Except where noted, wall pipes and castings shall be equipped with a water stop and shall be ductile or gray cast iron for piping with nominal pipe sizes to thirty (30) inches.

D. Wall sleeves shall be either galvanized steel, ductile or gray cast iron pipe and shall have a water stop where required.

1. For wall sleeves through floors, the top of the sleeve shall be raised 4-inches above finished floor elevation.

E. Wall pipes shall be of sufficient length to pass through the wall in accordance with the details on the Drawings and shall conform to the details shown on the Drawings.

F. The end of the wall pipes shall be of a type consistent with the piping to be connected to them and shall conform to their standards and specifications.

G. Wall pipes shall have the same interior protection as specified for the connecting piping.

H. Exterior protection shall be as specified for the yard or underwater piping.

## 2.10 WALL PENETRATION SEAL

A. Wall penetration seals shall be a modular mechanical type, consisting of interlocking sealing links of an elastomer such as ethylene propylene and piene monomer (EPDM) shaped to continuously fill the annular space between the pipe and wall sleeve.

1. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut.

2. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and sleeve.

3. The watertight seal shall be effective against a hydrostatic head of at least 40 feet.

4. The seal shall also be constructed so as to provide electrical insulation between the pipe and wall, thus reducing chances of cathodic reaction between these two members.

5. Metal hardware shall be type 18-8 stainless steel.

6. The seal shall be similar to the Link-Seal modular wall and casing seal manufactured by Thunderline Corporation or the equivalent by other manufacturers.

B. Select required inside diameter of each wall opening or sleeve for each pipe and the correct sizing of seal.

2.11 UNIONS

A. For ductile iron, carbon steel, and gray cast iron pipes assembled with threaded joints and malleable iron fittings, unions shall conform to ANSI 816.39.

B. For copper piping, unions shall have ground joints and conform to ANSI B16.18.

C. For PVC and CPVC piping, unions shall be socket weld type with Viton O-ring.

2.12 INSULATING TYPE FITTINGS

A. When joining two pipes of dissimilar materials, insulating type fittings shall be used to prevent galvanic action.

PART 3 EXECUTION

3.01 EXAMINATION

A. Furnish labor, tools, materials, and equipment necessary for installation and jointing of the pipe.

1. Piping shall be installed in accordance with the Drawings in a neat workmanlike manner, and shall be set for accurate line and elevation.

2. Piping shall be thoroughly cleaned before installation, and care shall be taken to keep the piping clean throughout the installation.

B. Before setting wall sleeves, pipes, castings, and pipes to be cast in place, check Drawings, figures, and shop drawings, which may have a direct bearing on the

pipe locations.

1. Assume responsibility for the proper location of the pipes and appurtenances during the construction of and renovation of the tanks and structures.

C. Piping shall be attached to pumps, valves, or equipment in accordance with the respective manufacturers' recommendations.

D. For piping assembled with threaded, solvent cemented, welded or soldered joints, liberal use of unions shall be made.
   1. Unions shall be provided close to main pieces of equipment and in branch lines to permit ready dismantling of piping without disturbing main pipelines or adjacent branch lines.

   2. A minimum of one union per straight run of pipe between fitting and/or valves with multiple lengths of pipe shall be used.

E. Elbows between 45 and 90 degrees, for scum and sludge lines, shall be long radius type, unless designated otherwise on the Drawings.

F. Changes in directions or elevations shall be made with fittings except for Flexible Process Tubing or as noted in the piping paragraphs.

3.01 DELIVERY, STORAGE, AND HANDLING

A. Material delivered to the site shall be inspected for damage, unloaded and stored with a minimum of handling.

   1. Material shall be stored in accordance with the manufacturer’s recommendations.
   2. The insides of pipe and fittings shall be kept free from dirt and debris.

   3. Gasket and plastic materials shall be kept protected from exposure to direct sunlight over extended periods.

   4. Solvents, solvent compounds, lubricants, elastomeric gaskets, and similar material required to install the pipes shall be stored in accordance with the manufacturer’s recommendations and shall be discarded if the storage period exceeds the recommended shelf or pot life.

   5. Storage facilities for plastic pipe, fittings, joint material and solvents shall be classified and marked in accordance with NAPA No. 704, with classification as indicated in NAPA Nos. 49 and 325M.

   6. Material shall be handled in such a manner as to insure delivery to the trench in a sound, undamaged condition.

7. Pipes shall be carried to the trench, not dragged.

3.02 SHIPPING, HANDLING, AND STORAGE

A. Special care in handling shall be exercised during delivery, distribution and storage of pipe to avoid damage and setting up stresses.

1. Damaged pipe will be rejected and shall be replaced at the CONTRACTOR's expense.

2. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.

B. No pipe shall be dropped from cars or trucks to the ground.

1. Pipe shall be carefully lowered to the ground by mechanical means.

2. In shipping, pipe and fittings shall be blocked in such manner as to prevent damage to castings or lining.

3. Broken or chipped lining shall be carefully patched.

4. Where it is impossible to repair broken or damaged lining in pipe because of its size, the pipe shall be rejected as unfit for use.

C. Mechanical joint pipe shall be laid with a 1/8-inch space between the spigot and shoulder of pocket.

3.03 LAYING PIPE

A. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall, in general, agree with manufacturer's recommendations.

1. At the time of laying, the pipe shall be examined carefully for defects, and should pipe be discovered to be defective after being laid, it shall be removed and replaced with sound pipe at the CONTRACTOR’S expense.

B. Perform earthwork including excavation, backfill, bedding, compaction, sheeting, shoring and bracing, denaturing and grading in accordance with Site Preparation - Section 02200.

C. Upon satisfactory excavation of the pipe trench and completion of the pipe bedding, a continuous trough for the pipe barrel and recesses for the pipe bells, or couplings, shall be excavated by hand digging.

1. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure shall be exerted on the pipe joints from the trench bottom.

D. Piping 3 inches and larger shall be provided with two 4 foot lengths of pipe for the first two joints outside a building or tank wall.

E. Pipe shall be installed in accordance with the manufacturer's recommendation.

1. Before being lowered into the trench, the pipes and accessories shall be carefully examined and the interior of the pipes shall be thoroughly cleaned of foreign matter and other approved methods.

2. At the close of each workday and during suspension of work, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud or other foreign material from entering the pipe.

F. Lines shall be laid straight and depth of cover shall be maintained uniform with respect to finish grade, whether grading is completed or proposed at time of pipe installation.

1. Where a grade or slope is shown on the Drawings, use laser based surveying instruments to maintain alignment and grade.

2. At least one elevation shot shall be taken on each length of pipe and recorded.

3. No abrupt changes in direction or grade will be allowed.

G. Concrete thrust blocks shall be provided in addition to restrained joint piping where indicated on the Drawings.

H. After pipe has been laid, inspected and found satisfactory, sufficient backfill shall be placed along the pipe barrel to hold the pipe securely in place during the conduction of the hydrostatic test.

1. No backfill shall be placed over the joints until the hydrostatic test is satisfactorily completed, leaving the joints exposed to view for the detection of visible leaks.

2. Upon satisfactory completion of the hydrostatic test, backfilling of the trench shall be completed.

## 3.04 INSTALLATION OF DUCTILE IRON PIPE AND FITTINGS

A. Unless otherwise directed, ductile iron pipe shall be laid with the bell ends facing upstream in the normal direction of flow and in the direction of laying.

1. For lines on an appreciable slope, the bells shall, at the discretion of the ENGINEER, face upgrade.

B. Push-on, thrust restrained and mechanical joints in ductile cast iron pipe and fittings shall be made in accordance with the manufacturer's standards except as otherwise specified herein.

1. Joints between push-on and mechanical joint pipe and/or fittings shall be made in accordance with AWWA C600, except that deflection at joints shall not exceed one-half of the manufacturer's recommended allowable deflection, or one-half of the allowable deflection specified in AWWA C600, whichever is the lesser amount.

C. Before laying push-on, thrust restrained and mechanical joint pipe and fittings, lumps, blisters, and excess bituminous coating shall be removed from the bell and spigot ends.

1. The outside of each spigot and the inside of each bell shall be wire brushed, and wiped clean and dry.

2. The entire gasket groove area shall be free of bumps or foreign matter, which might displace the gasket.

3. The cleaned spigot and gasket shall not be allowed to touch the trench walls or trench bottom.

4. Vegetable soap lubricant shall be applied in accordance with the pipe manufacturer's recommendations, to aid in making the joint.

5. The workmen shall exercise caution to prevent damage to the gasket or the adherence of grease or particles of sand or dirt.

6. Deflections shall only be made after the joint has been assembled.

D. Flanged joints shall only be used where indicated on the plans.

1. Before making up flanged joints in ductile iron pipe and fittings, the back of each flange under the bolt heads and the face of each flange shall have lumps, blisters, and excess bituminous coating removed and shall be wire brushed and wiped clean and dry.

2. Flange faces shall be kept clean and dry when making up the joint, and the workmen shall exercise caution to prevent damage to the gasket or the adherence of grease or particles of sand or dirt.

3. Bolts and nuts shall be tightened by opposites in order to keep flange faces

square with each other, and to insure that bolt stresses are evenly distributed.

E. Bolts and nuts in thrust restrained, mechanical and flanged joints shall be tightened in accordance with the recommendations of the pipe manufacturer for a leak-free joint.

1. The mechanics shall exercise caution to prevent overstress.

2. Torque wrenches shall be used until, in the opinion of the ENGINEER, the mechanics have become accustomed to the proper amount of pressure to apply on standard wrenches.

F. Cutting of the ductile iron pipe for inserting valves and fittings shall be done by the CONTRACTOR in a neat and workmanlike manner without damage to the pipe, the lining, or the coating.

1. Pipe 16 inches and larger in diameter shall be cut with a mechanical pipe saw.
2. After cutting the pipe, the plain end shall be beveled with a heavy file or grinder to remove sharp edges.

G. Areas of loose or damaged polyethylene lining associated with field cutting shall be repaired as recommended by the pipe manufacturer.

1. Repair methods shall be as recommended by the manufacturer and shall be submitted to the ENGINEER for review.

H. Work within the pipe shall be performed with care to prevent damage to the lining.

1. Damaged lining shall be repaired or the pipe section replaced as required by the ENGINEER.

2. No cable, lifting arms or other devices shall be inserted into the pipe.

3. Lifting, pulling or pushing mechanisms shall be applied to the exterior of the pipe barrel.

I. Homing the pipe shall be accomplished by the use of a hydraulic or mechanical pulling device, unless otherwise approved by the ENGINEER.

1. No pipe shall be driven or struck in order to seat it home.

J. Cleaning methods shall meet the ENGINEER's approval, and must be sufficient to remove silt, rocks, or other debris, which may have entered the pipeline during its installation.

K. Maximum tap size for corporation stops (Mueller thread) in ductile iron pipe shall be 1½ -inches.

3.05 INSTALLATION OF POLYVINYLCHLORIDE (PVC) PIPE

A. PVC pipes shall be installed in accordance with ASTM D2321.

3.06 HDPE INSTALLATION AND FUSION TESTING

A. The Manufacturer shall supply an Installation Manual to the ENGINEER which outlines and guideline for handling, joining, installation, embedding and testing of polyethylene pipeline.

1. These guidelines shall be used as reference material for the ENGINEER in the determination of the required procedures.

B. Joints between plain ends of polyethylene pipe shall be made by butt fusion when possible.

1. The Pipe Manufacturer's fusion process shall be followed at all times as well as the recommendations of the Fusion Machine Manufacturer.

2. The wall thickness of the adjoining pipes shall have the same DR at the point of fusion.

C. When saddle connections are fusion welded, the Manufacturer's recommended saddle fusion procedure shall be used.

D. If mechanical fittings (which are designed for, or tested and found acceptable for use with polyethylene pipe) are utilized for transitions between pipe materials, repairs, joining pipe sections, saddle connections, or at other locations; the recommendation of the Mechanical Fitting Manufacturer must be followed.

1. These procedures may differ from other pipe materials.

E. On each day butt fusion's are to be made, the first fusion of the day shall be a trial fusion.

1. The trail fusion shall be allowed to cool completely, and then fusion test straps shall be cut out.

2. The test strap shall be 12" or 30 times the wall thickness in length (minimum) and 1" or 1.5 times the wall thickness in width (minimum). Bend the test strap until the ends of the strap touch.

3. If the fusion fails at the joint, a new trial fusion shall be made, cooled

completely and tested.

4. Butt fusion of pipe to be installed shall not commence until a trail fusion has passed the bent strap test.

F. Socket and Saddle fusions shall be tested by a bent strap, as described by the Pipe Manufacturer.

1. The pipe Manufacturer shall provide visual guidelines for inspecting the butt, saddle, and socket fusion joints.

G. Pressure testing shall be conducted in accordance with the Manufacturer's recommended procedure.

1. Pressure testing shall use water as the test media.

2. Pneumatic (air) testing is prohibited.

3.07 JOINTS

A. Flanged Joints

1. Shall be made up with full-face gaskets as specified in the piping paragraphs.

2. Shall have the flange faces bearing uniformly on the gaskets.

3. Shall have the flanges drawn together uniformly until the joint is tight.

4. No washers shall be permitted for the bolt and nut assemblies.

5. The length of the bolts shall be uniform and in accordance with the standards specified herein.

a. The maximum projection of the bolt beyond the end of the nut shall be 0.25 inch. The bolt shall not fall short of the end of the nut.

B. Threaded Joints

1. Threads shall be clean, machine cut and pipe shall be reamed before erection.

2. Taps and dies shall be cleaned, sharpened and in good condition.

3. Threaded joints shall be made tight with Teflon tape.

4. After having been set up a joint shall not be backed off unless the joint is

broken. The threads shall be cleaned and new tape shall be applied.

C. Solvent Cemented Joints

1. Shall be made up in accordance with ASTM D2855 and the manufacturers' recommendations.

2. The CONTRACTOR is advised to handle the solvent cements in accordance with ASTM F 402.

3.08 PIPE SUPPORT SYSTEMS

A. Pipe support locations are not shown on the Drawings and shall follow the specifications herein in locating supports.

1. Where deviations and modifications are required, they shall be made subject to review by the ENGINEER.

B. Supports and parts required for the installation of the piping systems shall conform to the requirements of the ANSI Code for Pressure Piping B-31.1 and MSS Standard practice SP-58 and SP-69, except as modified and supplemented by the requirements set forth herein.

1. Piping shall be supported in such a manner to fulfill the intent of this specification.

C. Piping shall be rigidly supported from the building structure by approved hangers, inserts, or supports.

1. No piping shall be supported from other piping or from metal stairs, ladders, and walkways unless specifically permitted by the ENGINEER.

D. Unless otherwise indicated on the Drawings, piping supports shall consist of concrete piers or fabricated steel supports as specified below.

1. Materials and workmanship shall be in full compliance with the Concrete, Reinforcing Steel, and Structural Steel sections of these specifications.

E. Each section of the pipeline shall be laid out and connections made while the pipe is held in temporary supports

1. After completion of connections the pipe may be clamped in position.

2. When piping is correctly installed, a clamp or pipe connection may be loose or removed without displacement of the pipeline.

F. Supporting appurtenances shall be arranged to prevent undue stress on

equipment to which piping is connected.

1. Supporting appurtenances shall provide the desired pitch as specified or required for proper drainage of the piping.

2. The pipe suspension shall prevent excessive stress, excessive variation in supporting force, and possible resonance with imposed vibration while the system is in operation.

3. Valves and valve operators shall be rigidly supported independently of the piping.

4. Vertical runs of pipe shall be supported independently of the connected horizontal runs.

5. Vertical pipes shall be supported at each floor or at intervals of at least 10 feet by approved pipe collars, clamps, brackets or wall rests.

6. Supporting appurtenances, when used with copper piping, shall be copper, bronze or bronze plated.
7. Piping shall be supported independently of the equipment to which it is connected.

