SECTION 05 50 16

BLOCK AND TACKLE SYSTEM

PART 1 GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, shop drawings, equipment, labor, and materials for furnishing and installing a block and tackle system.

1.2 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2011) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1	(2009) Surface Texture, Surface Roughness, Waviness and Lay

ASTM INTERNATIONAL (ASTM)

ASTM A123	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A354	(2011) Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM A563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A572	(2012) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steels
ASTM A780	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM F436	(2011) Harden Steel Washers
ASTM ~~F1554~~F593	~~(2007a; E 2011) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength~~(2013a; E 2016) Standard Specification for Stainless Steel Bolts,

	Hex Cap Screws, and Studs
ASTM F594	(2009; E 2015) Standard Specification for Stainless Steel Nuts
~~ASTM F2329~~	~~(2015) Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners~~

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual

1.3 SYSTEM DESCRIPTION

1.3.1 Block and Tackle System Work Plan

The work required in accordance with this specification is of a complicated nature, requiring technical expertise and planning. Submit a work plan, which will indicate how the block and tackle system as shown in the plans will be installed, without damaging the new snatch block and new wire rope. The approved work plan must submitted and approved before any work can be performed. Include the following in the plan:

Installation plans for block and tackle system which includes the snatch block and wire rope.
Schedule for installation.

1.3.2 Wire Rope Safety Plan

The work area, conditions of work area(s), and type of work required can create considerable potential for accidents. Submit a safety plan indicating how accidents will be prevented. Include in the safety plan details of how the wire rope will be handled and installed to minimize the risk to personnel. Also include in the safety plan details of how the operation of the wire rope will be handled during the manual performance test of the closure gates to minimize the risk to personnel. Perform work in accordance with EM 385-1-1.

1.3.3 Tools, Equipment and Expertise

The work will take place over the ground surface at an elevated height and will required a vehicle with a hook point. For Campbell Closure Gate, the hook point and the vehicle shall be capable of pulling a minimum of 20980 lbs. For Broadway Closure Gate, the hook point and the vehicle shall be capable of pulling a minimum of 8000 lbs.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following

in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
Block and Tackle System Work Plan; G, DO
Wire Rope Safety Plan;G, DO
Manufacturer's Qualifications;G
Supervisor's Qualifications;G

SD-02 Shop Drawings
Wire Rope End Terminations;G, DO
Detail Drawings;G, DO

Submit detail drawings showing layout(s)and anchoring details as specified herein.

SD-03 Product Data

Orders; G, RO
Sequencing and Scheduling; G, RO
Materials; G, RO
Welding; G, RO
Tests, Inspections, And Verifications; G, RO
End Termination Attachment Method;G, DO
Lubrication;G
Pre-Stretching;;G

SD-06 Test Reports

Tension Testing;G
Attaching and Proof Loading Terminations;G
Wire Strength and Ductility;G
Pre-Forming;G
Stress Relief "(Wrapping Test)";G
End Terminations;G

SD-07 Certificates

Warranty;G
Type of Wire Rope;G, DO
Wire Rope Tension Testing Equipment;G

SD-11 Closeout Submittals

Acceptance Trial Operation; G, RO

1.5 SUPERVISOR'S QUALIFICATIONS

Submit the supervisor's experience in the installation of wire rope. The supervisor must have performed work similar to that required in this contract on at least three separate occasions. The supervisor must be on site at all times when wire rope is being delivered, stored, un-reeled, during testing, installation, and after installation testing. Submit the Contractor's Installation Supervisor's experience record before work at the site may begin.

1.6 ORDERS

The Contractor shall furnish 3 copies of purchase orders, mill orders, shop orders and work orders for all materials orders and items used in the work.

Where mill tests are required purchase orders shall contain the test site address and the name of the testing agency. The Contractor shall furnish a materials list of the materials to be used in the fabrication of each item.

The Contractor shall furnish a shipping bill or memorandum of each shipment of finished pieces or members to the project site giving the designation mark and weight of each item, the number of items, the total weight, and the car initial and number if shipped by rail in carload lots. Duplicate copies of shipping billing shall be mailed promptly to the Contracting Officer.

1.7 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.8 DELIVERY, STORAGE, AND HANDLING

1.8.1 General

Protect items from corrosion, deformation, and other types of damage. Wind the wire ropes on spools in the same direction as they were bent during manufacturing. Store items in an enclosed area free from contact with soil, weather and other elements. Store the wire ropes in well ventilated enclosures in the storage area

1.8.2 Inspection on Delivery

Upon delivery to the work or storage area, inspect the wire ropes, sockets, and snatch block in the presence of the Contracting Officer. Inspect the wire rope for dings, kinks or other damage. Unreel the wire ropes from spool to spool to allow complete inspection of the wire ropes over their entire length. Perform the unreeling/reeling operation, and furnish extra spools or any other equipment required. Remove and replace damaged items with new items. Materials and equipment delivered to the site by the Contracting Officer shall be unloaded by the Contractor. The Contractor shall verify the condition and quantity of the items delivered by the Contracting Officer and acknowledge receipt and condition thereof in writing. If delivered items are damaged or a shortage is determined, the Contractor shall notify the Contracting Officer of such in writing within 24 hours after delivery. Upon completion of the inspection, furnish the Contracting Officer with a written report of the results.

1.9 ENVIRONMENT PRECAUTIONS

Take special care to prevent any materials of any type falling into or contaminating waters surrounding the work site. Immediately notify the Contracting Officer if materials fall into or contaminate waters.

1.10 WARRANTY

Submit signed copies or the manufacturer's warranty of a 1 year warranty for all materials and services provided under this section

1.11 SEQUENCING AND SCHEDULING

A sequencing and scheduling plan which illustrates that work affecting roadways shall be developed by the Contractor for Contracting Officer

approval. The plan shall include schedules, lists of labor or materials to be provided, and any other aspects of the work that may impact on the operations and requirements as specified in Section 00 80 00 SPECIAL CONTRACT REQUIREMENTS. The protection plan shall clearly demonstrate how all public or private roads, streets, or highways will be kept open to traffic at all times during the construction period, except as otherwise specified or directed. Refer to SECTION 00 80 00 SPECIAL CONTRACT REQUIREMENTS for other requirements.

PART 2 PRODUCTS

2.1 MATERIALS

Submit system of identification which shows the disposition of specific lots of approved materials and fabricated items in the work before completion of the contract.

2.1.1 Structural Steel

Structural steel shapes (angles and plates) shall conform to ASTM A572, Grade 50, hot-dip galvanized.

2.1.2 BOLTS, ANCHOR RODS, NUTS, AND WASHERS

Bolts, anchor rods, nuts, washers shall conform to the requirements shown and specified herein.

2.1.2.1 Bolts

All high-strength bolts shall conform to ASTM A354, Grade BD and to be hot-dip galvanized. The finished shank of bolts shall be long enough to provide full bearing.

2.1.2.1.1 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard and to be hot-dip galvanized in accordance to the bolt ASTM.