8. In-line devices (flowmeters) shall be removable without the need for temporary supports for adjacent and connecting piping.

G. In general, the type of pipe supports to be used shall be as follows:

| Height of Centerline of Pipe Above Floor | Type of Support |
|---|---|
| 0 - 3 ft. | Concrete Pier |
| 3 - 6 ft. | Adjustable Pipe Saddle or Bracket Supports |
| Greater than 6 ft. | Hangers |

H. Wall bracket supports shall be used where shown for pipe to be installed adjacent to a wall.

1. Where it is not feasible to install hanger supports, adjustable pipe saddle supports may be used with the permission of the ENGINEER.

2. Specifications for the bracket, saddle and hanger supports are hereinafter given in the Schedule of Pipe Supports attached at the end of the section.

I. Install pipe supports in conformance with these specifications unless otherwise shown on the Drawings.

1. Where deviations and modifications are required, they shall be made only with the permission of the ENGINEER.

2. A detailed layout of pipe supports for each building shall be submitted to the ENGINEER for review.

J. For couplings, supports shall be placed on each side and as close to the coupling as possible.

1. Supports shall be of the guide type, which prevent axial movement resulting in pipe deflection or misalignment.

K. Structural steel members can be used to support pipe.

L. Stainless steel piping installed in wetwells, tanks, channels, or conduits shall be supported by hangers, hanger rods, anchorages, hardware, and inserts, fabricated of type 316 stainless steel (L grade, if welded).

M. Where a specific pipe support is called for on the drawings, this support shall be used as, and where indicated, for the specific application.
1. Spacing of supports shall be as specified herein, unless specifically modified by the ENGINEER.

N. Support, saddles, bearing plates, and hangers, shall support by direct contact the pipe a minimum of 120 degrees around, except as specified herein.

O. Where continuous concrete inserts are used, the maximum concentrated load shall not be more than 50 percent of the maximum recommended loading of the channel.

1. Pipe supports shall be positioned such that they will not interfere with the use of hoisting equipment, where provided.

P. Pipes subject to thermal expansion shall be installed perfectly aligned and concentricity guided.

1. These piping (process air, heated sludge, and hot water) support systems shall be submitted to the ENGINEER for review.

2. The submittal shall show location of anchors, concentric pipe Guides and Expansion Joints (single or double).

## 3.09 PIPE SUPPORT SPACING

A. The distance between supports for each size of pipe shall not exceed those listed in the table below.

| Nominal Pipe Size | Metallic Piping | Plastic, Fiberglass, and Copper Piping |
|---|---|---|
| O.D. (in.) | Max. Spacing (ft.) | Max. Spacing (ft.) |
| 1/2 | 5 | 3 |
| 3/4 to 1-1/2 | 6 | 3 |
| 2 to 3 | 6 | 4 |
| 4 | 10 | 5 |
| 6 and larger | 10 | 6 |

1. If the pipe size to be supported is not listed in the schedule, the next smaller nominal pipe size spacing shall be used.

2. There shall be a minimum of one support per laying length of pipe on uninterrupted horizontal runs.

3. This support shall be placed within one (1) foot of the joint.

4. If the pipe manufacturer recommends a smaller spacing interval than specified herein, then the manufacturer's spacing shall be used.

3.10 PIPE HANGERS AND HANGER RODS

A. Where pipe hangers are used, they shall be of the clevis or friction clamp type, except where there is a longitudinal movement due to temperature changes.

1. Pipe hangers shall be capable of supporting the pipe in all conditions of operation.

2. They shall allow free expansion and contraction of the piping, and prevent excessive stress resulting from transferred weight being induced into the pipe or connected equipment.

B. Hangers shall be designed so that they cannot become disengaged by movements of the supported pipe.

1. Lock nuts shall be used on hangers.

2. Piping systems shall be supported by means of hangers having an individual means of vertical adjustment for leveling of lines after piping is in place.

3. Provide spring hangers where pipe is subject to expansion and/or contraction.

C. Hanger rods shall be subject to tensile loading only.

1. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit swing.

2. Hanger rods and associated hardware shall be type 316 stainless steel.

D. Concrete inserts and/or expansion bolts shall be capable of supporting the maximum working load of the attached rod.

E. Sheet metal insulation protector saddle shall be used for hot water piping or refrigerant piping.

1. Saddle shall be Grinnell Fig.167, or equal.

3.11 SADDLES

A. Pipe saddles shall be used to cradle horizontal piping when being supported from below the springline, except where expansion of pipe requires rollers.

1. Saddles shall be capable of being adjusted after installation.

3.12 BASE ELBOWS TEES AND CONCRETE PEDESTALS

A. Base elbows, tees and concrete pedestals shall be provided at the locations shown on the drawings, and as specified.

1. Vertical runs of pipe shall be supported on a base elbow and/or concrete pedestal.

2. After completion of curing of the concrete pedestal, the piping shall be adjusted to the proper grade.

3.13 METAL FRAMING SYSTEMS

A. A metal framing system as manufactured by Unistrut, Globe-Strut, Power-Strut, or approved equal may be used for supporting the piping system.

1. The metal framing system shall be designed and installed according to manufacturer's recommended procedure and shall be capable of supporting the piping system as specified herein.

B. Channels, inserts and closure strips shall be cold formed mild steel conforming to ASTM A-245.

C. Fittings shall be Hot Rolled Steel conforming to ASTM A-307 or ASTM A-245.

1. Fasteners shall conform to ASTM A-307.

2. Pieces shall be hot-dip galvanized after fabrication, unless otherwise noted on the Drawings.

## 3.14 SUPPORTS FOR PLASTIC PIPE

A. Pipe supports that will be used with plastic pipe shall be provided with a bearing plate where the width of hanger is less one-half (1/2) of the supported pipe's diameter.

1. The bearing plate must provide bearing 180 degrees around and shall have a minimum laying length of one-half (1/2) the pipe diameter or three (3) inches minimum.

2. The bearing plates shall be rigid, corrosion resistant and not subject to long term plastic flow properties.

3. To assure one hundred (100) percent bearing, the pipe shall be seated on a filler material.

4. This material shall be compatible for use with the plastic pipe.

5. Clamps to be used with plastic pipe shall be fitted snug and shall not exert clamp pressure on the pipe.

## 3.15 THRUST RESTRAINT

A. Pipe anchors shall be spaced to divide pipe into sections.

1. Anchors shall be located at valves, changes in direction of piping, and major branch connections.

2. Anchors shall be of a type recommended by the pipe manufacturer and reviewed by the ENGINEER.

B. On piping, where sleeve type couplings and flanged adapters are located near fittings or valves, tie rods shall span across the coupling, as specified herein, to restrain movements of the pipe along its axial direction.

1. Such restraints can be deleted if both ends of the pipe are anchored in a concrete structure with no fitting or valve occurring within the span length, in the suction piping to a pump where the coupling is between the pump and valve, or when the water pressure measured at the crown of the pipe is less than five (5) feet.

C. Sleeve type couplings shall be harnessed except where noted.

1. The harnessing shall be as shown on the drawings or as specified herein.

2. Harnesses for steel pipe shall be in accordance with AWWA Manual M11 for the pipe size and pressure, working or test whichever is greater.

D. Harnesses for ductile iron pipe shall be tie rods spanning between adjacent flanges.

1. Friction clamps shall not be permitted.

2. The size and number of tie rods shall be the same as for steel pipe for the same pressure and pipe size.

E. Where the distance between adjacent flanges is in excess of ten (10) feet or where a harness cannot be used, the pipe supports adjacent to the coupling shall restrain the piping, preventing linear or angular movement resulting in the pipe separating from the coupling or misalignment in the joint.

F. Where expansion joints are used, control units shall be provided.

1. Tie rods and control units shall be installed in accordance with to the manufacturer's recommended procedures.

G. Tie rods and associated hardware shall be type 316 stainless steel.

H. Valves and fittings shall be restrained in an approved manner such that the any developed unbalanced force shall be supported independent of the piping system.

3.16 FLUSHING AND TESTING

A. General

1. Furnish necessary labor and equipment required for the field tests specified below including, but not limited to, air compressor, gauges, conduit caps, temporary pipe, and connections.

2. Provide potable water for flushing and testing purposes.

3. Furnish and install means and apparatus necessary for getting the water into the pipeline and flushing and testing; including pumps, gages, meters, necessary plugs and caps, and temporary blow-off piping required to discharge water. Complete with necessary reaction-blocking to prevent pipe movement during the flushing and testing.

4. Pipelines shall be flushed and tested in such lengths or sections as agreed upon between the CITY, ENGINEER, and CONTRACTOR.

5. Give the CITY and ENGINEER reasonable notice of the time prior to testing the pipeline.

6. The CITY reserves the right, within reason, to request flushing and testing of a section or portion of a pipeline.

7. For sewage force mains, unless otherwise specified, the minimum test pressure shall be 150 psig.

B. Flushing

1. At the conclusion of the installation work, thoroughly clean new pipe by flushing with water or other means to remove dirt, stones, and pieces of wood, which may have entered the pipe during the construction period.

   a. If after this cleaning should any obstructions remain, they shall be corrected by the CONTRACTOR, at his own expense and to the satisfaction of the ENGINEER.

   b. Pipelines shall be flushed at a rate of at least 2.5 feet per second for a duration suitable to the CITY, but in no event less than 60 minutes.

C. Pressure Testing

1. After the pipe has been installed, joints completed, thrust blocks have been in place for at least five days, and the trench has been partially backfilled leaving the joints exposed for examination, the pipe shall be filled with water in a manner to expel air.

   a. The pipeline shall be subjected to a test pressure of 150 psig, as measured at the low points of the pipe, for a period of at least two hours.

   b. Each valve shall be opened and closed several times during the test.

   c. The exposed pipe, joints, fittings, and valves shall be examined for leaks.

   d. Visible leaks shall be stopped or the defective pipe, fitting, joints, or valve(s) shall be replaced.

D. Leakage Testing

1. The leakage test may be conducted subsequent to or concurrently with the pressure test.

2. Pressure piping shall be tested in accordance with AWWA C600, latest revision.

3. After the new piping has been laid and backfilled, it shall be pumped to a pressure of one and one half (1½) times the maximum working pressure, or 150 psig, minimum, as applicable, and visible leaks stopped by approved methods.

4. After pressurizing the pipe, before beginning the leakage test, and in the presence of representatives of the ENGINEER, bleed water from the far end of the pipe until a noticeable drop is apparent on the gauge.

    a. The line will then be re-pressurized and the test begun.

5. The test shall be maintained for two hours, but may be continued for one additional hour if it becomes apparent that the leakage is equal to, or greater than, the amount allowable.

6. Where applicable, and when permitted by the ENGINEER, the CONTRACTOR may fill the line, and pressurize it prior to testing, to allow the pipe lining to saturate.

7. Water supplied to the main during the test to maintain the required pressure shall be measured by a 5/8-inch meter installed on the discharge side of the test pump, or by pumping from a calibrated container.

    a. Exhaustion of the supply or the inability to maintain the required pressure will be considered test failure.

    b. At the conclusion of the test, the amount of water remaining in the container shall be measured and the results recorded in the test report.

8. Provide a suitable pressure gauge, recently calibrated by a testing laboratory acceptable to the ENGINEER.

    a. Copy of certification of calibration table shall be available during the test and shall be submitted with the test report.

9. Maximum length of pipe in one test shall be 2,000 linear feet.

    a. If the CONTRACTOR wishes to test a longer length of pipe, the allowable leakage shall still only be based upon on 2,000 linear foot pipeline segment.

    b. After successfully tested segments of the pipeline have been joined together, re-pressurize the pipeline and inspect the exposed joint(s) for evidence of leakage.

10. Upon completion of a successful test, the ENGINEER and the CONTRACTOR shall certify the test results.

11. Questions pertaining to procedures used during the test shall be answered and decided by the ENGINEER.

12. Leaks or defective pipe disclosed by the hydrostatic test shall be corrected by the CONTRACTOR at his own expense, and the test shall be repeated.

E. Allowable Leakage – DIP and PVC Pressure Piping

1. No installation will be accepted by the ENGINEER until the leakage is less than the number of gallons per hour as determined by the formula:

$$Q = \frac{(S)(D)\,(\text{Square Root of } P)}{133{,}200}$$

in which Q = allowable leakage in gallons per hour, S = total length of pipe being tested in feet, D = diameter of pipe tested inches, and P = the average test pressure during the leakage test in pounds per square inch.

2. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in of nominal valve size shall be allowed.

F. Allowable Leakage – HDPE Pressure Piping (Monitored Make-Up Water Test)

1. The testing procedure for HDPE pipe consists of initial expansion, and test phase. During the initial expansion phase, the test section is pressurized to the test pressure, and enough make-up water is added each hour for three (3) hours to return to test pressure.
2. The test phase follows immediately, and may be two (2), or three (3) hours. At the end of the test time, the test section is returned to test pressure by adding a measured amount of water. If the amount of make-up water added does not exceed the Table 1 values below, leakage is not indicated.

Table 1: Test Phase Make-Up Amount

| Nominal Pipe Size (in.) | Make-Up Water Allowance (U.S. Gallons/100 ft. of Pipe) | |
|---|---|---|
| | 2-hour test | 3-hour test |
| 1½ | 0.10 | 0.17 |
| 2 | 0.11 | 0.19 |
| 3 | 0.15 | 0.25 |
| 4 | 0.25 | 0.40 |
| 6 | 0.60 | 0.90 |
| 8 | 1.00 | 1.50 |
| 10 | 1.30 | 2.10 |
| 12 | 2.30 | 3.40 |

| | | |
|---|---|---|
| 14 | 2.80 | 4.20 |
| 16 | 3.30 | 5.00 |
| 18 | 4.30 | 6.50 |
| 20 | 5.50 | 8.00 |
| 22 | 7.00 | 10.50 |
| 24 | 8.90 | 13.30 |
| 30 | 12.70 | 19.20 |
| 36 | 18.00 | 27.00 |
| 42 | 23.10 | 35.30 |
| 48 | 27.00 | 43.00 |
| 54 | 31.40 | 51.70 |

3. For any test pressure from 1 to 1½ times the system operating design pressure, the total test time including initial pressurization, initial expansion, and time of test pressure, must not exceed eight (8) hours. If the test is not completed due to leakage, equipment failure, etc., depressurize the test section, then allow it to "relax" for at least eight (8) hours before bringing the test section up to test pressure again.

3.17 PAINTING

A. Piping and supports shall be field painted as specified in Division 9 of the Specifications.

3.18 SPECIAL PROVISIONS AT CONCRETE EXPANSION JOINTS

A. At 3/4 or 1-inch concrete expansion joints, concrete encased pipes shall be provided with a sleeve type coupling.
   1. A cavity in the concrete shall be formed around the sleeve coupling.

3.19 REDUCING BRANCH CONNECTIONS

A. Reducing branch connections shall be made up with tee fittings, saddles, branch outlets, or special tapped tee fittings provided with a boss.

   1. No pipe wall shall be tapped unless the tap is made with a saddle or sleeve.

3.20 EXISTING UTILITIES

A. Pipelines shall be installed using due care with regard to existing utilities.

   1. Existing utilities are shown from best available as-built data and must be located by the CONTRACTOR ("potholed") prior to construction.

B. Reliance by the CONTRACTOR on existing utility locations shown on the drawings is not sufficient.

1. Locate existing utilities prior to construction.

3.21 VALVE BOXES

A. Valve boxes, manholes, and electrical boxes, which are proposed or existing, and are effected by the proposed work, shall be raised to the elevation of the final grading.

   1. This shall include additional materials as required on existing items.

B. Valve boxes shall be installed over each outside, buried valve, unless otherwise indicated.

   1. Valve boxes shall be centered over the valve.

   2. Fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides, or to undisturbed trench face if less than 4 feet.

3.22 DEPTH OF COVER

A. Ductile iron pipe shall receive 30 inches minimum cover with approved trench and backfilling techniques.

B. PVC/HDPE pipe shall receive 36 inches minimum cover with approved trench and backfilling techniques.

# PRESSURE TEST REPORT

## CRAIG A. SMITH & ASSOCIATES

CONSULTING ENGINEERS & SURVEYORS
1000 West McNab Road, Pompano Beach, Florida 33069

PROJECT NUMBER: _____ DATE: _____

PROJECT NAME: _____

LOCATION OF LINE TESTED: _____

_____

_____

TIME START TEST: _____ PRESSURE START TEST: _____ PSI

TIME END TEST: _____ PRESSURE END TEST: _____ PSI

TEST TIME (HRS. - MIN.) _____ AVERAGE PRESSURE: _____ PSI

QUANTITY WATER REQUIRED FOR RETURN TO START PRESSURE _____GAL

COMPUTATION OF ALLOWABLE LEAKAGE:

| | | | |
|---|---|---|---|
| LENGTH OF LINE TESTED | = | S | _____ |
| SIZE OF LINE IN INCHES | = | D | _____ |
| AVERAGE TEST PRESSURE | = | P | _____ |
| ALLOWABLE PER HOUR | = | Q | _____ |

TOTAL ALLOWANCE = _____ GAL. X _____ HRS. TESTED = _____

WITNESSED BY:

_____ _____

(ENGINEERS REPRESENTATIVE) (OWNER)

_____ _____

(COUNTY) (UTILITY COMPANY)

_____ _____

(CITY) (CONTRACTOR)

TEST RESULTS WERE: ( ) SATISFACTORY ( ) DOES MEET SPECIFICATIONS
( ) UNSATISFACTORY ( ) DOES NOT MEET SPECIFICATIONS

(Amount Allowable for Testing DIP/PVC) FORMULA $Q = \frac{S \times D \times \sqrt{P}}{133{,}200}$

END OF SECTION

SECTION 15110

VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Furnish materials, equipment, labor, and appurtenances required for proper installation and testing of operation valves, couplings, and connectors, as directed in the Drawings and Specifications.

B. The equipment provided includes, but is not limited to the following:

| Para | TITLE | Para | TITLE |
|---|---|---|---|
| 2.03 | AIR RELIEF VALVES | 2.15 | HYDRANTS |
| | | 2.39 | HYDRO-STOP |
| 2.13 | ANGLE METER STOPS | 2.05 | PLUG VALVES |
| 2.28 | BACK PRESSURE SUSTAINING Valves | 2.24 | METER STOPS |
| 2.17 | BACKFLOW PREVENTERS | 2.33 | POLYVINYLCHLORIDE (PVC) BUTTERFLY VALVES |
| 2.04 | BALL VALVES | 2.34 | PRESSURE REDUCING REGULATOR VALVES (LESS THAN 3 INCHES) |
| 2.22 | BASKET STRAINERS | 2.18 | PRESSURE REDUCING VALVES |
| 2.21 | BUTTERFLY VALVES | 2.07 | PVC AND CPVC CHECK VALVES |
| 2.06 | CHECK VALVES | 2.11 | SERVICE CLAMPS |
| 2.27 | COMBINATION BACK PRESSURE SUSTAINING / CHECK VALVES 3 INCHES AND LARGER | 2.36 | SEWER VACUUM BREAKERS |
| 2.16 | CONCRETE METER BOXES | 2.40 | SLUICE GATES |
| 2.23 | CORPORATION STOPS | 2.20 | SOLENOID VALVES |
| 2.26 | ELECTRONIC MOTOR ACTUATORS | 2.37 | STRAINERS |
| 2.14 | FLANGED COUPLING ADAPTERS | 2.29 | TAPPING SLEEVES |
| 2.10 | FLEXIBLE CONNECTORS | | |
| 2.09 | FLEXIBLE COUPLINGS | 2.30 | TAPPING VALVES |
| 2.08 | FOOT VALVES CHEMICAL FEED PUMPS | 2.12 | UNIONS |

| Para | TITLE | Para | TITLE |
|---|---|---|---|
| 2.02 | GATE VALVES | 2.38 | VALVE BOXES AND COVERS |
| 2.31 | GLOBE VALVES | 2.25 | VALVE I. D. DISKS |
| 2.32 | GAUGE COCKS | 2.19 | WATER PRESSURE GUAGES |
| 2.35 | HOSE BIBBS | | |

1.02 RELATED SECTIONS

A. Trenching - Division 2

B. Excavation and Fill - Division 2

C. Paints and Coatings - Division 9

D. Measurement and Control Instrumentation - Division 13

E. Pipes and Tubes - Division 15

F. Shop Drawings, Product Data, and Samples - Division 1

1.03 DESCRIPTION OF SYSTEMS

A. Equipment and materials specified herein are intended to be standard items for use in controlling the flow of water, wastewater, chemical, and air.

B. Provide valves and appurtenances of the size shown in the Drawings

1. Provide similar valves from one manufacturer.

C. Mark valves and appurtenances with the name of the manufacturer and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.

D. Provide open-left, counter-clockwise valves.

1.04 QUALIFICATIONS

A. Provide valves and appurtenances from well established reputable firms with full experience and qualification in the manufacture of the equipment to be furnished.

B. Design, construct, and install equipment in accordance with the best practices and methods and in conformance with these Specifications.

1.05 SUBMITTALS

A. Provide with each submittal complete information and data specified and additional information required to evaluate the proposed product compliance with Specifications.

B. Partial or incomplete submissions will be returned to the CONTRACTOR not approved.

C. Submit the following data:

1. Catalog Data consisting of specifications, illustrations and a parts schedule that identifies the materials to be used for the various parts and accessories.

2. Provide sufficiently detailed illustrations and information to serve as a guide for assembly and disassembly and for ordering parts.

3. Complete assembly, and installation drawings with clearly marked dimensions.

4. Weight of component parts and assembled weight.

5. Design calculations.

6. Listing of lubricants required for the equipment with a minimum of two equivalent and compatible natural and/or synthetic lubricants produced by different manufacturers.

7. Estimated quantity of lubricant required for one year of operation.

8. Sample data sheet of equipment nameplate(s) including information contained thereon.

9. Spare parts list.

10. Special tools list.

D. Obtain from the manufacturer and submit to the ENGINEER copies of the results of certified shop tests.

E. Obtain from the manufacturer and submit to the ENGINEER copies of certified letters of compliance in accordance with the General Conditions.

F. Submit operation and maintenance manual in accordance the procedures and requirements set forth in the General Conditions.

1.06 TOOLS, SUPPLIES AND SPARE PARTS

A. Obtain from the equipment manufacturer and submit to the ENGINEER the following spare parts lists in accordance with the procedures and requirements set forth in the General Conditions.

1. A complete list of parts and supplies with current unit prices and source of supply.

2. A list of parts and supplies that are either normally furnished at no extra cost with the purchase of the valve or hydrant as specified herein to be furnished as part of the Contract.

a. Submit this list of parts as part of the shop drawing submission.

B. Completely identified parts with a numerical system to facilitate parts inventory control and stocking.

C. Provide proper identification for each part by a separate number.

D. Provide the same parts number for those parts that are identical for more than one size.

E. Compile from the shop drawing submittals and furnish a comprehensive list of special tools required for the equipment.

F. For each solenoid valve, provide a spare solenoid coil, suitably boxed and labeled, as elsewhere specified.

1.07 MANUFACTURER'S RECOMMENDATIONS

A. Where installation procedures are required to be in conformance with the recommendations of the manufacturer of the material being installed, furnish printed copies of these recommendations to the ENGINEER prior to the installation.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Provide valves and accessories in the quantity, quality, types, and sizes as indicated in the Drawings and Specifications.

B. Design operation of valves and gates so that less than forty pounds of force is required to operate the handwheel, lever, or chain when applied at the extremity of the wheel or lever.

1. The handwheels on valves:

| Valve Size | Minimum Operating Wheel Diameter |
|---|---|
| 14 inch and smaller | 8 inches |
| larger than14 inch | 12 inches |

2. Except where noted otherwise, provide handwheel or lever operated interior and exposed valves if the centerline of the valve operator is within 6 feet of the floor or platform from which it is to be operated, and chain wheel operated if the distance is greater than 6 feet unless otherwise shown in the Drawings.

3. Extend chains to within three (3) feet from the operating floor.

4. Support rotated operators independent of the valve to prevent torsional loads induced on the piping system.

C. Provide operators that are counter-clockwise to open, unless otherwise specified.

1. Provide operators with the open direction clearly and permanently marked.

2. Provide valve operators, manual, motor, and pneumatic, with the valve by the valve manufacturer.

3. Selection of the proper operator to meet the operating conditions specified is the responsibility of the valve manufacturer.

4. The valve manufacturer is responsibility for field calibration and testing of the operators and valves to ensure a proper installation and an operating system.

D. Provide valves with a minimum design pressure rating of 150-psi and capable of a test pressure of 300-psi.

1. For service applications with pressures in excess of 150-psi, valves provide having a minimum pressure rating in excess of the service application working pressure.

2. Provide Victaulic ends on above grade valves with interior valves with a nominal pipe size of 3 inches and larger ends unless otherwise noted.

3. Provide threaded ends above grade, interior valves less than 3-inch size.

4. Provide mechanical joint pipe ends on buried service valves.

5. Provide Buried service valves with AWWA operating nuts, extension stems, and cast iron valve boxes.

6. Provide extended valve stems, stem guides and operating nuts, as indicated or required.

E. Provide valves of one type from of one manufacturer.

F. Provide levers at each lever operated valve.

1. Provide tee wrenches for yard piping valves and hydrants at a rate of one (1) per five (5) valves.

G. Provide cast iron parts of valves meeting the requirements of ASTM Designation A126, "Standard Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class 'B'".

1. Provide flat-faced flanged ends having bolt circle and bolt patters conforming to ANSI B16.1 Class 125 unless otherwise specified.

2. Provide clean castings and sound, without defects and no plugging, welding or repairing of defects will be permitted.

3. Provide hexagonal bolt heads and nuts conforming to ANSI B18.2.

4. Provide full-faced gaskets made of natural or synthetic elastomers in conforming with ANSI B16.21 suitable for the service characteristics especially chemical compatibility and temperature.

5. Provide nonferrous alloys of various types for parts of valves as specified.

6. Where no definite specification is given, provide the recognized acceptable standard material for that particular application.

H. Buried valves and other valves located below the operating deck or level, specified or noted to be key operated, shall have an operator shaft extension from the valve or valve operator to finish grade or deck level, a 2-inch square AWWA operating nut, and cover or box and cover, as may be required.

I. Except as otherwise specified, paint buried valves with 2 coats of asphalt varnish in accordance with the requirements of AWWA Standard C 500.

1. Protect this protective coating from damage until valve is backfilled.

J. Provide valve identification tags in accordance with Division 1 for valves.

K. Apply the same coatings to the valves as the adjacent piping.

L. Provide blind flanges or plugs for valves, which are dead ends for active pipelines to prevent leakage.

M. Raised face flanges in conformance with ANSI 816.5 class 150 will not be acceptable.

2.02 GATE VALVES

A. For Nominal Pipe Sizes less than 3-inches

1. Gate valves for water service for less than 3 inches in diameter shall conform to the requirements of Federal Specification WW-V-54 for Class B, Type II, and shall be bronze, double disc, solid wedge, rising stem, inside screw, screwed bonnet, 150 pound S.P., 300 W.O.G. with stuffing box repackable under pressure and renewable parts.

a. Ends shall be as shown or indicated in the Contract Drawings.

2. Small gate valves shall be as manufactured by Crane Company No. 431 or 435-UB to match application, or equal.

B. For Nominal Pipes Sizes 3-inches and larger

1. Gate valves 3 inches and larger shall be ductile iron body, bonnet and gate casing, epoxy coated, gate valves with the gate encapsulated in rubber that conforms to the requirements of AWWA C500 or C509 as applicable for the services noted except as modified or supplemented herein.

2. Valves for exposed and interior service shall be outside screw and yoke (OS&Y), solid wedge type and shall be provided with handwheels.

a. Valves shall have flanged bodies and packing for stem seals.

b. The valve shall be U.S. Pipe Metroseal 250, American-Darling or approved equal.

3. Valves for buried service for nominal pipe sizes 3 to 12-inches shall have resilient seats and non-rising stems with double O-ring stem seals conforming to AWWA C509.

a. Valves ends shall be flanged, mechanical joint, or "ring-tite" joint as required for the type of pipe used.

b. Valves shall be provided with 2-inch square operating nuts.

c. Valves for buried service larger than 16 inches shall be double disc type with non-rising stems equipped with double O-ring seals conforming to AWWA C500.

4. Valves for potable and fire service water shall be of the double disc type as manufactured by Mueller A-2483-6, or equal with stems of silicon bronze conforming to ASTM B98, Alloy No. 661 or equal.

a. Valves shall be provided with seals consisting of multiple ring, V-type packing, which shall be adjustable and replaceable in the valves while in service without undue leakage.

C. Special Provisions

1. Special Provisions for AWWA double disc valves sixteen (16) inches and larger are:

a) Shall be provided with by-passes conforming to AWWA standards when so designated in the schedule.

b) Shall be provided when installed in a horizontal position with bronze tracks, bronze rollers and scraper in accordance with AWWA specifications.

2.03 AIR RELIEF VALVES

A. Furnish and install air release valves as indicated in the Drawings and as directed by the ENGINEER in the field, with below ground exhaust or intake.

1. The bid price for air release valves shall include costs for purchasing, delivering, and installing the air release valves and accessories complete, including tapping the main, furnishing and installing the tapping saddle, plug valve and valve box, the below ground air release valve, the enclosure and fountain and necessary piping and appurtenances, as shown in the Drawings and Specifications.

B. Sewer air release valves shall be specially designed for use on sewerage force mains.

1. The valves shall be threaded connection with a cast iron body and internal stainless steel trim parts.

2. Working parts shall be located in the upper portion of the internal chamber.

3. The lower chamber shall contain a ball float, which shall be suitable for 150-psi working pressure.

4. The orifice size shall be as indicated in the drawings.

5. The Combination Sewage Air Valves shall consist of two separate valve bodies, one Release Sewage Air and one Sewage Air and Vacuum Valve.

6. Air release valves shall be piped into a compact assembly and shall include provisions to back flush the valves.

7. The Sewage Air Release Valve shall function automatically to release entrained air to the atmosphere.

8. The Sewage Vacuum Valve shall exhaust large quantities of air during the filling of the system and allow air to reenter during drainage or when a vacuum occurs.

9. Once air is exhausted, the valve shall seat tightly to prevent sewage leakage.

C. Air valve shall be as manufactured by APCO, G-A Industries, Val-Matic or Crispin and shall meet ANSI/AWWA C-512.

D. The connection to the main shall be stainless steel tapping saddle, as shown in the Drawings.

E. Air Valve enclosure (manholes) shall have the inside and outside surfaces of the walls coated with two coats of heavy duty coal tar epoxy coating containing not less than 72.9 percent by volume nonvolatile solids.

1. The masonry surface may be damp, but not wet.

2. If necessary, utilize blowers to achieve the necessary drying.

3. The first coast shall be thinned approximately 15 percent with a thinner recommended and furnished by the manufacturer.

4. The total dry film thickness of the finished coating shall not be less than 10 mils.

5. The coating shall be Coppers 300-M, or equal, applied in accordance with the manufacturer’s recommendations.

6. Take necessary precautions to protect the workmen against toxic or harmful fumes during the painting operations.

F. The air release valve for use in water mains shall be installed as shown in the Drawings.

1. The valves shall have cast iron body, cover and baffle, stainless steel float, bronze water diffuser Buna-N or Viton seat and stainless steel trim.

2. Valves shall be provided with a vacuum check to prevent air from reentering the line.

3. The fittings shall be threaded.

4. The air release valves shall be Model 200 WD as manufactured by APCO Valve and Primer Corporation and Manufacturing Corp., Lyons, Illinois or equal.