2.1.2.1.2 Washers

ASTM F436, plain carbon steel and to be hot-dip galvanized.

2.1.2.2 Anchor Rods

ASTM ~~F1554~~F593 ~~Gr 36, Class 1A and hot-dip galvanized in accordance with ASTM F2329~~UNS Designation S31600 and SH Conditioned.

2.1.2.2.1 Nuts

Nuts shall conform to ASTM ~~A563~~F594 ~~and be hot-dip galvanized in accordance with ASTM F2329~~UNS Designation S31600 and SH Conditioned.

2.1.2.2.2 Washers

Washers shall ~~conform to ASTM F436 and be hot-dip galvanized in accordance with ASTM F2329~~be stainless steel 316.

2.1.3 MANUFACTURED UNITS

Manufactured units shall conform to the requirements shown and specified herein.

2.1.3.1 Snatch Block

Campbell Ave Closure Gate: Snatch Block shall be Model HB-40030 manufactured by Jeamer or an approved equal.
Broadway Closure Gate: Snatch Block shall be Model HB-20008 manufactured by Jeamar or an approved equal.

2.1.3.1.1 Sheaves

Sheaves shall be galvanized and sized for the wire rope used with snatch block.

2.1.3.2 Wire Rope

Provide wire rope and terminal end hardware which are the standard product of a manufacturer regularly engaged in the manufacture of wire rope, and that essentially duplicate products having been in satisfactory use for at least 5 years prior to bid opening. Submit manufacturer's qualifications statement.

2.1.3.2.1 Quantity

Furnish one wire rope for each closure gate (2 in total).

a. The wire rope for Broadway Closure Gate shall be: 60 feet long, 3/4 inch diameter, Operating load of 8,000 lbs, and rated for a Breaking Load of 58,800 lbs (for a 5 to 1 Break to Operating Ratio))

b. The wire rope for Campbell Closure Gate shall be: 90 feet long, 1 1/4 inch diameter, Operating load of 19240 lbs, and rated for a Breaking Load of 103,000 lbs (for a 5 to 1 Break to Operating Ratio))

2.1.3.2.2 Type of Wire Rope

The wire rope must be of the following type;

2.1.3.2.2.1 Strand Configuration

16x9 Seale

2.1.3.2.2.2 Lay

Right, regular

2.1.3.2.2.3 Diameter

As indicated above, with a tolerance of minus and plus 5 percent

2.1.3.2.2.4 Finish

Galvanized

2.1.3.2.2.5 Minimum Breaking Strength

as indicated above

2.1.3.2.2.6 Material

Extra improved plow steel

2.1.3.2.2.7 Core Type

Independent wire rope core

2.1.3.2.2.8 Pre-Formed

Yes

2.1.3.2.3 Pre-Stretching

Submit Pre-Stretching Procedure. Pre-stretch the wire ropes before attaching their end terminations. This is done by subjecting them to three cycles at 40 percent of its nominal strength. Hold the 40 percent loads for 5 minutes with 5 percent loads for 5 minutes between cycles. A method of dynamic pre-stretching may be proposed.

2.1.3.2.4 Wire Strength and Ductility

Perform testing in accordance with FS RR-W-410 to verify wire strength and ductility. Submit test results.

2.1.3.2.5 Pre-forming

Provide pre-formed wire rope, and perform testing in accordance with FS RR-W-410 to verify pre-forming. Submit test results.

2.1.3.2.6 Stress Relief "(Wrapping Test)"

Stress relieve the wire rope, and perform testing in accordance with FS RR-W-410 to verify stress relief. Submit test results.

2.1.3.2.7 Weld Distribution

Wire joints in any strand must not be closer than 18 inches in any strand.

2.1.3.2.8 Galvanizing

The wire rope must be woven from drawn galvanized wire. That is, the wires galvanized prior to their last drawing operation. The wire rope must have the same accepted industry standards for nominal strength as it would, had it not been galvanized.

2.1.3.2.9 Strand Pitch Length

Not be less than 4-1/2 times the nominal rope diameter.

2.1.3.2.10 Core Strand Wires

The number of wires in the core strand must be equal to or greater than the number of wires in the other strands. Use the same material as the wires in the other strands, or use a material with a lower tensile

strength.

2.1.3.2.11 End Terminations

Submit shop drawings, as specified. At the free ends of the wire rope shall be a factory installed Swaged Flemish Loop with a hot dipped galvanize Extra Heavy Wire Rope Thimble. The assembly shall be factory installed/assembled for quality control and shall not be field removable. The thimble shall meet Federal Specification FF-T-276b, Type III. Provide documentation and certification the swage connection was properly installed such that the completed swage connection meets 100% of the rated working load of the wire rope.

2.1.3.2.12 Tension Testing

Submit rope tension test report. Perform a tension test to verify the wire rope meets the accepted industry standards for nominal strength. Test two rope samples to failure to be sure the expected performance level has been met. Perform the test using suitable tension testing equipment and by qualified personnel. Submit certification of rope tension testing device. Cut the rope samples to no less than 3 feet of length. The test will not be considered valid if the failure occurs less than 2 inches from either socket or holding mechanism. Relative speed between the machine heads must not exceed 1 inch per minute.

2.1.3.2.13 Attaching and Proof Loading Terminations

The manufacturer must attach the end terminations after pre-stretching the wire rope. The end termination attachment method must be as indicated within this specification. After their attachment, proof load the wire ropes at 40 percent of nominal strength of the rope. Measure the length of the wire ropes to the nearest 0.01 inch at the operating load of each respective wire rope. Submit proof load of terminations test report and measured rope lengths.

2.1.3.2.14 Wire Rope Lubrication

Submit manufacturer's literature for factory and field lubricant. The field and factory lubricants must be compatible. Do not lubricate the wire rope.

2.2 FABRICATION

2.2.1 Detail Drawings

Detail drawings of block and tackle system and appurtenant items, including fabrication drawings, shop assembly drawings, delivery drawings, and field installation drawings, shall conform to the requirements specified herein. Detail drawings for metalwork and machine work shall include catalog cuts, templates, fabrication and assembly details and type, grade and class of material as appropriate. Elements of fabricated items inadvertently omitted on contract drawings shall be detailed by the fabricator and indicated on the detail drawings.

2.2.1.1 Fabrication Drawings

Fabrication drawings shall show complete details of materials, tolerances, connections, and proposed welding sequences which clearly differentiate shop welds and field welds.

2.2.1.2 Shop Assembly Drawings

Shop assembly drawings shall provide details for connecting the adjoining fabricated components in the shop to assure satisfactory field installation.

2.2.1.3 Delivery Drawings

Delivery drawings shall provide descriptions of methods of delivering components to the site, including details for supporting fabricated components during shipping to prevent distortion or other damages.

2.2.1.4 Field Installation Drawings

Field installation drawings shall provide a detailed description of the field installation procedures. The description shall include the location and method of support of installation and handling equipment; provisions to be taken to protect concrete and other work during installation; method of maintaining components in correct alignment; and methods for installing other appurtenant items.