G. The two-valve air release valves for use in sewage force mains shall be provided in air release valve enclosures.

1. One valve shall be a sewage air release valve, both with stainless steel trim.

2. Valve shall be Val-Matic Model No. 485/30/S, similar by APCO or equal.

3. The vales shall be as follows:

a. Sewage Air/Vacuum Valve:

1) The valve body shall be of cast iron ASTM A126-B. The floats, float guide, and stem shall be of stainless steel Type 316.

2) The resilient seat shall be of Buna-N.

3) The valve shall be suitable for 150-psig working pressure.

4) Valve shall have standard 2 inch NPT inlets and outlet ports.

5) Provisions shall be made for back-flushing the valve with clean water.

6) The overall height of the valve not including the flushout attachment shall not exceed 22 inches.

b. Sewage Air Release Valve:

1) The valve body and cover shall be of cast iron construction, ASTM A126-B, and internal working parts shall be of stainless steel Type 316.

2) The venting orifice shall be of 3/8-inch in diameter and the seating material shall be of Viton.

3) The inlet opening shall be standard 2 inch NPT screwed connection.

4) The valve shall include a flush-out feature for periodic cleaning of the internal mechanism.

5) The overall height of the valve body shall not exceed 21 inches.

2.04 BALL VALVES

A. Bronze

1. Ball valves for service unless otherwise indicated shall be end entry type with bronze body and trim, TFE seats, TFE or Viton Stem seals and flanged or threaded end connections as indicated.

a. Valve body shall be either two or three piece design; no design with an internal retaining ring for the ball shall be acceptable.

b. Valves shall be Class 150.

c. Valves shall be as manufactured by Hills

2. McCanna, or equivalent by Jamesbury, WKM or Whitey.

a. Valves shall be supplied with manual lever or "T" handle.

b. Valves shall be non-lubricated, and capable of sealing in either flow direction.

B. Stainless Steel

1. Ball valves for use with stainless steel piping systems, including instrument isolation, air lines, moisture drains, and caustic soda shall be end entry type with type 316 stainless steel body and trim, TFE seats and seals and flanged or threaded connections as indicated.

a. Valve body shall be either two or three piece design. No internal ring for the ball shall be acceptable.

b. Valves shall be class 150.

c. Valves shall be McCannaflo series 602 by Hills McCanna or equivalent models by Jamesbury, WKM or Whitey.

d. Valves shall be supplied with manual lever or "T" handle.

1) Valves used as moisture drain valves shall be installed at low points of the line and plugged or capped.

## 2.05 PLUG VALVES

A. Provide the non-lubricated, eccentric plug type valves with elastomer faced plugs equivalent to series 100 models as manufactured by DeZurik Company or Ballcentric as manufactured by Henry Pratt.
   1. The construction of the valve shall require the opening movement of the valve to cause the plug to rise off the seat contact rather than sliding from its seat.

B. Port areas for nominal pipe sizes four (4) inches and smaller shall be equal to 100 percent of the nominal full pipe area.

   1. Port areas for nominal pipe sizes larger than four (4) inches shall be 82 percent, or greater, of the nominal full pipe area.

C. Valves shall be provided with limit stops and rotate 90 degrees from fully open to fully closed and shall be capable of providing shut-off up to the full working pressure rating in either direction working pressure ratings are as follows:

| Nominal Pipe Size (in.) | Working Pressure (psi) |
|---|---|
| 2 to 12 | 175 |
| 14 to 36 | 150 |
| 42 to 72 | 125 |

D. Valves shall be bolted bonnet design and be provided with lever operators for interior and exposed service with nominal pipe sizes six (6) inches and less.

E. Interior and exposed service with nominal pipe sizes eight (8) inches and larger shall be provided with totally enclosed worm gear actuators.

   1. The actuators shall be properly sized to suit the maximum differential across the valve.

F. For buried or submerged service, provide valves with a totally enclosed worm gear and AWWA operating nut.

   1. Valves with nominal pipe sizes eight (8) inches and larger shall have permanently lubricated totally enclosed worm gear actuators.

G. Flanged valves shall be faced and drilled conforming to ANSI B16.1 Class 125.

   1. Mechanical joint bells shall conform to AWWA C111.

   2. Screwed ends shall conform to the NPT Standard.

H. Exposed nuts, bolts, springs, and washers shall be type 316 stainless steel.

I. Valves shall have the standard face to face dimensions of AWWA gate valves for nominal pipe size three (3) to twelve (12) inches with flanged end connection.

J. Valve Bodies and plugs shall be semi-steel conforming to the requirements of ASTM A126 Grade B, cast iron.

1. Plugs shall be covered with Buna-N for general service and for digester gas service the covering provide High Nitrile Buna-N.

K. Valve seats shall be corrosion resistant consisting of a welded in overlay of 90 percent pure nickel.

L. Provide replaceable valve bearings of bronze or non-metallic composition for both the upper and lower journals.

M. Shaft seals shall be multiple ring, V-type Buna-N packing.

1. The stuffing box shall be designed to allow the packing to be adjusted and replaced when the valve is in service.

N. Gear actuators shall be totally enclosed worm gear type with permanently lubricated bronze bearings and shall be designed to Handle the seating and unseating torque at the specified handwheel pull for applications with the maximum pressure differential in either direction.

O. Manual actuators for buried service shall be provided with AWWA operating nut and a completely enclosed mounting bracket and actuator cover and extension stem sufficiently long to extend within 12 inches of the ground surface and shall be housed in a valve box and cover.

P. Where indicated in the Drawings, valve operators shall be provided with extension bonnets.

## 2.06 CHECK VALVES

A. Check Valves Less than 3-inches

1. Unless otherwise indicated or specified, check valves less than 3 inches in size shall be standard, all-bronze construction, horizontal or vertical-swing check valves as required, with screwed ends.

a. Valves shall be Crane Co. No. 37, Walworth Co., No. 406, or equal.

B. Check Valves 3-inches and Larger

1. Unless otherwise indicated or specified, check valves 3 inches and larger shall be swing check type with clear waterway design with outside lever and weights conforming to the requirements of AWWA C508.

    a. Valves shall have Class 125 flanged ends faced and drilled in accordance with ANSI Standard.

    b. Check Valves shall have cast iron bodies, with the following components of stainless steel: body ring, disc ring, clapper hinge shaft, hinge shaft key, clapper spacers, disc stud, disc stud nut and bushing, disc retaining washer and cotter pin.

    c. The hinge pin shall extend outside the cast iron body through lubricated stainless steel bushings and outside packed glands on each side of the valve.

    d. Each bushing shall be provided with a buttonhead grease fitting.

    e. Stainless steel shall be at least 18-8 nickel-chromium content.

    f. Check valves shall be tested at the factory and shall be drip tight under a hydrostatic pressure of 200-psi applied to the downstream side of the disc.

    g. A certified test report shall be furnished with each valve.

    h. Check valves shall be GA Industries Fig. X250D, or equal.

2. Valves shall be furnished with air cushion cylinders and bleed cocks.

C. Globe Style Silent Check Valve

1. Silent operating type check valve that begins to close as the forward flow velocity diminishes and be fully closed at zero velocity preventing flow reversal and resultant water hammer or shock.

2. Operation of the valve shall not be affected by position of installation.

3. Valve design shall incorporate a center guide, spring loaded poppet, guided at opposite ends, and having a short linear stroke that generates a flow area equal to the pipe.

4. Spring shall be designed to withstand 100,000 cycles without failure and exert a force to open the valve with a differential pressure of 0.5-psi and to fully open at a flow velocity of 4 fps.

5. Valve disc shall be concave to the flow direction.

6. A Buna-N seal shall be furnished to provide zero leakage and the seal shall provide for both metal to metal seal and metal to Buna-N seal.

7. Component parts shall be field replaceable without the need of special tools.

8. Globe Style Valve shall be manufactured by Val-Matic Valve and Manufacturing Corp. or approved equal

2.07 PVC AND CPVC CHECK VALVES

A. Check valves shall be swing check type or ball check type manufactured from PVC or CPVC compounds.

1. PVC check valves shall be provided on PVC and fiberglass piping.

2. CPVC check valves shall be provided on CPVC piping.

3. Swing check valves shall be furnished with teflon seats, teflon seals and flanged end connections.

4. Ball check valves shall be furnished with Viton seats, Viton seals and threaded ends.

B. Ball check valves shall be provided on piping less than 3 inches in diameter.

C. Swing check valves with outside lever and weight or spring shall be provided on piping 3 inches in diameter and larger.

D. Check valves shall be as manufactured by Asahi/America, or equal.

2.08 FOOT VALVES CHEMICAL FEED PUMPS

A. Foot valves shall be PVC Type 1 construction, Viton ball and body seal, PVC strainer, and shall be supplied with spigot end connector and union nut.

B. Foot valves shall be Model No. 8333 as manufactured by Plastiline, Inc., Pompano Beach, Florida, Peabody-Barnes, Mansfield, Ohio, or equal.

2.09 FLEXIBLE COUPLINGS

A. Flexible couplings shall be either the split type or the sleeve type as shown in the Drawings.

1. Split type couplings shall be used with interior piping and with exterior piping as noted in the Drawings.

a. The couplings shall be mechanical type for radius groove piping.

b. The couplings shall mechanically engage and lock grooved pipe ends in a positive couple and allow for angular deflection and contraction and expansion.

2. Couplings shall consist of malleable iron, ASTM Specification A46, Grade 32510 housing clamps in two or more parts, a single chlorinated butyl composition sealing casket with a “C” shaped cross-section and internal sealing lips projecting diagonally inward, and two or more oval track head type bolts with hexagonal heavy nuts conforming to ASTM Specification A183 and A194 to assemble the housing clamps.

   a. Bolts and nuts shall be cadmium plated.

3. Victaulic type couplings and fittings may be used in lieu of flanged joints.

   a. Provide pipes with radius groove as specified for use with the Victaulic couplings.

   b. Flanged adapter connections at fittings, valves, and equipment shall be Victaulic Flange Style 741, equal by Gustin-Bacon Group, Division of Certain-Teed Products, Kansas City, Kansas, or equal.

4. Sleeve type couplings shall be used with buried piping.

   a. The couplings shall be of steel and shall be Dresser Style 38, Smith Blair Style 413, or equal.

   b. The coupling shall be provided with black steel bolts and nut unless indicated otherwise.

5. Couplings shall be furnished with the pipe stop removed.

6. Couplings shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.

## 2.10 FLEXIBLE CONNECTORS

A. Flexible connectors shall be supplied for the piping as shown in the Drawings.

1. Connectors shall be constructed of bronze and braid with female copper tube sweat fitting brazed on each end.

2. Connectors shall be style BF as manufactured by Vibration Mountings and Control, Inc., Butler, NY, American, Waterbury, CN, Metraflex, Chicago, IL, or ENGINEER's approval equal.

2.11 SERVICE CLAMPS

A. Stainless-steel, double strap service clamps shall be used on pipe.

2.12 UNION

A. Unions on ferrous pipe 2 inches in diameter and smaller shall be 150 pounds malleable iron, zinc coated.

B. Unions shall not be concealed in walls, ceilings or partitions.

2.13 ANGLE METER STOP

A. Angle meter stops shall be manufactured by Mueller Catalog No. H14258, and be the 90 degree angle type with lock-wing head shutoff.

2.14 FLANGED COUPLING ADAPTER

A. Coupling adapter shall be Smith-Blair Model No. 912, or equal.

1. Body and follower flange shall be iron.

2. Bolt circle, size, and spacings shall conform to ASA 125 flange.

3. Gasket shall be Smith-Blair Grade 30 or 60, or equal.

4. O-Ring shall be grade 60.

5. Cross and tee bolts shall conform to ANSI A21.11.

2.15 HYDRANT

A. Hydrant shall have a 6 inches pipe connection, one (1) 5-1/4 inch main valve opening, two (2) 2-1/2 inch hose nozzles, and one (1) 4-1/4 inches hose nozzles.

1. Hydrants shall be cast iron body, fully bronzed mounted, suitable for a working pressure of 150 pounds and shall be in accordance with the latest specification of the AWWA C-502.

2. Hydrants shall be of the O-Ring seal type.

3. Operating nut shall open counter-clockwise and be of the pentagonal shape, measuring 1 1/2 inches from point to opposite flat.

B. Hydrants shall be painted on coat of zinc chromate primer and two finish coats of an approved paint as directed by the OWNER.

C. Hydrants shall be “Centurion” Number A-423, Traffic Type, as manufactured by Mueller Company, or an approved equal.

1. Furnish one operating manual and one hydrant wrench.

2.16 CONCRETE METER BOX

A. Concrete meter box shall be Series No. 37-T by Brooks Products, Inc., Medley, FL, or equal.

B. Box body shall be precast concrete with a cast iron traffic cover weighing 27 lbs.

C. Box body shall be nominal 12 inch deep.

D. Set box in concrete side walk as shown in the Drawings.

2.17 BACKFLOW PREVENTER

A. Backflow preventer shall be an approved reduced pressure zone backflow preventer conforming to the requirements of Section 4620 of the South Florida Building Code, Broward edition.

1. Units shall meet the following standards:

a. ASSE 1013, AWWA C506

b. UL EX 3185.

B. Backflow preventer shall be Watts Regulator Model No. U909S, Febco Model 825Y, or equal.

1. The unit shall come complete with two independent check valves, strainer and ball type test cocks.

2. Body shall be bronze construction with tight seating rubber check valves.

3. Ball valves test cocks shall be bronze.

4. Joints shall be N.P.T. and gate valves shall be non-rising stem.

C. Unit shall be rated 175-psi.

1. One-inch diameter units shall have no more than a 13-psig pressure drop at 30 gpm.

D. Parts must be removable or replaceable without removal of the unit from the line.

2.18 PRESSURE REDUCING VALVE

A. Pressure reducing valve shall be forged brass or cast iron body fully bronze mounted, direct acting, bronze internal trim, reinforced neoprene diaphragm
   1. Valves shall have an inlet side pressure gauge connection and adjusting screw or “T” handle.

B. Pressure reducing valve sizes smaller that 1/2 inches shall have screwed ends; those 2 inches or larger, flanged ends and those in between these sizes shall have union ends.

C. Strainers shall be of the “Y” type.
   1. Strainers shall have bronze bodies with a removable bronze screen and shall be as manufactured by Watts Regulator Company, Lawrence, MA, or equal.

D. The pressure reducing valve shall be as manufactured by Watts Regulator Company, Series No. 223 SHP, or equal.

2.19 WATER PRESSURE GAUGE

A. Pressure gauge shall be direct mounted, cast aluminum case, a 3-1/2 inch diameter dial and furnished with a clear glass crystal window, 1/4-inch shut-off valve, and a bronze pressure snubber.

   1. Gauges shall be weatherproof.

   2. The Face dial shall be white finished aluminum with jet-black graduations and figures.

   3. The face dial shall indicate the units of pressure being measured (e.g., feet or inches) or be dual scale.

B. Pressure gauge shall be Model 600 as manufactured by H.O. Trerice Co., or equal.

2.20 SOLENOID VALVE

A. Provide 2-way or 3-way solenoid valves as required, with a NEMA 4X water tight, dust tight, and corrosion resistant enclosure.

1. They shall be of the type that is normally closed, energized to open, closed on failure, and can be opened manually on failure.

    a. Plunger assembly (plunger and tube) shall be type 316 stainless steel.

    b. Disc shall be Viton or Teflon.

    c. Valves shall have a molded epoxy resin class B temperature range coil for continuous duty and a NEMA 4X water tight coil housing.

    d. Solenoid valves shall be suitable for operation on a 120 volt, 60 hertz power supply or 24 VDC power supply as appropriate and shall be as manufactured by Automatic Switch Co., Magnatrol Corp., or equal.

## 2.21 BUTTERFLY VALVES

A. Provide a rubber seated, self-adjusting permanent packing, streamline disc, cast iron bodied butterfly valve as manufactured by Henry Pratt, model 2F II or MK II.

B. Provide a butterfly valves conforming to AWWA C-504, latest edition.

1. Bodies shall be cast iron per ASTM A-126 Class B (model 2F II) or Class 40 (model MK II).

2. Discs shall be cast or ductile iron with type 316 stainless steel or monel edge.

3. Shafts shall be type 304 stainless steel with self-lubricating, corrosion resistant sleeve-type bearings.

C. Butterfly valves unless otherwise specified, shall be the product of one manufacturer and shall meet the full requirements of AWWA C504 except as modified or supplemented herein.

D. Provide valve seats of a synthetic compound, such as Buna-n or EPDM located in the valve body.

1. Simultaneously mold, vulcanize and bond seat to the body or retain by mechanical means without use of retaining rings, segments, screws or hardware in the flow stream.

E. Butterfly valves shall be AWWA class 150B and shall be bubble tight at 150-psi differential in both directions and hydro tested to 300-psi.

1. Where specified, use flanged ends on above ground valves paced and drilled to ANSI B16.1 Class 125.

2. Where specified, use mono-flange bodies above ground valves incorporating an overlapping seat, which also forms a gasket for the flange face.

3. For buried valves provide mechanical joint ends conforming to ANSI 21.11.

4. Provide valves manufactured by Henry Pratt Company, DeZurik, or Mueller.

F. For manual valves actuators provide either worm gear type or traveling nut type and meet the requirements of AWWA C-504 section 3.8 except capable of withstand an input torque of 450 FT-LBS at the open and close stops.

2.22 BASKET STRAINER

A. Basket strainers shall be installed as shown in the Drawings.

1. Strainer shall have cast iron body with 125-pound flanges and a clamped cover.

2. Each clamped cover shall be removable by hand with two large hand knobs.

B. Strainer shall have duplex perforated baskets.

1. Strainer shall be designed for continuous serve so that the two strainers may be placed alternatively in and out of service while the other is being cleaned.

C. Strainer baskets shall be stainless steel with 1/8-inch perforations allowing a pressure drop of .52-psi at a flow of 300 gpm when clean.

D. Strainer shall include vent, drain and handle from isolation plug rotation.

E. Strainer shall be by Mueller Steam Specialty Company, Model No. 691 or equal.

2.23 CORPORATION STOP

A. AWWA C800 type, tapered threaded inlet, except when connecting to tapped fittings which require IPS tapered threads, outlet compression connection or IPS threads to suit connecting pipe, stop 1 inch smaller rated 100-psi, larger stop rated 80-psi.

1. Manufacturers and Products:

a. Ford Meter Box Co.,
b. Mueller Co.,
c. Or Equal.

2.24 METER STOPS

A. Meter stops shall be manufactured by Mueller No. H14250 or Ford and be the 90° angle type with lock-wing head shutoff as approved by the OWNER.

2.25 VALVE I.D. DISKS

A. Disk shall be 3-inch diameter brass, 1/8 inch thick with brass theft proof anchor pin permanently attached to underside of the disk.

1. The top surface is to be engraved with 1/4 inch to 3/8-inch capital letters.
2. Valve I.D. disk shall identify valve size, type of valve and number of turns to open such as (24 inches, Plug Valve, L-36).

2.26 ELECTRIC MOTOR ACTUATORS

A. Electric actuators shall meet the requirements of AWWA C-540 and be rated to produce not less than the required valve seating and dynamic torques.

1. Motors shall be sized for 1.5 times the actuator torque requirements.

2. Motors shall move the valve from full open to full close, or the reverse in 60 seconds plus or minus 10 percent.

3. Electric actuators shall include the electric motor, reduction gearing, stem coupling, position limit switches, torque switches, a ductile iron gear case and auxiliary automatic declutching handwheel.

4. Actuators shall include open-stop-close push buttons, open and close indicator lights and a lockable 3-position selector switch, local-off-remote.

B. The actuator shall position a throttling valve based upon a 4-20 ma signal from the control panel.

1. The position of the vale shall be field adjustable to allow the desired flow.

C. Actuator shall contain a 4-20 ma feedback signal to indicate the position of the valve and a position indicator needle.

1. Failure mode shall be last position.

D. The actuator shall operate on 120 VAC 60 Hz 3 phase and be enclosed in NEMA 4x enclosure.

1. Components of the actuator shall be fully capable of operating outdoors.

2. Actuators shall be provided with a lighting arrestor.

E. Actuator shall be totally compatible with the approved valve it will be mounted upon and controlling.

F. Actuator shall permit hand wheel (which is to be included on the actuator) operation.

1. The electric motor and hand wheel may not be operated simultaneously.

G. Provide actuators (electric motors and gearing) of Series 2000 as manufactured by E. I. M., L-120 as manufactured by Limitorque, or SA series as manufactured by AUMA Actuators, Inc.

1. Flow rate maximum and maximum differential pressure as shown in the Drawings.

2.27 COMBINATION BACK-PRESSURE SUSTAINING/CHECK VALVES THREE INCHES AND LARGER

A. Hydraulically operated, diaphragm actuated, pilot controlled globe valve, cast iron, ductile iron, or steel body, rated 175-psi, ANSI B16.1 flanged ends, bronze or stainless steel trim, stainless steel stem, externally mounted strainers with cocks, solenoid, and limit switch, single pole double throw, 120V AC rated, a minimum upstream pressure, and prevents backflow.

B. Manufacturers and Products:

1. Cla-Val; Model 51G-01,

2. WATTS, ACV

3. Golden Anderson;

4. Singer;

5. Inbal Series 700

6. OCV Model 125

7. Ross Valve

8. Or Equal

2.28 BACK PRESSURE SUSTAINING VALVES

A. For Nominal Pipe Sizes less than 3-inches

1. Back pressure sustaining valves shall maintain constant upstream pressure by by-passing or relieving excess pressure, and shall maintain close pressure limits without causing surges.

    a. The valve shall be a direct acting, adjustable, spring-loaded, diaphragm valve, designed to permit flow when controlling pressure exceeds spring setting.

    b. The valves shall be bronze body with stainless steel diaphragm and stainless steel trim, with plugged outlet and a pressure adjustment range of 40-200-psi.

    c. Valves shall be Cash-Acme Type FR, or equal.

B. For Nominal Pipe Sizes 3-inches and Larger

1. The back pressure sustaining valve shall be designed to protect the pressure integrity of the upstream pressure system by only opening when the upstream pressure exceeds an adjustable pilot setting.

2. The back pressure sustaining valve shall modulate as required to maintain a pre-set pressure on the upstream side of the valve.

    a. If upstream pressure drops below valve setting, the valve shall close.

3. The valve shall be designed so that turning clockwise on the sustaining pilot handwheel will increase the setting and turning counter-clockwise will decrease the setting.

4. Needle valves shall be furnished to provide independent and adjustable control of the main valve opening and closing speed.

    a. The valve shall be shipped completely piped and ready for installation.

5. The main valve shall operate on the differential piston principle such that the area on the underside of the piston is no less than the pipe area, and the area on the upper surface of the piston is of greater area than the underside of the piston.

6. The valve piston shall be guided on its outside diameter by long stroke stationary v-ports, which shall be downstream of the seating surface to minimize the consequences of throttling.

    a. Throttling shall be done by the valve v-ports and not the valve seating surfaces.

7. The valve shall be capable of operating in any position and shall incorporate only one flanged cover at the valve top from which internal parts shall be accessible.

    a. There shall be no stems, stem guides, or spokes within the waterway.

    b. There shall be not springs to assist the valve operation.

8. The valve body shall be of cast iron ASTMA-126 with flanges conforming to the latest ANSI Standards.
    a. The valve shall be extra heavy construction throughout.

    b. The valve interior trim shall be bronze B-62 as well as the main valve operation.

9. The valve seals shall be easily renewable while no diaphragm shall be permitted within the main valve body.

10. Controls and piping shall be of non-corrosive construction.

11. A visual valve position indicator shall be provided for observing the valve piston position.

    a. The back pressure sustaining valve shall be as manufactured by Golden-Anderson Industries Figure 6700-DR, Clayton, or equal.

2.29 TAPPING SLEEVES

A. Tapping sleeves shall fit existing cast iron, ductile, PVC or AC pipe.

    1. Determine the outside diameter of the pipe before ordering the sleeve.

B. Tapping sleeves shall be cast iron or ductile iron, designed for a working pressure of at least 150-psi for connections to distribution system.

C. The tapping sleeve shall be mechanical joint ended, on the run, and shall have connecting flange outlet, with centering groove, for connecting to the tapping valve.

    1. The flange outlet on tapping sleeve and the tapping valve shall be industry standard.

        a. The tapping sleeve must be interchangeable with tapping valves by other manufacturers.

D. The tapping sleeve shall be furnished with necessary longitudinal gaskets, glands, split end gaskets, and bolts and nuts, as specified below under

TAPPING VALVES, or shall be standard carbon steel square, hex, or T-head bolts and nuts, which have been galvanized.

E. The tapping sleeve shall be furnished with a tapped and plugged outlet for testing purposes.

1. Threads shall be ANSI B2.1 (NPT).

2. Tapping sleeve and valve shall be hydrostatically tested after installation and prior to tapping.

F. Tapping sleeve to be manufactured from gray cast iron meeting or exceeding ASTM A126 Grade B or ductile iron meeting ASTM A536 Grade 65-45-12.

1. Slide flange seals shall be of the O-ring type of either round, oval or rectangular cross-sectional shape.

G. Tapping sleeves to be used in conjunction with a mating tapping valve from same manufacturer.

1. Outlet flange of sleeve to be counter-bored per MSSAP-60 for true alignment of tapping valve and tapping machine.

2. Sizes of outlet to be available through equal opening of sleeve diameters up to 24 inches.

H. Size 12 inches and smaller must be capable of working on Class ABCD Pipe diameter without changing either half of sleeve.

1. Size 14 inches and larger must be specified as to which class size is needed.

2. Sleeves are to include the end joint accessories and split glands necessary to assemble sleeve to pipe.

3. MJ bolts and nuts are to conform to ANSI/AWWA C111/A21.11.

4. No special tools other than standard socket wrench to be required for assembly of sleeve to main.

I. Sleeve shall be coated with asphaltic varnish per Federal Specification TT-V-51, Military Specification MIL C-450, or equal.

2.30 TAPPING VALVES

A. Tapping Valves shall be as specified for Gate Valves.

B. The valves for connection to distribution system shall have a standard mechanical joint end for connection to new piping, and a flange inlet with centering ring, for connecting to the tapping sleeve, which shall be interchangeable with other manufacturer's tapping sleeves.

C. Tapping valves shall conform to Specification AWWA C509, latest version, covering gate valves except as modified for passage and clearance of tapping machine cutter.

1. The opening through the valve flange to the tapping sleeve outlet must have a raised male face to insure true alignment of valve and tapping machine.

2. The outlet of the valve shall have the desired joint connection for the intended pipe.

D. Tapping valves shall allow full size cutter to be used.

1. Seating of the disc gate shall not require sliding or wedging to achieve a zero leakage seal.

2. A maximum of three inter moving parts shall be required for operation of the valve.

3. The stem collar must be protected from outside grit, sand, by dual O-rings above the stem collar.

4. Provide an O-ring below the stem collar sealing off the lubrication chamber from the line fluid.

5. Pressure energized O-rings to be used in place of flat gasket on flanged joints in valve body/bonnet.

E. Interior and exterior ferrous surfaces shall protect against corrosion by fusion-bonded epoxy coating, minimum 8 mils thick.

1. Coating shall be applied prior to assembly to insure coverage of exposed areas, including bolt holes.

F. Mechanical joint tapping sleeve and resilient seated tapping valves shall be manufactured by American-Darling Valves, Clow Valve Corp., Mueller, or approved equal.

2.31 GLOBE VALVES

A. Valves less than 3-inches shall be bronze body, stem and bonnet, steel disc and seat ring type.

1. Valves shall be designed for a minimum 300-psi cold-water non-shock service.

2. Valves shall have screwed ends.

3. Valves shall be no. 14-1I2 P as manufactured by Crane Co., Mueller Co., or equal.

B. Valves 3-inches and larger shall be iron body and bonnet with bronze stem and disc.

1. Valves shall be designed for a minimum 200-psi cold-water non-shock service.

2. Valves shall have flanged connections conforming to ANSI 816.1.

3. Valves shall be No. 351 as manufactured by Crane Co., Powell Valves, or equal.

2.32 GAUGE COCKS

A. Gauge cocks shall be screwed, bronze, tee handle, as manufactured by Crane Co. Model No. 712 or 744.

2.33 POLYVINYLCHLORIDE (PVC) BUTTERFLY VALVES

A. PVC butterfly valves shall be manufactured from polyvinyl chloride (PVC) compounds and shall be provided on PVC and fiberglass piping as indicated.

1. Butterfly valves shall be wafer style with PVDF disc, teflon or Viton seal and 316 stainless steel shaft.

2. Valves shall be G.F. Plastics Type 367, Asahi/America Type 75, or equal.

2.34 PRESSURE REDUCING REGULATOR VALVES (LESS THAN 3-INCHES)

A. The pressure reducing regulator valve shall be direct acting, adjustable, spring-loaded, normally open diaphragm valve, which closes when downstream pressure exceeds the spring setting.

1. Valve body and cover shall be bronze with reinforced Buna-N diaphragm, Buna-N seat and bronze piston and cylinder.

2. The outlet pressure range of the valves shall be adjustable between 10 and 30-psi.

3. Valves shall be provided with screwed ends as shown in the Drawings.

4. Valves shall be Cash Acme Type B, or equal.

2.35 HOSE BIBBS

A. Reuse Water System

1. Hose bibs shall be 1-inch bronze body angle valves with screwed inlet, hose outlet, quick-connect coupling, cap and chain.

a. Hose bibs shall have a minimum 200-psi non-shock, cold water pressure rating.
b. Quick acting hose couplings shall be compatible with the hoses furnished.

c. Bibs shall be, Crane No. 117, Walworth or equal.

B. Potable Water System

1. Hose bibs shall be 3/4-inch brass, rough chrome plated, with vacuum breaker and loose key stop.

2. Hose bibs shall be Chicago No. 998, Sloan or equal.

C. Tags

1. Provide permanent, plastic or brass nametags located above the hose bibs, which shall state either "POTABLE" or "REUSE WATER - DO NOT DRINK," as required.

2. Letters shall be approximately 3/4-inch high.

2.36 SEWAGE VACUUM BREAKERS:

A. Sewage vacuum relief valves shall be provided as shown on the force mains.

1. Valve shall be 4 inch, flanged, heavy duty, counterweighted, vacuum relief valve, G. A. Industries/ Golden Anderson, or equal.

2. Counterweights shall be adjustable lead weights on steel arms and shall be initially set by the manufacturer so as to open at a vacuum pressure of 1/2-inch Hg.

3. Final settings shall be made after field tests witnessed by the ENGINEER; counterweights shall than be sealed.

4. The body shall be cast iron, ASTM A126B.

5. The plug shall be type 304 stainless steel and the seat shall be resilient type.

6. The connections shall be 125 lb. flanged.

7. Where necessary, provide spool piece adapter to isolation plug valve.

8. Provide flushing connection, complete with bronze ball or eccentric plug (seat towards SVR) valve, as shown or, where not shown, provide flushing connection complete with quick disconnect hose connection (common to air relief valve and pressure gauge) and bronze ball valves.

9. Quick disconnects shall be supplied by Hansen Couplings, or equal.

    a. Shop painting shall be complete with required prime and finish coats, as specified.

10. Valve shall not be field painted, except for touching up damaged finish.

11. CONTRACTOR to exercise extreme care that field painting does not “gum up” the sensitive operation of this valve.

2.37 STRAINER

A. Strainer shall be Y-Pattern bronze or iron body, with threaded end connections, and shall be provided with a cylindrical 20 mesh Monel screen.