2.2.2 Structural Fabrication

Material must be straight before being laid off or worked. If straightening is necessary it shall be done by methods that will not impair the metal. Sharp kinks or bends shall be cause for rejection of the material. Material with welds will not be accepted except where welding is definitely specified, indicated, or otherwise approved. Bends shall be made by approved dies, press brakes or bending rolls. Where heating is required, precautions shall be taken to avoid overheating the metal and it shall be allowed to cool in a manner that will not impair the original properties of the metal. Proposed flame cutting of material other than structural steel shall be subject to approval and shall be indicated on detail drawings. Shearing shall be accurate and all portions of the work shall be neatly finished. Corners shall be square and true unless otherwise shown. Re-entrant cuts shall be filleted to a minimum radius of ¾ inch unless otherwise approved. Finished members shall be free of twists, bends and open joints. Bolts, nuts and screws shall be tight.

2.2.2.1 Dimensional Tolerances for Structural Work

Dimensions shall be measured by an approved calibrated steel tape of approximately the same temperature as the material being measured. The overall dimensions of an assembled structural unit shall be within the tolerances indicated on the drawings or as specified in the particular section of these specifications for the item of work. Where tolerances are not specified in other sections of these specifications or shown, an allowable variation of 1/32 inch is permissible in the overall length of component members with both ends milled and component members without milled ends shall not deviate from the dimensions shown by not more than 1/16 inch.

2.2.2.2 Structural Steel Fabrication

Structural steel may be cut by mechanically guided or hand-guided torches, provided an accurate profile with a surface that is smooth and free from cracks and notches is obtained. Surfaces and edges to be welded shall be prepared in accordance with AWS D1.1/D1.1M. Where structural steel is not

to be welded, chipping or grinding will not be required except as necessary to remove slag and sharp edges of mechanically guided or hand-guided cuts not exposed to view. Hand-guided cuts which are to be exposed or visible shall be chipped, ground or machined to sound metal.

2.2.3 Welding

Welding shall conform to the requirements specified herein. Welds shall be in accordance with AWS D1.1/D1.1M of the type shown and approved detail drawings. Radiographic examination is required on the major shop and field welds of the type and location indicated and as follows: all connections which might cause structural failure of the block and tackle system. Welds which have been designated to receive radiographic examination and are found to be inaccessible to a radiation source or film, or are otherwise so situated that radiographic examination is not feasible may be examined, with written approval, by dye penetrant, magnetic particle tests, or ultrasonic tests.

2.2.4 Bolted Connections

Bolts, nuts and washers shall be of the type specified or indicated. All nuts shall be equipped with washers. Beveled washers shall be used where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where the use of high strength bolts is specified or indicated the materials, workmanship and installation shall conform to the applicable provisions of ASTM A490.

a. Bolt Holes - Bolt holes shall be accurately located, smooth, perpendicular to the member and cylindrical. Holes for high strength bolts shall have diameters of not more than 1/16 inch larger than bolt diameters. If the thickness of the material is not greater than the diameter of the bolts the holes may be punched. If the thickness of the material is greater than the diameter of the bolts the holes may be drilled full size or subpunched or subdrilled at least 1/8 inch smaller than the diameter of the bolts and then reamed to full size. Poor matching of holes will be cause for rejection. Drifting occurring during assembly shall not distort the metal or enlarge the holes. Reaming to a larger diameter of the next standard size bolt will be allowed with approval for slight mismatching.

2.2.5 Machine Work

Tolerances for machine-finished surfaces designated by non-decimal dimensions shall be within 1/64 inch. Sufficient machining stock shall be allowed on placing pads to ensure true surfaces of solid material. Finished contact or bearing surfaces shall be true and exact to secure full contact. Journal surfaces shall be polished and all surfaces shall be finished with sufficient smoothness and accuracy to ensure proper operation when assembled. Parts entering any machine shall be accurately machined and all like parts shall be interchangeable except that parts assembled together for drilling or reaming of holes or machining will not be required to be interchangeable with like parts. All drilled holes bolts shall be accurately located.

2.2.5.1 Finished Surfaces

Surface finishes indicated or specified shall be in accordance with ASME B46.1. Values of required roughness heights are arithmetical average deviations expressed in microinches. These values are maximum. Lesser degrees will be satisfactory unless otherwise indicated. Compliance with

surface requirements shall be determined by sense of feel and visual inspection of the work compared to Roughness Comparison Specimens in accordance with the provisions of ASME B46.1. Values of roughness width and waviness height shall be consistent with the general type of finish specified by roughness height. Where the finish is not indicated or specified it shall be that which is most suitable for the particular surface, provide the class of fit required and be indicated on the detail drawings by a symbol which conforms to ASME B46.1 when machine finishing is provided. Flaws such as scratches, ridges, holes, peaks, cracks or checks which will make the part unsuitable for the intended use will be cause for rejection.

2.2.5.2 Unfinished Surfaces

All work shall be laid out to secure proper matching of adjoining unfinished surfaces unless otherwise directed. Where there is a large discrepancy between adjoining unfinished surfaces they shall be chipped and ground smooth or machined to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown and shall be chipped ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts shall be filled in an approved manner.

2.2.6 Miscellaneous Provisions

2.2.6.1 Metallic Coatings

Zinc coatings - Zinc coatings shall be applied in a manner and of a thickness and quality conforming to ASTM A123 unless noted otherwise. Where zinc coatings are destroyed by cutting, welding or other causes the affected areas shall be regalvanized. Coatings 2 ounces or heavier shall be regalvanized with a suitable low-melting zinc base alloy similar to the recommendations of the American Hot-Dip Galvanizers Association to the thickness and quality specified for the original zinc coating. Coatings less than 2 ounces shall be repaired in accordance with ASTM A780.

2.2.6.2 Shop Assembly

Each machinery and structural unit furnished shall be assembled in the shop to determine the correctness of the fabrication and matching of the component parts unless otherwise specified. Tolerances shall not exceed those shown. Each unit assembled shall be closely checked to ensure that all necessary clearances have been provided and that binding does not occur in any moving part. Assembly in the shop shall be in the same position as final installation in the field unless otherwise specified. Assembly and disassembly work shall be performed in the presence of the Contracting Officer unless waived in writing. Errors or defects disclosed shall be immediately remedied by the Contractor without cost to the Government. Before disassembly for shipment each piece of a machinery or structural unit shall be match-marked to facilitate erection in the field. The location of match-marks shall be indicated by circling with a ring of white paint after the shop coat of paint has been applied or as otherwise directed.