B. Strainer shall be rated for 200-psi C.W.P. and shall be model No. 9881I2 by Crane, No. 3699 1/2 Walworth or equal.

C. Provide a suitably sized gate or ball valve to blow off the strainer screen on each unit installed.

2.38 VALVE BOXES AND COVERS

A. Valve box and cover assemblies shall be the adjustable slide type with round bases fabricated of asphalt coated cast iron and designed to withstand heavy traffic loads.

1. They shall be model No. F2450 by Clow Corporation, or equivalent models by Mueller, or equal.

2. Base shall be Clow Model No. F2480 for 4-inches and smaller, Model F-2465 for 6-inches and 8-inches, Model F-2484 for 10-inches and larger.

3. The cover shall be Clow Model F-2494.

B. Extension sleeves, Clow model No. F2475, shall be provided as required.

C. The covers shall be marked "WATER", "SEWER" or "DRAIN" and shall have a bell end sufficiently large to fit over the stuffing box of the valve.

D. Valves shall be provided with extension stems to bring the operating nut within twelve (12) to eighteen (18) inches of the finished grade.

E. Two operating "T" wrenches suitable for use with the AWWA operating nut shall be provided.

F. For corporation and curb stops, valve boxes and covers shall be furnished in cast iron with:

1. Stationary rod and guide ring.

2. Arch pattern base.

3. Extension sections as required.

4. Cover.

2.39 HYDRO-STOP

A. Provide a Double Line Stop and Permanent Bypass as required and as manufactured by IPSCO or Hydro-Stop.

B. Use Line Stop in conjunction with tapping sleeves.

C. The line stop and tapping sleeve shall be mechanical compatible

D. Any of the following types of line stops are acceptable:

1. Pivoting Head Line Stop

2. Folding Head Line Stop

3. Cylinder Wedge Line Stop

E. Provide Line Stop components conforming to AWWA standards.

2.40 SLUICE GATES

A. Provide heavy duty fabricated stainless steel type 316 sluice gates complete with anchor bolts, operating stems, gate lift operator, frame and guide rails, gate sealing gaskets, and appurtenances for a completely operational sluice gate system.

B. Provide stems of type 316 stainless steel.

C. Provide Sluice Gate conforming to AWWA C-501.

1. Frame and Guide Rails.

   a. Provide flanged or flat back frame with a rectangular opening.

   b. Leakage rate shall be 0.025 gpm/ft. or wetted perimeter for both seating and unseating head conditions.

2. Cover or Slide.

   a. Provide a single Fabricated Stainless Steel Disc with horizontal and vertical ribs.

3. Seating Faces.

   a. Provide frames equipped with UHMW seats/seals to ensure no metal-to-metal contact.

4. Manually Operated Lifts.

   a. Provide a removable crank pedestal for each gate.

   b. Provide crank with less than 40 pounds of effort.

   c. Provide 90$^{o}$ gear box operator.

5. Stem, Stem Guides, and Stem Couplings.

   a. Provide type 316 stainless steel stems sized to withstand normal operating stresses.

   b. Provide adjustable stem guides with bronze bushings.

6. Provide a Sluice Gate System from one single supplier WHIPPS, Inc. Series 940 or approved equal.

7. Provide one portable gas power drive unit to attach and match manual operator.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Valves and appurtenances shall be installed in the location shown, true to alignment and rigidly supported.

B. Install floor boxes, brackets, extension rods, guides, the various types of operators and appurtenances that are in masonry floors or walls, and install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured.

   1. Before setting these items, check plans and figures which have a direct bearing on their location and he shall be responsible for the proper location of these valves and appurtenances during the construction of the structures.

C. Flanged joints shall be made with hot dipped galvanized bolts, nuts, and washers.

   1. Mechanical joints shall be made with mild corrosion resistant alloy steel bolts and nuts.

   2. Exposed bolts shall be painted the same color as the pipe.

   3. Buried bolts and nuts shall be heavily coated with two (2) coats of bituminous paint.

D. Prior to assembly of split couplings, the grooves as well as other parts shall be thoroughly cleaned.

   1. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap or graphite paste, and the gasket shall be slipped over one pipe end.

   2. After the other pipe had been brought to the correct position, the gasket shall be centered properly over the pipe ends with the lips against the pipes.

   3. The housing sections shall then be placed.

   4. After the bolts have been inserted, the nuts shall be tightened until housing sections are firmly in contact, metal-to-metal, without excessive bolt tension.

E. Prior to the installation of sleeve-type couplings, the pipe ends shall be cleaned thoroughly.

   1. Soapy water may be used as a gasket lubricant.

   2. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6 inches from the end, and the middle ring shall be placed on the already laid pipe end until it is properly centered over the joint.

3. The other pipe end shall be inserted into the middle pipe already laid.

4. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares.

5. After the bolts have been inserted and nuts have been made up fingertight, diametrically opposite nuts shall be progressively and uniformly tightened around the joint, preferably by us of a torque wrench of the appropriate size and torque for the bolts.

F. Valve boxes shall be installed as shown in the Drawings.

1. Joints shall be made in the standard manner.

2. Valve stems shall be vertical.

3. Place cast iron box over each stem with base bearing on compacted fill and top flush with final grade.

4. Boxes shall have sufficient bracing to maintain alignment during backfilling.

5. Remove sand or undesirable fill from within the valve box.

G. Valves shall be manually opened and closed before installation to check their operation, and the interior of the valves shall be cleaned.

1. Valves shall be placed in the positions shown in the Drawings.

2. Joints shall be made as directed under the piping specifications.

H. Circular butterfly valves shall be installed with the shaft in a horizontal position.

1. Operators shall be provided with the necessary gearing to be positioned as shown in the Drawings.

I. Hydro-stop installation

1. Perform a Wet/Hot tap as described in the tapping sleeve portion of this specification.

2. Install the line stop equipment on the temporary tapping valve.

3. Open the temporary tapping valve.

4. Insert the stop head into the pipeline through the temporary tapping valve.

5. Stop flow.

6. Make repairs to pipe or install new pies as required by the Drawings.

7. Remove line stop head through the hot/wet tap connection.

8. Close the temporary plug.

9. Remove the line stop equipment.

10. Install a completion plug on the tapping sleeve.

3.02 VALVE SUPPORTS

A. Valves shall be supported as integral components of the piping systems as specified in the Pipe Support Systems.

B. Horizontally mounted valve operators, manual, pneumatic or electric, whose weight exceeds 25 pounds shall be supported independently of the valve and piping system.

C. Vertically mounted valve operators, manual, pneumatic or electric, whose weight exceeds 100 pounds shall be supported independently of the valve and piping system.

D. Valve supports shall anchor the valves against an unbalanced force in either direction.

1. The magnitude of the force shall be based on a pressure equal to twice the maximum working pressure with a maximum allowable stress of 1/2 of the support's yield strength.

3.03 SHOP PAINTING

A. Ferrous surfaces of valves and appurtenances shall receive an exterior coating of rust-inhibitive primer.

1. Interior coatings shall be the manufacturer’s standard except that valves for potable water lines shall be coated with paints approved by EPA, FDA, and AWWA for potable water service.

a. Pipe connection openings shall be capped after shop painting to prevent the entry of foreign matter prior to installation.

3.04 FIELD PAINTING

A. Metal valves and appurtenances specified herein and exposed to view will be painted as part of the work.

1. Paint in accordance with the requirements Paint - Division 9.

3.05 INSPECTION AND TESTING

A. Valves shall be hydrostatically field tested at the specified pipeline test pressures specified in the piping sections.

1. Leakage or "sweating" of joints shall be stopped and joints shall be tight.

2. Motor operated and cylinder operated valves shall be tested for control operation as directed by the ENGINEER.

3. Valves shall be operated at the pressures specified in the piping schedules for the connected pipe.

B. Testing shall be performed in accordance with the specifications and the ANSI and/or AWWA standards contained herein including leakage tests.

1. Supply copies of the certified test results provided by the manufacturer, in accordance with the Division 1 - Submittals Procedure, to the ENGINEER.

C. The OWNER may at its discretion visit and inspect the manufacturer's facilities.

1. During the inspection visit, a witness shop test shall be performed for all standard tests listed in applicable standards.

D. Obtain and submit certified statements that the valves and hydrants comply with the requirements of the standards specified herein.

3.06 DELIVERY, STORAGE, AND HANDLING

A. Material delivered to the site shall be inspected for damage, unloaded and stored with a minimum of handling.

1. Material shall not be stored on the ground and shall be stored in accordance with the manufacturer’s recommendations.

2. The insides of pipe and fittings shall be kept free from dirt and debris.

3. Gasket and plastic materials shall be kept protected from exposure to direct sunlight over extended periods.

4. Solvents, solvent compounds, lubricants, elastomeric gaskets, and similar material required to install the pipes shall be stored in accordance with the manufacturer’s recommendations and shall be discarded if the storage period exceeds the recommended shelf or pot life.

5. Storage facilities for plastic pipe, fittings, joint material and solvents shall be classified and marked in accordance with NFPA No. 704, with classification as indicated in NFPA Nos. 49 and 325M.

6. Material shall be handled in such a manner as to insure delivery to the trench in a sound, undamaged condition.

7. Carry pipes to the trench, do not drag pipe.

END OF SECTION

# SECTION 16050

# ELECTRICAL

## PART 1 - GENERAL

### 1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required for a complete electrical system at the Center Island Pump Station for the Town of Golden Beach, Florida, as hereinafter specified and shown on the Drawings.

B. The work, apparatus and materials which shall be furnished under these Specifications and accompanying Drawings shall include all items listed hereinafter and/or shown on the Drawings. Certain equipment which will require wiring thereto and/or complete installation is indicated. All materials necessary for the complete installation shall be furnished and installed by the CONTRACTOR to provide complete power, lighting, instrumentation, wiring and control systems as indicated on the Drawings and/or as specified herein.

C. The CONTRACTOR shall furnish and install the necessary cables, protective devices, conductors, supports, raceways, exterior electrical system, etc., to serve lighting loads and miscellaneous electrical loads as indicated on the Drawings and/or as specified. The CONTRACTOR shall install any control panel provided under this or any other sections on the specifications.

D. The work shall include complete testing of all equipment and wiring at the completion of the work and making any minor connection changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; sub-standard work will be rejected.

E. For process instrumentation furnish and install all conduit, wire and interconnections between primary elements, transmitters, local indicators and receivers.

F. Each bidder or his authorized representatives shall, before preparing his proposal, visit all areas in which work under this Section is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that he or his representative has visited the areas and noted the locations and conditions under which the work will be performed and that he takes full responsibility for a complete knowledge of all factors governing his work.

G. All power interruptions to existing equipment shall be at the OWNER's convenience. Each interruption shall have prior approval.

H. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this Section shall be furnished at no extra cost.

I. Furnish and install a complete underground system of ducts, manholes and handholes as herein specified and shown on the drawings.

J. The CONTRACTOR shall furnish and install all items shown on the electrical drawings.

1.02 SERVICE AND METERING

A. Permanent electrical power will be provided by the Florida Power & Light Company (FPL) at voltages indicated on the drawings for the stormwater pump station.

B. The CONTRACTOR shall furnish and install the new secondary conduit and wire from the Florida Power & Light transformer to the service entrance equipment at the stormwater pump station. See the electrical drawings for additional requirements.

C. Pay all FPL costs for providing the new service transformer at the stormwater pump station. The power company contact is Jaimmy Cervantes, (305) 626-7691.

1.03 CODES, INSPECTION AND FEES

A. All material and installation shall be in accordance with the latest edition of the National Electrical Code and all applicable national, local and state codes, laws and ordinances.

B. Pay all fees required for permits and inspections.

1.04 TESTS

A. Test all systems and repair or replace all defective work. Make all necessary adjustments to the systems and instruct OWNER's personnel in the proper operation of the systems.

B. The following minimum tests and checks shall be made prior to the energizing of electrical equipment. Test shall be by the CONTRACTOR and

a certified test report shall be submitted providing all test results and stating that the equipment meets and operates in accordance with the Manufacturer's and job specifications, and that equipment and installation conforms to all applicable Standards and Specifications:

1. Testing of protective relays for calibration and proper operation.

2. Test all 600 volt wire insulation with a megohm meter after installation. Make tests at not less than 1000 volts. Submit a written test report of the results to the engineer.

3. Mechanical inspection of all circuit breakers to assure proper operation.

C. The Engineer shall be notified forty-eight (48) hours before tests are made to enable the Owner to have designated personnel present.

1.05 SLEEVES AND FORMS FOR OPENINGS

A. Provide and place all sleeves for conduits penetrating slabs, floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured. Include all conduits shown as future.

1.06 CUTTING AND PATCHING

A. All cutting and patching shall be done in a thoroughly workmanlike manner.

1.07 INTERPRETATION OF DRAWINGS

A. The Drawings are not intended to show exact locations of conduit runs.

B. All three-phase circuits shall be run in separate conduits unless otherwise shown on the Drawings.

C. Unless otherwise approved by the Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.

D. Where circuits are shown as "home-runs," all necessary fittings and boxes shall be provided for a complete raceway installation.

E. The CONTRACTOR shall harmonize the work of the different trades so that interferences between conduits, piping, equipment, architectural and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc., required to accomplish this shall be furnished and installed by the CONTRACTOR

without additional expense to the Owner. In case interference develops, the Owner's authorized representative is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.

F. Verify with the Engineer the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.

G. The locations of equipment, fixtures, outlets, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

H. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

I. Circuit layouts shown are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the equipment.

J. The ratings of motors and other electrically operated devices together with the size shown for their branch circuit conductors and conduits are approximate only and are indicative of the probable power requirements insofar as they can be determined in advance of the purchase of equipment.

K. All connections to equipment shall be made as shown, specified and directed and in accordance with the approved shop drawings, regardless of the number of conductors shown on the Electrical Drawings.

1.08 SIZE OF EQUIPMENT

A. Investigate each space in the building where equipment must pass to reach its final location. If necessary, the Manufacturer shall be required to ship his material in sections sized to permit passing through such restricted areas in the building.

B. The equipment shall be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the Manufacturer shall be required to brace the equipment suitably, to insure that the tilting does not impair the functional integrity of the equipment.

1.09 RECORD DRAWINGS

A. As the work progresses, legibly record all field changes on a set of project Contract Drawings. When the project is complete, furnish a complete set of reproducible "As-built" drawings for the Project Record Documents.

1.10 COMPONENT INTERCONNECTIONS

A. Component equipment furnished under this Specification will not be furnished as integrated systems.

B. Analyze all systems components and their shop drawings; identify all terminals and prepare drawings or wiring tables necessary for component interconnection.

1.11 SHOP DRAWINGS

A. As specified under other Sections, shop drawings shall be submitted for approval for all materials, equipment, apparatus, and other items as required by the Engineer.

B. Shop drawings shall be submitted for the following equipment:

1. FPL Meter
2. Disconnect switches
3. Pump Control Panel (PCP)
4. Generator
5. Wire & cable
6. Conduit
7. Grounding System
8. Conduit layout drawings
9. Trailer Mounted Generator

C. The Manufacturer's name and product designation and catalog cutsheets shall be submitted for the following material:

1. Conduit
2. Receptacles
3. Boxes and fittings
4. Switches
5. Lamps
6. Control relays

D. Prior to submittal by the CONTRACTOR, all shop drawings shall be checked for accuracy and contract requirements. Shop drawings shall bear the date

checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to Specifications and Drawings. This statement shall also list all discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted shall be returned.

E. The Engineer's check shall be only for conformance with the design concept of the project and compliance with the Specifications and Drawings. The responsibility of, or the necessity of, furnishing materials and workmanship required by the Specifications and Drawings which may not be indicated on the shop drawings is included under the work of this Section.