2.2.7 TESTS, INSPECTIONS, AND VERIFICATIONS

The Contractor shall have required material tests and analyses performed and certified by an approved laboratory to demonstrate that materials are in conformity with the specifications. These tests and analyses shall be

performed and certified at the Contractor's expense. Tests, inspections, and verifications shall conform to the requirements of the particular sections of these specifications for the respective items of work unless otherwise specified or authorized. Tests shall be conducted in the presence of the Contracting Officer if so required. The Contractor shall furnish
specimens and samples for additional independent tests and analyses upon request by the Contracting Officer. Specimens and samples shall be properly labeled and prepared for shipment.

2.2.7.1 Nondestructive Testing

When doubt exists as to the soundness of any material part such part may be subjected to any form of nondestructive testing determined by the Contracting Officer. This may include ultrasonic, magnaflux, dye penetrant, x-ray, gamma ray or any other test that will thoroughly investigate the part in question. The cost of such investigation will be borne by the Government. Any defects will be cause for rejection and rejected parts shall be replaced and retested at the Contractor's expense.

2.2.7.2 Tests of Machinery and Structural Units

The details for tests of machinery and structural units shall conform to the requirements of the particular sections of these specifications covering these items. Each complete machinery and structural unit shall be assembled and tested in the shop in the presence of the Contracting Officer unless otherwise directed. Waiving of tests will not relieve the Contractor of responsibility for any fault in operation, workmanship or material that occurs before the completion of the contract or guarantee. After being installed at the site, each complete machinery or structural unit shall be operated through a sufficient number of complete cycles to demonstrate to the satisfaction of the Contracting Officer that it meets the specified operational requirements in all respects.

2.2.7.3 Inspection of Structural Steel Welding

The Contractor shall maintain an approved inspection system and perform required inspections in accordance with Contract Clause CONTRACTOR INSPECTION SYSTEM. Welding shall be subject to inspection to determine conformance with the requirements of AWS D1.1/D1.1M, the approved welding procedures and provisions stated in other sections of these specifications. Nondestructive examination of designated welds will be required. Supplemental examination may be required.

2.2.7.3.1 Visual Examination

All visual examination of completed welds shall be cleaned and carefully examined for insufficient throat or leg sizes, cracks, undercutting, overlap, excessive convexity or reinforcement and other surface defects to ensure compliance with the requirements of AWS D1.1/D1.1M applicable sections.

2.2.7.3.2 Supplemental Examination

When the soundness of any weld is suspected of being deficient due to faulty welding or stresses that might occur during shipment or erection the Government reserves the right to perform nondestructive supplemental examinations before final acceptance. The cost of such inspection will be borne by the Government.

2.2.8 Structural Steel Welding Repairs

Defective welds in the structural steel welding repairs shall be repaired in accordance with AWS D1.1 applicable sections. Defective weld metal shall be removed to sound metal by use of air carbon-arc or oxygen gouging. The
surfaces shall be thoroughly cleaned before welding. Welds that have been repaired shall be retested by the same methods used in the original inspection. Except for the repair of members cut to remove test coupons and found to have acceptable welds costs of repairs and retesting shall be borne by the Contractor.

PART 3 EXECUTION

3.1 EXAMINATION
3.1.1 QA Inspections

Up to two representatives of the Contracting Officer will be present to witness the various manufacturing processes for the wire rope. At a minimum, a site visit will be made to witness the tension test, and the wire rope will be inspected upon delivery. Inspection during removal of the existing wire rope and installation of the new wire rope will be ongoing.

3.1.2 Verify Dimensions

After becoming familiar with the details of the work, verify dimensions in the field, and immediately advise the Contracting Officer of any discrepancies before performing any work.

3.2 INSTALLATION

Installation shall conform to the requirements specified herein. Block and tackle system and appurtenant items shall be assembled for installation in strict accordance with the contract drawings, approved installation drawings, and shop match-markings. Before assembly and installation, all bearing surfaces requiring lubrication shall be thoroughly cleaned and lubricated with an approved lubricant. All components to be field-welded shall be in correct alignment before welding is commenced.

3.2.1 Alignment and Setting

Each machinery or structural unit shall be accurately aligned by the use of steel shims or other approved methods so that no binding in any moving parts or distortion of any member occurs before it is fastened in place. The alignment of all parts with respect to each other shall be true within the respective tolerances required. Machines shall be set true to the elevations shown.

3.3 PROTECTION OF FINISHED WORK

3.3.1 Machined Surfaces

Machined surfaces shall be thoroughly cleaned of foreign matter. All finished surfaces shall be protected by suitable means. Unassembled bolts shall be oiled and wrapped with moisture resistant paper or protected by other approved means. Finished surfaces of ferrous metals to be in bolted

contact shall be washed with an approved rust inhibitor and coated with an approved rust resisting compound for temporary protection during fabrication, shipping and storage periods.

3.4 ACCEPTANCE TRIAL OPERATION

After completion of the block and tackle system installation, the Contracting Officer will examine the block and tackle system for final acceptance. The block and tackle systems will be examined first to determine whether or not the workmanship conforms to the specification requirements. The Contractor will then be required to use the block and tackle system to operate the gates from the fully-opened to the fully-closed position a sufficient number of times to demonstrate that all parts are functioning properly. Required repairs or replacements to correct defects, shall be made at no additional cost to the Government. The trial operation shall be repeated after defects are corrected. The pull force required to fully open and close gates shall be recorded by the contractor and submitted to the Contracting Officer.

3.5 CLEAN SHEAVES

Clean all sheave grooves with a power wire brush, and inspect them for wear, abrasion, corrosion or other roughness and verify their dimensions are suitable for the new wire rope. Immediately advise the Contracting Officer of any problems.

3.6 STORAGE

Contractor must deliver the snatch block and wire rope and its attachments to 1 Rose Ln, Union Beach, NJ 07735. Storage items shall be in an enclosed area free from contact with soil and weather.

3.7 ORDERLY WORK AREA/SITE CLEANUP

Maintain neat and orderly storage and work areas. The Contract will not be considered complete until all the tools, equipment and property have been removed from the site, and the storage and work areas have been restored. Remove all dirt, debris, litter etc. from project and dispose of in a proper manner.

-- End of Section --

SECTION 31 00 00

EARTHWORK
08/08

PART 1 GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, labor, equipment, and materials, and performing all operations necessary for fill placement and compaction for the project and all other fill placement incidental to the construction of the embankments and floodwalls as specified herein or as shown on the drawings.

1.2 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction. Ground water elevation is 1 to 3 feet below existing surface elevation.

e. Material character is indicated by the boring logs.

f. Hard materials will not be encountered in most of the excavations.

1.3 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM A139/A139M	(2004; R 2010) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A252	(2010) Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C136/C136M	(2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D1140	(2014) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	(2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D1586	(2011) Penetration Test and Split-Barrel Sampling of Soils
ASTM D2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2216	(2010) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2937	(2010) Density of Soil in Place by the Drive-Cylinder Method
ASTM D422	(1963; R 2007; E 2014; E 2014) Particle-Size Analysis of Soils
ASTM D4318	(2010; E 2014) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D698	(2012; E 2014) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

1.4 DEFINITIONS

1.4.1 Embankment

The terms "levee" or "embankment" as used in these specifications are defined as the earth and rock fill portions of the levee structure or other fills related to the levee structure. "Backfill" as used in this section is defined as that fill material which cannot be placed around or adjacent to a structure until the structure is completed or until a specified time interval has elapsed after completion.

1.4.2 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

1.4.3 Topsoil

Material suitable for topsoils obtained from offsite areas excavations is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.4.4 Hard/Unyielding Materials

Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 3 inch in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.4.5 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.5 SYSTEM DESCRIPTION

Subsurface soil boring logs are included in Section 00 90 03. The subsoil investigation report and samples of materials taken from subsurface investigations may be examined at the NAB Materials and Investigations Unit, Fort McHenry, Baltimore, MD. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.5.1 Blasting

Blasting will not be permitted.

1.5.2 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.Calculations shall include data, assumptions and references used and be certified by a registered Professional Engineer in the State of New Jersey.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Dewatering Work Plan; G, RO

SD-03 Product Data

Utilization of Excavated Materials; G
Opening of any Excavation or Borrow Pit; G, RO

Procedure and location for disposal of unused satisfactory material. Procedure and location for disposal of unsatisfactory material. Proposed source of borrow material and related material testing. Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas.

SD-06 Test Reports

Testing

Borrow Site Testing

Within 48 hours of conclusion of physical tests, submit 3 copies of test results, including calibration curves and results of calibration tests.

SD-07 Certificates

Testing

PART 2 PRODUCTS

2.1 Soil Materials

2.1.1 Satisfactory Materials

Any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SM, SP-SM, or SP free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location up to a maximum of 3 inches. Materials for embankment and backfill construction will be obtained from sources provided by the

Contractor and from commercial sources. Materials obtained from common excavation which meet the requirements for random earth or structural fill materials, or which can be processed to meet the requirements for these materials, as specified herein, may be utilized in the appropriate zones of the embankment. All roots, limbs, and wood splinters shall be removed from embankment materials. Materials containing sod or other organic or perishable material shall not be used in the embankment. The Contractor shall submit to the Contracting Officer the source or sources from which he intends to obtain materials for embankment construction. It shall be the responsibility of the Contractor to obtain Federal, State, and local permits which may be required for excavation and reclamation of any borrow areas. Where reclamation of the borrow area is required, a copy of the plan and procedures to be utilized for reclamation shall be furnished to the Contracting Officer.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC. Materials classified as GM and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

2.1.4 Expansive Soils

Soils that have a plasticity index equal to or greater than 13 when tested in accordance with ASTM D4318.

2.1.5 Select Gravel Fill

Select gravel fill will be required for the gravel adjacent to the floodwall and shall be obtained by the Contractor. Provide materials classified as GP or GW by ASTM D2487 where indicated. The liquid limit of such material shall not exceed 40 percent when tested in accordance with ASTM D4318. The plasticity index shall not be greater than 0 percent when tested in accordance with ASTM D4318, and not more than 5 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D1140. The select gravel fill be determined by a registered Professional Engineer in the State of New Jersey in accordance with Appendix D of EM 1110-2-1913 or another approved method. The gradation may change throughout the jobsite as needed. This determination shall be submitted to the Government for approval. The following gradation shall be used for bidding purposes only.

Sieve Size	Percent Passing by Weight
1-1/2"	100
1"	90 - 100
1//2"	65 - 95
3/8"	45 - 85
No. 4	20 - 45
No. 30	0 - 15
No. 200	0 - 5

2.1.6 Select Earth Fill Material

Select earth fill will be required for the earth embankment and shall be obtained by the Contractor. The select earth fill materials shall have a plasticity index (PI) between 5 and 50 as determined by ASTM D 4318 testing method. ~~The select earth fill shall be well graded having a maximum particle size not exceeding 1/2 of the placement lift thickness and not less than 35% by weight passing a Standard No. 200 sieve.~~**The select earth fill shall be well graded having a maximum particle size not exceeding 1/2 of the placement lift thickness up to a maximum of 3 inches in diameter and not less than 35% by weight passing a Standard No. 200 sieve.** The select earth fill shall consist of materials meeting the above requirements and classified in ASTM D 2487 as clays (CL), silty or sandy clays (CL-ML, CL); silts (ML), clayey sands (SC), or clayey gravels (GC). All stones and rock fragments exceeding 2/3 of the placement lift thickness shall be removed at the source prior to hauling to the fill. Uniform silts or sands, soft organic soils, frozen materials, or other soils deemed unsuitable by the Contracting Officer shall not be utilized in the select earth fill. Uniform silts or sands are defined as silts and sands with a uniformity coefficient (Cu=D60/D10) which is less than 6.

2.1.7 Select Granular Fill Material

Select granular fill will be required for the sand material adjacent to the floodwall and for the sand toe drain in the levee section and shall be obtained by the Contractor. Provide materials classified as SP or SW by ASTM D2487 where indicated. The liquid limit of such material shall not exceed 40 percent when tested in accordance with ASTM D4318. The plasticity index shall not be greater than 0 percent when tested in accordance with ASTM D4318, and not more than 5 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D1140. The select granular fill be determined by a registered Professional Engineer in the State of New Jersey in accordance with Appendix D of EM 1110-2-1913 or another approved method. The select granular fill must meet filter

criteria for the native soil, embankment fill, and the select gravel fill as applicable. The gradation may change throughout the jobsite as needed. This determination shall be submitted to the Government for approval. The following gradation shall be used for bidding purposes only.

Sieve Size	Percent Passing by Weight
No. 4	95-100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 65
No. 50	10 - 30
No. 100	0 - 10
No. 200	0 - 5

2.2 REQUIREMENTS FOR OFFSITE SOILS

~~Soils brought in from off site for use as backfill shall be tested for petroleum hydrocarbons, BTEX, PCBs and HW characteristics (including toxicity, ignitability, corrosivity, and reactivity). Backfill shall not contain concentrations of these analytes above the appropriate State and/or EPA criteria, and shall pass the tests for HW characteristics. Determine petroleum hydrocarbon concentrations by using appropriate State protocols. Determine BTEX concentrations by using~~**Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCPL test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using** EPA SW-846.3-3 ~~Method 5035/8260B. Perform complete TCLP in accordance with~~ **Method 5030/8020. Perform TCLP in accordance with** EPA SW-846.3-3 ~~Method 1311. Perform HW characteristic tests for ignitability, corrosivity, and reactivity in accordance with accepted standard methods. Perform PCB testing in accordance with accepted standard methods for sampling and analysis of bulk solid samples~~**Method 1311**. Provide borrow site testing ~~for petroleum hydrocarbons and BTEX from a grab sample of material from the area most likely to be contaminated at the borrow site (as indicated by visual or olfactory evidence), with at least one test from each borrow site. For each borrow site, provide borrow site testing for HW characteristics from a composite sample of material, collected in~~

~~accordance with standard soil sampling techniques. Do not bring material onsite until tests results have been received and approved~~**for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Fill must be additionally tested for potential chemical contaminants. The testing requirement is for Priority Pollutants (PP+40). All soils exhibiting chemical levels exceeding NJDEP Residential Direct Contact Soil Cleanup Criteria must not be used at this site. Do not bring material onsite until tests have been approved** by the Contracting Officer.