F. The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this Section.

G. No material shall be ordered or shop work started until the Engineer's approval of shop drawings has been given.

1.12 CONDUIT DRAWINGS

A. In addition to the manufacturer's equipment shop drawings, the Contractor shall submit for the approval, electrical installation working drawings for the pump station site and any other areas where there is work required to be performed containing the following:

1. Concealed and buried conduit layouts shown on floor plans drawn at not less than 1/4-inch = 1-foot-0-inch scale. The layouts shall include locations of enclosed circuit breakers, process equipment, transformers, lift station control panel, motors, switches large junction or pull boxes, instruments, and any other electrical devices connected to concealed or buried conduits.

2. Plans shall be drawn on high quality reproducible, bond size 36-inch x 24-inch, and shall be presented in a neat, professional manner.

3. Concrete floors and/or walls containing concealed conduits shall not be poured until conduit layouts are approved.

4. Site plan conduit layout drawings shall be at 1" = 30'0".

Note: ACAD drawing files are available from the Engineer.

1.13 WARRANTY

A. Provide warranty for all the electrical equipment in accordance with the requirements of other Sections. Under no circumstances shall the warranty be for less than one year starting from substantial completion.

## PART 2 - PRODUCTS

### 2.01 GENERAL

A. The materials used in all systems shall be new, unused and as hereinafter specified. All materials where not specified shall be of the very best of their respective kinds. Samples of materials or Manufacturer's specifications shall be submitted for approval as required by the Engineer.

B. Materials and equipment used shall be Underwriters Laboratories, Inc. listed and conform with applicable standards of NEMA and ANSI.

C. Electrical equipment shall, at all times during construction, be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR at his expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, at the cost and expense of the CONTRACTOR, or shall be replaced by the CONTRACTOR at his own expense.

### 2.02 RACEWAYS AND FITTINGS

A. Below grade conduits shall be Schedule 80 PVC, except for conduits noted in part B below.

B. Raceways containing pump cables and float cables shall be PVC coated hot-dipped galvanized rigid steel (GRS) conduit with Underwriter's approval.

C. Above grade exposed conduits shall be aluminum.

D. All conduit fittings shall be zinc coated threaded type, of Appleton, Crouse-Hinds, Pyle National, Thomas & Betts, or approved equal manufacture. All conduits shall be made up tight and no running threads will be permitted, "Erickson" couplings being used wherever necessary. Where conduit is cut, the inside edge shall be reamed smooth to prevent injury to conductors.

### 2.03 CONDUCTORS

A. Wire for lighting and receptacle circuits above grade shall be type THWN-2.

B. Wire for all power motor circuits and below grade lighting and receptacle circuits shall be type XHHW-2, stranded.

C. Single conductor wire for control, indication and metering shall be type MTW No. 14 AWG, 19 strand or type XHHH No. 14 AWG stranded.

D. Multi-conductor control cable shall be No. 14 AWG, 19 strand.

E. Wire for process instrumentation or shielded control cable shall be No. 16 AWG, shielded and stranded. All shielded cables shall be provided with a #16 shielded ground.

## 2.04 MISCELLANEOUS EQUIPMENT

A. Disconnect Switches:

1. Fusible disconnect switches shall be heavy-duty, NEMA type H., quick-make, visible blades, 600 volt, 3-pole with full cover interlock. All current carrying parts shall be copper.

2. Where disconnects are called for on the Drawings, the CONTRACTOR shall provide a 480 volt, 3-pole, fusible switch in a NEMA 4X stainless steel enclosure with copper lugs.

3. Switches shall be horsepower rated as manufactured by Square D, Cutler Hammer or GE.

B. Control Stations:

1. Control stations shall be heavy-duty type, with full size operators.

2. Enclosure types shall be stainless steel. Control stations shall be Class 9001, manufactured by the Square D Company or approved equal.

3. Pilot lights shall be complete with glass jewels and 150 volt lamps.

C. Boxes and Fittings:

1. Pressed steel switch and outlet boxes shall be hot-dipped galvanized as manufactured by the Raco Manufacturing Co., Adalet Co., O.Z. Manufacturing Co., or approved equal.

2. Boxes used outdoors or in "wet" locations shall be NEMA 4X 316 stainless steel.

3. Conduit sealing bushings shall be O.Z./Gedney Type CSB or approved equal.

D. Float Switch - Fixed Mount

1. Type:

a. Type SO ball float switch.

2. Functional/Performance:

a. Differential - Less than 1-inch.
b. Switch Rating - 4.5 amps at 115 VAC, 3.0 amps at 115 VAC

3. Physical:

a. Float - Molded high density polyethylene.
b. Switch - Totally encapsulated mercury switch.
c. Cable - Heavy duty, synthetic rubber jacketed, integral to float.

4. Options/Accessories Required:

a. Provide 316 stainless steel adjustable clamp tubes, pipe brackets, and U-bolts.

b. The floats shall be mounted on a vertical one-inch stainless steel pipe with all stainless steel hardware.

c. The lead wire shall be a waterproof cable of sufficient length so that no splice or junction box is required in the wetwell.

5. Manufacturers:

a. Flygt
b. Roto-Float

E. Alarm Beacon Light

1. Type:

a. Strobe type, rotating, alarm indicating beacon.

2. Functional:

a. Power Supply - 120 volts ac.

b. Lamp - 60 watt bulb.

3. Physical:

a. Globe - Polycarbonate.
b. Housing - NEMA 4X, conduit mount, weatherproof.

4. Accessories:

a. Provide a red globe on one beacon (“General Trouble”) and a blue globe on the other beacon (“Generator Running”).
b. Rotating strobe reflector.

5. Manufacturer:

a. Edwards, or approved equal.

## 2.06 PUMP CONTROL PANEL (PCP)

A. Construction:

1. The stormwater pump station control panel shall be a NEMA Type 3R, dead front enclosure, constructed of not less than 14-gauge 304 stainless steel. The enclosure shall be equipped with a door and shall incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. The controls shall be as shown on the electrical drawings. Main and generator breaker shall be provided as shown on the drawings. Breakers shall be rated for 480 volt operation and have an AIC rating of 25,000 amps minimum.

2. PCP shall be U.L. listed. Label to be on panel at time of inspection.

B. Components:

1. All motor branch circuit breakers, motor starter and control relays shall be of highest industrial quality, securely fastened to the removal back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

2. A magnetic air circuit breaker, Type KA as manufactured by Square D Company, or approved equal, shall be furnished for the pump motor. Circuit breaker shall be adjustable. Circuit breaker shall be

adequately sized to meet the pump motor and station operating conditions.

3. A mechanical disconnect mechanism shall be installed on each circuit breaker to provide a means of disconnecting power to the pump motor. Breaker shall be capable of being locked in the open position.

4. An open frame, across-the-line, NEMA rated, magnetic motor starter, as manufactured by Allen-Bradley Company, or approved equal, shall be furnished for the pump motor. Motor starter shall be equipped to provide under-voltage release and overload protection on all three (3) phases. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position. Overload reset pushbuttons shall be located on the exterior of the control compartment doors.

5. Control relays shall be plug-in type with contacts rated at 300 VAC, 10 amperes, noninductive. Time delay relays shall be electric type.

C. Operating Controls and Instruments:

1. All operating controls and instruments shall be securely mounted on the control compartment door. All controls and instruments shall be clearly labeled to indicate function.

2. Pump mode selector switch shall be Hand-Off-Auto type to permit override of automatic level control and manual actuation of shutdown of pump motor. Operation of pump in manual mode shall bypass all safety shutdown circuits except pump motor overload shutdown. Switches shall be oil-tight, as manufactured by Allen-Bradley, or approved equal, providing three (3) switch positions, each of which shall be clearly labeled according to function. Separate indicator lamps, which shall operate at 120 volts input, shall be provided mounted above H/O/A selector switches. Lamps shall be easily replaceable from the front of control compartment door without removing switch modules from their mounted positions.

3. Indicator lamps shall be mounted in oil-tight modules, as manufactured by Allen-Bradley, or approved equal. Lamp modules shall be equipped to operate at 120 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position.

4. A six (6) digit, nonreset elapsed time meter shall be connected to the motor starter to indicate the total running time of the pump in "hours"

and "tenth of hours". The elapsed time meter shall be Bulletin 705, HK Series as manufactured by Eagle Signal or approved equal.

5. Controls shall be as shown on the electrical drawings.

D. Boxes and Covers:

1. Boxes and covers shall be bolted together and gasketed.

2. Conduit openings shall be tapped.

3. Doors shall have a vault handle and 3-point catch, interlocked with circuit breaker. Door hinges shall be concealed. Two (2) keys shall be supplied for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door.

4. Covers shall have a keyed switch for acknowledging authorized entry and resetting alarm.

E. Manufacturer:

1. The new control panels shall be manufactured by STA-CON, C.C. Controls or Unitron Controls.

F. Installation:

1. Unless otherwise noted on the Drawings, top of cabinets shall be mounted 6 feet, 6 inches above finished floor, properly aligned and adequately supported independently of the connecting raceways.

2. All wiring in the control panel shall be neatly formed, grouped, and identified to provide a neat and orderly appearance.

3. All nameplates shall be properly secured.

## PART 3 - EXECUTION

### 3.01 CONDUIT INSTALLATION

A. Where conduits enter or leave all outlet boxes, cabinets safety switches, tap boxes, motor controllers, etc., other than those having threaded hubs, a standard lock nut shall be used on the outside of the box. Busings 1-inch and larger shall be of an approved insulated type. Unless otherwise indicated, conduit 2-inches and larger shall be supported at intervals not

exceeding twelve (12) feet and for smaller sizes at intervals not exceeding eight (8) feet.

B. During construction, all installed raceways shall be temporarily plugged or otherwise protected from the entrance of moisture, dirt, trash, plaster, moisture, etc., through neglect of the CONTRACTOR to so protect them, shall be replaced by the CONTRACTOR without additional expense to the Owner. No kinked, clogged or deformed raceways will be permitted on the job. Raceways shall be cut to proper length so that ends will fit accurately in the outlets. Where raceways cross building expansion joints, a suitable raceway expansion fitting shall be used.

C. Size of raceway shall not be less than NEC requirements, but in no case shall be less than indicated on the Drawings. Combining of circuits, other than detailed, will not be permitted. The CONTRACTOR shall install larger size raceways than detailed where there is excessive length of unbroken run or excessive number of bends.

D. Bends in metallic raceways shall be made while "cold" and in no case shall the raceways be heated. Raceways shall not be bent through more than 90 degrees. The radius of bends shall not be less than six (6) times the internal diameter of the raceway. Not more than four (4) (equivalent 90 degree) bends will be permitted between outlets, the bends at the outlets being counted.

E. Raceways shall be properly aligned, grouped and supported. Exposed raceways shall be installed at the right angles to or parallel to the principal structural members. Concealed raceways, unless otherwise indicated, may take the most direct route between outlets. Raceways shall be firmly held in place. Raceways shall run to avoid trapping wherever possible. Where areas are indicated for future openings, foundations, etc., all raceways shall be run around such areas. The CONTRACTOR shall provide necessary inserts in poured concrete areas and shall furnish and install all necessary sleeves through walls, floors and roofs for passage of raceways. Sleeves through roofs and/or exterior walls shall be properly sealed by the CONTRACTOR against entrance of moisture, etc., into the building. Where necessary repairs to the building structure using material in no way inferior to that originally installed and using labor skilled in the trades involved.

3.02 BOXES

A. Install all outlet boxes, tap, junction or pull boxes, device boxes, etc., necessary for the complete installation as indicated on the Drawing and/or specified herein. All boxes shall be rigidly mounted and shall be equipped with suitable screw fastened covers. Where necessary for boxes to be

supported away from the ceiling, structural steel members shall be provided for supports. All raceways entering boxes shall be mechanically and electrically secure. Open knockouts or holes in boxes shall be plugged with suitable blanking devices. Boxes shall be cleared of all plaster, dirt, trash, etc., before the installation of any wiring devices and/or before the installation of cover plates.

3.03 CONDUCTORS

A. Splices, taps and attachments of fittings and lugs shall be electrically and mechanically secure. Approved solderless lugs and connectors shall be sued for all conductors with 2-bolt type being used for sized No. 4/0 and larger. There shall be plenty of slack cable in boxes, outlets and cabinets to insure that there is no binding at the bushings. All lugs shall be of the correct sizes for the conductor in order to fit the conductor into a lug. Taping of joints shall be either with Scotch electrical tape or varnished cambric tape and friction tape to secure insulation strength equal to that of the conductors joined.

B. Splices shall be compression type with heat shrink weatherproof boot. Conductors shall be color coded in accordance with NEC.

3.04 GROUNDING

A. The entire electrical system shall be completely and effectively grounded as required by the NEC, shown on the drawings and as specified hereinafter.

B. All metallic raceways shall be mechanically and electrically secure at all joints and at all boxes, cabinets, fittings and equipment. Metallic raceways entering the motor control center control panels or other electrical boxes shall be grounded to the appropriate ground bus. All metallic raceways shall be electrically continuous throughout the entire conduit system. Bond wires shall be used in exterior concrete pull boxes.

C. The ground plane shall consist of a minimum of 3-5/8" x 20' copper ground rods spaced at least 10' apart. Rods and system ground shall be connected with a #2 copper ground to the service entrance ground. The ground resistance shall be tested and additional rods or plates added to achieve a dry season resistance not exceeding 5 ohms. The ground resistance of the system shall be tested by 3 point method fall of potential.

3.05 INSTALLATION OF MOTORS

A. The CONTRACTOR shall megger each motor winding before energizing the motor and, if insulation resistance is found to be low, shall notify the Engineer

and shall not energize the motor. The following table, based on AIEE formula, gives minimum acceptable insulation resistance in megohms at various temperatures and for various voltages with readings being taken after one (1) minute of megger test run.

**TABLE 2**

| Degree Winding Temperature | | Voltage | | |
|---|---|---|---|---|
| °F | °C | 115V | 230V | 460V |
| 37 | 3.9 | 60 | 108 | 210 |
| 50 | 10 | 32 | 60 | 120 |
| 68 | 20 | 13 | 26 | 50 |
| 86 | 30 | 5.6 | 11 | 21 |
| 104 | 45 | 2.4 | 4.5 | 8.8 |
| 122 | 50 | 1 | 2 | 3.7 |
| 140 | 60 | 0.5 | 0.85 | 1.6 |

B. The CONTRACTOR shall check all motors for correct clearances and alignment and for correct lubrication, and shall lubricate if require in accordance with Manufacturer's instructions. The CONTRACTOR shall check direction of rotation of all motors and reverse connections if necessary.

C. Installation

1. Motor Connections: All motors shall be connected to the conduit system by means of a short section 18-inch minimum of flexible conduit unless otherwise indicated. For motor connections of No. 6 AWG and small wire size, the CONTRACTOR shall furnish flexible

conduit with an approved grounding conductor inside the flexible section. For motor connections of No. 4 AWG or larger wire size, the CONTRACTOR shall install a grounding conductor in the conduit and terminate at the motor control center with an approved grounding clamp.

D. Tests and Checks

1. All motors shall be given the standard short commercial test prior to shipment. This shall consist of no load current, check current balance, winding resistance, air gap measurement, high potential tests and bearing inspection. Copies of the certified short commercial test shall be provided to the Engineer, if requested, prior to shipment.

## 3.06 CONDUCTOR COLOR CODING

A. All conductors shall be color coded as specified hereinafter. Color coding shall be by means of colored insulation material, colored braid or jacket over the insulation, or by means of suitable colored permanent, non-aging insulation tape equal to Scotch #471 or "Texcel 98" applied to conductors at each outlet, cabinet or junction point.

B. The following system of color coding shall be strictly adhered to:

1. Ground leads, green.

2. Grounded neutral leads, white.

3. Ungrounded phase wires of a delta connected 277/480-volt, 3-phase, 4-wire system, brown, purple and yellow.

4. All control leads, other than line connected "hot" leads, shall be yellow, orange and brown and/or I.P.C.E.A. standard control cable coding provided method of identification is different from method used on power conductors.