2.3 BURIED WARNING AND IDENTIFICATION TAPE

Provide polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 6 inches minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes	
Red	Electric
Yellow	Gas, Oil; Dangerous Materials
Orange	Telephone and Other Communications
Blue	Water Systems
Green	Sewer Systems
White	Steam Systems
Gray	Compressed Air

2.3.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.3.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.4 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.5 PIPE CASING

2.5.1 Casing Pipe

ASTM A139/A139M, Grade B, or ASTM A252, Grade 2, smooth wall pipe. Match casing size to the outside diameter and wall thickness as indicated. Protective coating is not required on casing pipe.

2.5.2 Spacers

Casing spacers shall be non-metallic and manufactured of preformed sections of high-density polyethylene. Spacers shall conform to ISO 9001:2015 quality management reporting and certified for strength and quality. The spacers require projection type perimeter surfaces with a minimum number of projections equal to the circumference diameter in inches. Spacing between spacer rings (span) shall be calculated based on the actual weight of pipe filled with liquid. Spacing shall not exceed 10 feet / 3 meters. Verify manufacturer's load carrying capacity for each type of spacer used. Require spacer thickness to permit the pipe bell contain clear space to inner surface of pipe casing. Casing spacers shall be installed using double backed tape and fastened tightly to the carrier pipe.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

~~Where indicated or directed, strip topsoil to a depth o~~**In all areas where excavation is to occur or where fill is to be placed, strip topsoil to a depth of**f 12 inches. Spread topsoil on areas already graded and prepared for topsoil, or transport and deposit in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 1 1/2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Remove from the site any surplus of topsoil from excavations and gradings.

3.2 Additional Geotechnical Exploration

As soon as practical after notice to proceed, perform soil borings to verify the geotechnical recommendations. The Contractor shall complete the number of soil borings as shown on the plans. The Contractor shall hire a geotechnical engineering firm with at least 5 years of experience in drilling, sampling, and boring log production to complete these borings. The borings shall be accomplished using the Standard Penetration Test (SPT) Procedure per ASTM D1586 using a 1-3/8 inch ID x 2 foot 8 inch long split spoon sampler. Sample spoons shall be advanced automatically by a 140 pound hammer dropped 30 inches. Testing shall be accomplished at 2.5' intervals to a total depth of 65 feet. These explorations shall be completed and the results submitted to the Contracting Officer for review at a minimum of 20 days before the start of fill or excavation activities. The boring logs shall be prepared in a format similar to the logs shown in

Section 00 09 03 BORING DATA. The Contractor shall retain all soil samples collected for a period of one year after completion of the soil borings and shall provide any soil samples, at no additional charge, to the Government at the request of the Contracting Officer.

3.2.1 Toe Drain Gradation

Perform additional sampling during excavation of the toe trench to determine the needed gradation of select granular material and select gravel fill as specified above. Samples shall be taken at a rate of at least one sample per 100 linear feet of trench. Samples locations shall be chosen by the Contractor's geotechnical engineering personnel or at the direction of the Contracting Officer.

3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from the borrow areas selected by the Contractor or from approved private sources. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Notify the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit or borrow areas to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, excavate borrow pits and other excavation areas providing adequate drainage. Transport overburden and other spoil material to designated spoil areas or otherwise dispose of as directed. Provide neatly trimmed and drained borrow pits after the excavation is completed. Ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory and unsatisfactory as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.6 GROUND SURFACE PREPARATION

3.6.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

3.6.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. No fill may contain ice or any frozen material.

3.7 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials and excess satisfactory material at an approved offsite disposal site. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Submit procedure and location for disposal of unsatisfactory and any unused satisfactory material. Submit proposed source of borrow material.

3.8 BURIED TAPE AND DETECTION WIRE

3.8.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.8.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over it's entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.9 BACKFILLING AND COMPACTION

Place backfill adjacent to any and all types of structures, and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials, to prevent wedging action or eccentric loading upon or against the structure. Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with

the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.9.1 Trench Backfill

Backfill trenches to the grade shown. Backfill the trench to 2 feet above the top of pipe prior to performing the required pressure tests. Leave the joints and couplings uncovered during the pressure test. Do not backfill the trench until all specified tests are performed.

3.9.1.1 Bedding and Initial Backfill

Provide bedding of the type and thickness shown. Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Compact backfill to top of pipe to 95 percent of ASTM D698 maximum density. Provide plastic piping with bedding to spring line of pipe.

3.9.1.2 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, with satisfactory material. Place backfill material and compact as follows:

3.9.1.2.1 Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas

Deposit backfill in layers of a maximum of 12 inches loose thickness, and compact it to 90 percent maximum density for cohesive soils and 95 percent maximum density for cohesionless soils. Compaction by water flooding or jetting is not permitted. Apply this requirement to all other areas not specifically designated above.

3.9.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 7 days, and cure for 10 days from November to April, temperatures permitting, place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.10 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.10.1 Water Lines

Excavate trenches to a depth that provides a minimum cover of 4 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.10.2 Electrical Distribution System

Provide a minimum cover of 24 inches from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.11 EMBANKMENTS

3.11.1 Earth Embankments

Construct earth embankments from select earth fill materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 12 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise brake up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density with a moisture content within 0 to +5 percent of optimum moisture. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.11.2 Toe Drains

Construct toe drains adjacent to the floodwall areas and levee areas out of select granular material for the areas marked as sand and the select gravel material for the areas marked as gravel. Place the material in successive horizontal layers of loose material not more than 6 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise brake up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 95 percent laboratory maximum density.

3.12 SUBGRADE PREPARATION

3.12.1 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

3.12.2 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, compact each layer of the embankment to at least 95 percent of laboratory maximum density.

3.13 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.13.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.13.2 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.14 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of 4 inches and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from offsite areas.

3.15 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. Submit qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer.

a. Determine field in-place density in accordance with ASTM D1556, ASTM D2167, or ASTM D6938. When ASTM D6938 is used, check the calibration curves and adjust using only the sand cone method as described in ASTM D1556. ASTM D6938 results in a wet unit weight of soil in determining the moisture content of the soil when using this method.For the select earth fill materials, a minimum of one water content determination will be required for every density test of the in-place material, and one water content determination will be

required for every 5000 CY of material at any borrow source. Water content determinations shall be performed in accordance with ASTM D2216. If a conflict occurs between the moisture content as determined by ASTM D6938 and ASTM D2216, the moisture content determined by ASTM D2216 will control. A soil classification test shall be performed for every in-place density test in accordance with ASTM D2487.

b. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. ASTM D2937, use the Drive Cylinder Method only for soft, fine-grained, cohesive soils. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements.

c. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.15.1 Fill and Backfill Material Gradation

Perform one test per 500 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM C136/C136M, ASTM D422, ASTM D1140.

3.15.2 In-Place Densities

a. Perform one test per 1,000 cubic yards, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. Perform one test per 250 cubic yards, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. Perform one test per 500 linear feet, or fraction thereof, of each lift of embankment or backfill for roads and trenches.

3.15.3 Check Tests on In-Place Densities

If ASTM D6938 is used, check in-place densities by ASTM D1556 as follows:

a. One check test per lift for each 5,000 cubic yards, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.

b. One check test per lift for each 1,000 cubic yards, of fill or backfill areas compacted by hand-operated machines.

c. One check test per lift for each 500 linear feet, or fraction thereof, of embankment or backfill for roads and trenches.

3.15.4 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. Water content determinations shall be performed in accordance with ASTM D 2216. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.

3.15.5 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 1,500 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.15.6 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.15.7 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 2 feet above the top of the pipe, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Contracting Officer's Representative. Inspect pipe sizes larger than 48 inches with either video inspection or with a in person inspection, while inspecting smaller diameter pipes by the use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.16 DISPOSITION OF SURPLUS MATERIAL

Remove surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber shall be removed from the site or as directed by the Contracting Officer. Any stockpile of brush, refuse, stumps, roots, and timber or other organic material shall be removed after no more than 2 weeks of being in a stockpile.

-- End of Section --

SECTION 31 23 00.00 20

EXCAVATION
02/11

PART 1 GENERAL

1.1 SCOPE

The work covered by this section consists of furnishing all plant, labor, equipment, and materials, and performing all operations necessary for excavation for the levee and floodwall area, removal and disposal of waste material, and all other excavation incidental to the construction of the embankments and floodwalls as specified herein or as shown on the drawings.

1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D698	(2012; E 2014) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

1.3 DEFINITIONS

1.3.1 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.3.2 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring and Sheeting Plan; G, RO

Dewatering Work Plan; G, RO

1.5 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.6 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

d. Ground water elevation is 1 to 3 feet below existing surface elevation.

e. Material character is indicated by the boring logs.

f. Hard materials will not be encountered in most of the excavations.

g. Blasting will not be permitted. Remove material in an approved manner.

1.7 QUALITY ASSURANCE

1.7.1 Shoring and Sheeting Plan

Submit drawings and calculations, certified by a registered Professional Engineer in the State of New Jersey, describing the methods for any needed shoring and sheeting of excavations. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal. Calculations shall include data, assumptions and references used and be certified by a registered Professional Engineer in the State of New Jersey.

1.7.2 Dewatering Work Plan

Submit procedures for accomplishing dewatering work. Calculations shall include data, assumptions and references used and be certified by a registered Professional Engineer in the State of New Jersey.

1.7.3 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within 2 feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new

grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Shoring and Sheeting

Submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving. In addition to Section 25 A and B of EM 385-1-1 and other requirements set forth in this contract, include provisions in the shoring and sheeting plan that will accomplish the following:

a. Prevent undermining of pavements, foundations and slabs.

b. Prevent slippage or movement in banks or slopes adjacent to the excavation.

c. Shoring system shall limit deflections at top of wall to maxiumum of 1/2 inch and be of sufficient strength to avoid distress and/or cracking of existing structures, including roadways.

3.1.1.1 Geotechnical Engineer

Hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for updating the excavation and dewatering plans as construction progresses to reflect changing conditions and submit an updated plan if necessary. Submit a monthly written report, informing the Contractor and Contracting Officer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Contractor is responsible for arranging meetings with the Geotechnical Engineer at any time throughout the contract duration.

3.1.2 Care of Water

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.1.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development, and

throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils, prevent erosion and undermining of foundations. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.1.2.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval by the Contracting Officer, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 3 feet below the working level.

Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system. Relieve hydrostatic head in previous zones below subgrade elevation in layered soils to prevent uplift.

3.1.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction.

3.1.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged at no additional cost to the Government.

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, stumps, logs, shrubs, brush and vegetation and other items that would interfere with construction operations within the clearing limits. Remove stumps entirely. Grub out matted roots and roots over 2 inches in diameter to at least 36 inches below existing surface.

~~3.2.2 Stripping~~

~~Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be wasted. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.~~

3.2.2 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.3.1 Structures With Spread Footings

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Fill over excavations with concrete during foundation placement.

3.3.2 Pile Cap Excavation and Backfilling

For pile foundations, stop the excavation at an elevation of from 6 to 12 inches above the bottom of the footing before driving piles. Backfill and compact overexcavations and changes in grade due to pile driving operations to 95 percent of ASTM D698 maximum density.

3.3.3 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length.

3.3.4 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all

unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.3.5 Final Grade of Surfaces to Support Concrete

Excavation to final grade shall not be made until just before concrete is to be placed. For pile foundations, the excavation shall be stopped at an elevation 6 to 12 inches above the bottom of the footing before driving piles. After pile driving has been completed, the remainder of the excavation shall be completed to the elevations shown. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond.

3.4 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to plus or minus 3 percent of optimum moisture. Minimum subgrade density shall be as specified herein.

3.5 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved borrow materials shall be obtained as specified herein.

-- End of Section --

SECTION 33 40 00

STORM DRAINAGE UTILITIES
02/10

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	~~(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products~~(2015) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A48/A48M	(2003; R 2012) Standard Specification for Gray Iron Castings
ASTM A536	(1984; R 2014) Standard Specification for Ductile Iron Castings
ASTM B26/B26M	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C139	(2014) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C270	(2014a) Standard Specification for Mortar for Unit Masonry
ASTM C32	(2013) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C425	(2004; R 2013) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C361	(2016) Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
ASTM C443~~M~~	~~(2012) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)~~(2011) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478~~M~~	~~(2015) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)~~(2015a) Standard Specification for

	Precast Reinforced Concrete Manhole Sections
ASTM C55	~~(2014a) Concrete Brick~~(2016) Standard Specification for Concrete Building Brick
ASTM C62	(2013a) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C76~~M~~	~~(2014) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)~~(2015) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C828	(2011) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C877~~M~~	~~(2002; R 2009) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections (Metric)~~(2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C923~~M~~	~~(2008b; R 2013) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)~~(2008; R 2013; E 2016) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C969~~M~~	~~(2002; R 2009) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)~~(2017) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C990	(2009; R 2014) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1171	~~(1999; R 2007) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)~~(2016; E 2016) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking Outdoors (Triangular Specimens)
ASTM D1557	~~(2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000~~

	~~ft-lbf/ft3) (2700 kN-m/m3)~~(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2167	~~(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method~~(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D3212	(2007; R 2013) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D6938	~~(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)~~(2017) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM F1417	(2011a) Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe

Submit printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

Drainage Structure Miscellaneous Metal

SD-04 Samples

Pipe for Culverts and Storm Drains

SD-07 Certificates

Pipeline Testing
Hydrostatic Test on Watertight Joints
Determination of Density
Frame and Cover for Gratings

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

Manufactured in accordance with and conforming to ASTM C76, Class IV and Class V.