C. The color coding assigned to each phase wire shall be consistently followed throughout the Work.

## 3.07 PAINTING

A. Painting shall be as specified in Division 9 and as shown on the Drawings except that all exposed raceways, fitting, boxes, supports, panelboards, etc., shall be prepared for painting by removing therefrom all oil, grease, dirt, etc.

The CONTRACTOR shall employ the necessary precautionary methods to prevent painting over of obscuring any nameplate, designation, etc., on all electrical apparatus and devices.

B. The painting of electrical gear, indoor busways, motor controllers, pushbuttons, transformers and similar electrical apparatus shall be limited to touching-up any surface scratched or marred during shipment or erection. The materials used shall match exactly the surfaces being touched up.

3.08 SUPPORTS

A. The CONTRACTOR shall furnish and install all necessary supports for properly mounting all electrical equipment and raceways. Such supports shall be fabricated and installed in a neat and workmanlike manner, and care shall be taken that at no time shall any portion of the building structure be overloaded. Should the building structure sustain damage through carelessness or through failure of the CONTRACTOR to properly support and install the electrical equipment, the CONTRACTOR shall bear all costs involved in repairing or replacing such installation.

B. All steel shapes exposed to the weather shall be galvanized after all cutting, drilling, and/or welding is done. All shop connections shall be welded or riveted and all field connections shall be bolted on all outdoor structures. Where the field cutting or drilling of galvanized steel is necessary, the CONTRACTOR shall apply one (1) coat of priming paint and one (1) finish coat of aluminum and oil paint.

3.09 TESTS AND CHECKS

A. The following minimum tests and checks shall be made after the assembly of the motor control centers, but prior to the termination of any field wiring.

1. Megger terminals and buses after disconnecting devices sensitive to megger voltage.

2. A 1,000V DC megger shall be used for these tests.

3. The first test shall be made with main circuit breaker closed and all remaining breakers open. A second test shall be made with all circuit breakers closed.

4. The test results shall be recorded and forwarded to the Engineer for his review. Minimum megger readings shall be 100 megohms in both tests.

B. The following shall be done before energizing any motor control center or control panel.

1. Remove all current transformer shunts after completing the secondary circuit.

2. Install overload relay heaters based on actual motor nameplate current. If capacitors are installed between starter and motor, use overload relay heaters based on measured motor current.

3. Check all mechanical interlocks for proper operation.

4. Vacuum clean all interior equipment.

END OF SECTION

# SECTION 16200

# DIRECTIONAL BORE

## PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Work included in this section consists of furnishing all equipment, materials and labor required for the installation of complete bore casings, and all appurtenances as specified on the drawings and specifications for the Florida Department of Transportation.

1.02 GOVERNMENTAL AGENCIES

A. All work shall conform to the applicable standards of the Florida Department of Transportation.

1.03 SUBMITTALS

A. The Contractor shall submit shop drawings of all casings, pipe, and pipe fittings to be used for construction.

1.04 MEASUREMENT AND PAYMENT

A. Measurement and payment will be based upon work completed and accepted in accordance with the plans and specifications. No separate payment will be made for excavation, trenching, backfilling, leakage tests or other incidental items of work not authorized by the Engineer, in writing, as extra work.

1.05 GUARANTEE

A. The Contractor shall guarantee all materials and equipment furnished and installed, and all work performed for a period of one (1) year from the date of substantial completion. The guarantee shall stipulate that the completed system is free from all defects due to faulty materials or workmanship and the Contractor shall promptly make such corrections as may be necessary by reason of such defects including the repairs of any damage to other parts of the system resulting from such defects.

## PART 2 PRODUCTS

2.01 MATERIALS

A. The casing pipe shall conform to ASTM A-139 Grade B, Latest Revision. Casing specifications shall conform to the Florida Department of Transportation:

1. Florida Department of Transportation - Composition and Strength-All casings shall conform to the appropriate strength and composition requirements set forth in the main body of the utility accommodation Guide and to the following additional requirements.

a. Unless otherwise tested and approved by the Department prior to beginning work, all encasement pipes shall be new and of round, smooth wall, leakproof construction.

b. All casings shall conform to the following minimum thickness requirements:

| Nominal Outside Diameter - inches | Minimum Wall Thickness - inches |
|---|---|
| ¾” | 0.113” |
| 1” | 0.133” |
| 1 ¼” | 0.140” |
| 1 ½” | 0.145” |
| 2” | 0.154” |
| 4” | 0.188” |

B. CONTRACTOR shall size casing as per the quantity and size of conduits shown on the contract drawings.

## PART 3 - EQUIPMENT

3.01 GENERAL

A. In keeping with the overall objective of this guide, this section is intended to set forth guidelines in the area of equipment solely to prevent unnecessary stoppages and subsequent damage to the roadway.

B. All equipment used in the execution of work shall have the built-in capacity, stability and necessary safety features required to fully comply with the specifications and requirements of this guide without showing evidence of undue stress or failure.

C. It shall be the responsibility of the permittee to assure that the equipment to be used in the crossing operation is in sound operating condition. Backup equipment may be required where job site conditions indicate that severe damage to the roadway or a hazardous condition may result in the event of an equipment breakdown and where the condition of the equipment to be used indicates that routine component replacement or repair will likely be necessary during the crossing.

1. Auger Power Units - Power units providing rotational force to the cutting head and/or the auger used to remove spoil material as the bore progresses, may also provide power for jacks used to push the casing. Power units shall be in proper operating condition and shall have sufficient power to satisfactorily complete the proposed crossing according to the manufacturers recommendations.

2. Augers - Screw-type steel drive tubes or shafts with one male end and one female end for coupling and welded steel flighting (threads).

a. Auger shafts shall be straight and otherwise undamaged.

b. Flighting shall be undamaged and securely welded to the body of the auger shaft and be continuous with no gaps from end to end of each auger section.

3. Cutting Heads - Boring attachment fastened to leading end of first auger section equipped with special teeth, bits, blades, chippers or cutters used to cut or chip away rock or hard soils in advance of auger.

a. Cutting heads shall be undamaged and have no missing or broken teeth or bits.

b. Pinned or hinged wing cutters must be constructed in such a manner as to ensure overboring does not exceed limits specified.

4. Auger Tracks - Supports boring machine and provides line and grade control.

a. Tracks shall be straight and otherwise undamaged with no broken welds.

b. Tracks shall be constructed so as to remain rigid at joints and allow no appreciable flexing as power unit passes.

5. Jacks - Hydraulic, mechanical or manual power units providing horizontal thrust for pushing casing or carrier pipe. Shall have sufficient power to satisfactorily complete the proposed crossing according to the manufacturers recommendations.

a. Hydraulic - Shall be in sound operating condition. Hoses shall not be cracked or split; all couplings and fittings shall be tight and entire system reasonably free from leaks. Hydraulic cylinder rods should be clean and smooth to prevent damage to cylinder seals.

b. Mechanical - Includes manual and power drivers, ratchet type jacks, winch and pulley systems. All mechanical jacking systems shall be in sound operating condition with no broken welds, excessively worn parts, broken teeth, badly bent or otherwise misaligned components. All ropes, cables, clamps and other non-mechanical but essential items shall be in sound condition.

c. Other-Devices of systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved for use by the Department prior to commencement of work. Consideration for approval will be made on an individual basis for each properly permitted crossing. The proposed device or system will be evaluated prior to approval or rejection on its potential ability to complete the crossing satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular conditions of the job.

d. Jetting or water sluicing methods, jetting with compressed air, or boring or tunneling devices with vibrating type heads that do not provide positive control of line and grade shall not be allowed.

6. Anchors and Braces -The boring base or deadman must be sufficiently strong to withstand the pressures generated by the boring unit throughout the boring operation without appreciable movement or deformation.

7. Dewatering Equipment - Equipment used to evacuate ground and surface water from boring and receiving pit areas and along path of proposed bore.

a. Pump - Shall be in proper operating condition and off sufficient capacity to satisfactorily dewater the pit and bore areas under the conditions of the particular job.

8. Horizontal Boring Equipment - Equipment shall include locking devices, surveying instruments, power plants, hydraulic motors and attachments as well as mud mixing units and related equipment.

9. Other Equipment - Any equipment used on the job that has not been defined and covered previously in this Section must be in proper working order and otherwise conform to the requirements as outlined under Equipment - General, at the beginning of the section.

3.02 SHIPPING, HANDLING AND STORAGE

A. Special care in handling shall be exercised during delivery, distribution and storage of pipe to avoid damage and setting up stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.

## PART 4 - PERSONNEL REQUIREMENTS

4.01 GENERAL

A. A responsible representative of the permittee must be present at all times during the crossings of the streets. A responsible representative as specified herein is defined as a person experienced in the type of work being performed and who has the authority to represent the permittee in a routine decision making capacity concerning the manner and method of carrying out the work.

## PART 5 - INSTALLATION

5.01 GENERAL

A. Erection or Installation of Appropriate Safety and Warning Devices - Erection or installation of appropriate safety and warning devices shall be completed prior to beginning work.

B. Subsurface Soil and Drainage Investigation - In general, the greatest influences on the success or failure of an underground crossing are the existing subsurface soil

and water conditions. To correctly plan individual crossing procedures such as dewatering, use of cutting heads, positioning of auger within the casing and to accurately locate potential problem areas, subsurface investigation must be made by the contractor.

C. Dewatering - Evacuation of ground and surface water from jacking and receiving pits and from path of proposed crossing. Where the ground water level is above the invert of the proposed crossing dewatering is necessary to reduce the water level to below invert of the proposed crossing, and must be designed, installed and in operation prior to beginning the crossing as follows:

1. Except where rock is present throughout the length of the bore and no likelihood of sand pockets exists.

2. Where the existing groundwater level and particular soil type involved indicates that excessive flow back of spoil material is likely as the boring progresses.

D. Equipment Set Up

1. Aligning and leveling of auger tracks - To properly control line and grade during the crossing operation, it is imperative that the tracks be rigidly set to the predetermined level and alignment requirements of the job. Control should be ensured by the use of appropriate engineering instruments.

2. Auger and casing section lengths should not be under, or within three (3) feet of any Roadway Pavement when the crossing operation is halted to joint new auger and casing sections. As an exception, in areas where obstructions will not allow continuous operations under paved areas as stipulated in this section, all preparations for adding additional casing and augers should be made prior to stopping under the pavement and the joint made as quickly as possible.

3. Crossings made by closed end jacking method or crossings made in materials other than loose unstable soils, are not subject to the provisions of this section.

4. Methods of Reducing Skin Friction - Friction between the outer surface of the casing and the surrounding soil may be reduced by increasing the diameter of the casing hole by no more than 3/4 inch greater than outside diameter of casing itself.

5. Relationship between auger and cutting head to leading end of first casing section. The leading end of the first casing section shall be straight cut ninety degrees to the centerline of the casing and the distance between the back of the cutting head or leading edge of the first bare auger section, to the leading end of the casing shall be as follows under the appropriate soil condition.

   a. Rock - On crossings made through solid rock, where the cutting head must precede the casing, the space between the back of the cutting head and the end of the casing shall be limited to the clearance

necessary to allow the cutting head to function without coming in contact with the end of the casing. In areas where sand pockets may be encountered the cutting head must be construction so that it can be retracted into the casing, to within the limits specified in this section for the particular material encountered.

b. Hard pan, clay, hard sand-clay and stable cohesive soils - As in rock, the cutting head should normally precede the casing but the type cutting head used must allow no more than two (2) inches between the back of the head and the leading end of the casing. Cutting heads with cylindrical, pointed chippers designed for use in solid rock shall not be used.

c. Loose unstable soil - The distance between the leading end of the first auger section and the leading end of the casing shall be as necessary to maintain a solid plug of spoil material inside the forward portion of the casing. For casing diameters eight (8) inches or greater, the minimum space between the leading end of the auger, or cutting head as allowed below, and the leading end of the casing shall be no less than one-half the casing diameter. However, the setback shall be increased if necessary to prevent undue flow back of the spoil material. No setback is required for casing diameters less than eight (8) inches.

d. Cutting heads may be used only where the subsurface investigation report or other reliable information indicates the likelihood of encountering a very hard soil strata, rock or other obstructions such as tree stumps; and it is determined prior to beginning work that the area of difficulty may be passed by the use of an appropriate cutting head. The cutting head shall remain inside the casing as outlined above except during the passage of such obstructions.

e. On large diameter jacked crossings where clean out of the bore is accomplished by special digging machine or by hand, the distance between the leading end of the casing and the actual cleanout operation shall be no less than that necessary to ensure that voids will not form around the outside of the casing. The use of tunnel liners will be allowed only where the installation method and soil conditions ensure that voids will not be formed around the outside of the liner during installation.

5. Auger size and spacing - The leading auger section used in conjunction with a cutting head must be full-sized having an outside diameter not less than the inside diameter of the casing less the amount needed to provide the minimum working clearance necessary. In no case shall the auger diameter be less than 1/2 inch smaller than the inside casing diameter unless some other positive means of restricting the movement of the cutting head as previously required is assured. Less than full-sized augers that are large enough to remove spoil satisfactorily will be allowed when the auger is not used in conjunction with a cutting head and is to remain within the casing at all times, except as follows:

| Crossing Conditions | | Minimum Length in Feet of Full Sized Auger from Leading End of Casing |
|---|---|---|
| Rock | | 0 |
| Hard-pan, clay, hard sand-clay | (dry) | 0* |
| | (wet) | 20 |
| Stable cohesive soils | (dry) | 0 |
| | (wet) | 20 |
| Loose unstable soils | (dry) | 20 |
| | (wet) | 40 |

Crossings requiring dewatering are to be considered as wet in the above table.

* Full sized augers are not required if lateral movement of the cutting head has been otherwise restricted in a satisfactory manner.

6. Length - Casings shall be of sufficient length to extend under all pavements and in no case shall the end of the casing be closer than four (4) feet (eight (8) feet preferably) from the pavement edge including paved shoulders, or two (2) feet from back of curb plus additional length as necessary to extend to the excavated slopes of the jacking and receiving pits. The ends of casings under limited access facilities and all casings for flammable materials shall be no closer to the pavement edge (including paved shoulders) than the toe of the front slope.

7. Couplings

   a. Couplings - Couplings shall be tight, tack welded if necessary and sufficiently rigid (no noticeably movement in joint) to prevent misalignment during driving or pushing operation. Tack welding of couplings is only required where necessary to ensure the integrity of the joint.

   b. Coupling thickness shall be such that the overall casing diameter is increased by no more than 3/4" total. All couplings shall be leakproof.

8. Drilling Fluids - If drilling fluids are used to lubricate the auger and facilitate the removal of cuttings, they shall consist of a mixture of water and gel-forming colloidal material such as bentonite, or a polymer surfactant mixture producing a slurry of custard-like consistency.

   Plain water may be used if appropriate under the conditions outlined in this exhibit.

9. Shoring and Bracing Materials - Materials used for sheeting, sheet piling, cribbing, bracing, shoring and underpinning shall be in good serviceable condition and timbers shall be sound, free from large or loose knots and of proper dimensions, as required by OSHA regulations.

E. Crossing Operation - The actual crossing operation shall be accomplished during daylight hours and shall not begin after the hour pre-established as the latest starting time that will allow completion during daylight hours.

F. Equipment Breakdowns or Other Unforeseen Stoppages. If forward motion of the casing is halted at any time other than for reasons planned for in advance (addition of casing and auger sections, etc.) and prevention of voids under paved areas cannot be assured, the casing must be filled with concrete by pressure grouting as soon as possible and abandoned. If removal of the augers from a casing to be abandoned will allow voids to form under paved areas at the casing head, the augers must be abandoned also.

G. When an obstruction is encountered that cannot be passed or an existing utility is damaged, cutting of the pavement for inspection will be approved by the local Maintenance Engineer or his representative, when consideration of all pertinent facts indicate that such action would offer the most practical solution to the problem for all parties concerned. Any such authorized pavement opening shall be repaired according to the appropriate specifications in the Utility Accommodation Guide.

**END OF SECTION**