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be concrete meeting the requirements of NJDOT Standards and Specifications.

2.2.2 Drainage Structure Miscellaneous Metal

Submit product information and installation of drainage structure hatch cover.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in

the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalis, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.2 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.3.3 Brick

Brick shall conform to ASTM C62, Grade SW; ASTM C55, Grade S-I or S-II; or ASTM C32, Grade MS. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

2.3.4 Precast Reinforced Concrete Manholes

Conform to ASTM C478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.5 Frame and Cover for Gratings

Submit certification on the ability of frame and cover or gratings to carry the imposed live load. Frame and cover for gratings shall be cast gray iron, ASTM A48/A48M, Class 35B; cast ductile iron, ASTM A536, Grade 65-45-12; or cast aluminum, ASTM B26/B26M, Alloy 356.0T6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. The word "Storm Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.6 Joints

2.3.6.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for preformed flexible joint sealants shall conform to ASTM C990, and rubber-type gaskets shall conform to ASTM C443. Factory-fabricated resilient joint materials shall conform to ASTM C425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.6.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C877.

2.3.6.3 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately 3/8 inch thick, meeting the requirements of ASTM D1056, Type 2 , and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D1171. Rubber O-ring gaskets shall be 13/16 inch in diameter for pipe diameters of 36 inches or smaller and 7/8 inch in diameter for larger pipe having 1/2 inch deep end corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of ASTM C990 or ASTM C443. Preformed flexible joint sealants shall conform to ASTM C990, Type B.

b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the storm drainage structure exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A123/A123M.

2.5 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.

2.6 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.6.1 Concrete Pipe

A hydrostatic test shall be made on the watertight joint types as

proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to ASTM C990 or ASTM C443. Test requirements for joints in clay pipe shall conform to ASTM C425. Test requirements for joints in PVC, PE, and PP plastic pipe shall conform to ASTM D3212.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 00 00 EARTHWORK and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 18 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in granular material minimum 4 inch in depth in trenches with soil foundation. Depth of granular bedding in trenches with rock foundation shall be 1/2 inch in depth per foot of depth of fill, minimum depth of bedding shall be 8 inch up to maximum depth of 24 inches. The middle third of the granular bedding shall be loosely placed. Bell

holes and depressions for joints shall be removed and formed so entire barrel of pipe is uniformly supported. The bell hole and depressions for the joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Measurable deflection of installed flexible pipe is not allowed.

3.3.1 Concrete Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.4 JOINTING

3.4.1 Flexible Watertight Joints

3.4.1.1 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.2 External Sealing Band Joint for Noncircular Pipe

Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of precast reinforced concrete, or bituminous coated corrugated metal; complete with frames and covers or gratings; and

with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation equal to the midpoint (spring line) of RCP or has reached an elevation of at least 12 inches above the top of the pipe for flexible pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 6 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 6 inches. Use select granular material for this entire region of backfill for flexible pipe installations.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the

pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under airfield and heliport pavements, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7.5 Determination of Density

Testing is the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D2167 or ASTM D6938. When ASTM D6938 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D6938 results in a wet unit weight of soil and ASTM D6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D6938. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING

3.8.1 Leakage Tests

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall conform to ASTM C828. Low pressure air testing for concrete pipes shall conform to ASTM C969. Low pressure air testing for plastic pipe shall conform to ASTM F1417. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C828 or ASTM C969, after consultation with the pipe manufacturer. Joint and gaskets shall be in accordance with ASTM C361. Factory testing of pipe joints and gaskets shall be in accordance with ASTM C443 Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 250 gallons per inch in diameter per mile of pipeline per day of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished.

3.8.2 Deflection Testing

No sooner than 30 days after completion of installation and final backfill, an initial post installation inspection shall be accomplished. Clean or flush all lines prior to inspection. Perform a deflection test on entire length of installed flexible pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed limits in paragraph PLACING PIPE above as percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a laser profiler or mandrel.

a. Laser Profiler Inspection: If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, remove pipe which has excessive deflection, and replace with new pipe. Initial post installation inspections of the pipe interior with laser profiling equipment shall utilize low barrel distortion video equipment for pipe sizes 48 inches or less. Use a camera with lighting suitable to allow a clear picture of the entire periphery of the pipe interior. Center the camera in the pipe both vertically and horizontally and be able to pan and tilt to a 90 degree angle with the

axis of the pipe rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera's view or interfere with proper documentation of the pipe's condition. The video image shall be clear, focused, and relatively free from roll static or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe. For initial post installation inspections for pipe sizes larger than 48 inches, visual inspection shall be completed of the pipe interior.

b. Pull-Through Device Inspection: Pass the pull-through device through each run of pipe by pulling it by hand. If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show excess allowable deflections of the average inside diameter of pipe, remove pipe which has excessive deflection, replace with new pipe, and completely retest in same manner and under same conditions. Pull-through device: The mandrel shall be rigid, nonadjustable having a minimum of 9 fins, including pulling rings at each end, engraved with the nominal pipe size and mandrel outside diameter. The mandrel shall be 5 percent less than the certified-actual pipe diameter for Plastic Pipe, 5 percent less than the certified-actual pipe diameter for Corrugated Steel and Aluminum Alloy, 3 percent less than the certified-actual pipe diameter for Concrete-Lined Corrugated Steel and Ductile Iron Culvert provided by manufacturer. When mandrels are utilized to verify deflection of flexible pipe products, the Government will verify the mandrel OD through the use of proving rings that are manufactured with an opening that is certified to be as shown above.

c. Deflection measuring device: Shall be approved by the Contracting Officer prior to use.

d. Warranty period test: Pipe found to have a deflection of greater than allowable deflection in paragraph PLACING PIPE above, just prior to end of one-year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection. Inspect 100 percent of all pipe systems under the travel lanes, including curb and gutter. Random inspections of the remaining pipe system outside of the travel lanes shall represent at least 10 percent of the total pipe footage of each pipe size. Inspections shall be made, depending on the pipe size, with video camera or visual observations. In addition, for flexible pipe installations, perform deflection testing on 100 percent of all pipes under the travel lanes, including curb and gutter, with either a laser profiler or 9-fin mandrel. For flexible pipe, random deflection inspections of the pipe system outside of the travel lanes shall represent at least 10 percent of the total pipe footage of each pipe size. When mandrels are utilized to verify deflection of flexible pipe products during the final post installation inspection, the Government will verify the mandrel OD through the use of proving rings.

3.8.3 Post-Installation Inspection

Check each reinforced concrete pipe installation for joint separations, soil migration through the joint, cracks greater than 0.01 inches, settlement and alignment.

a. Replace pipes having cracks greater than 0.1 inches in width or deflection greater than 5 percent deflection. An engineer shall

evaluate all pipes with cracks greater than 0.01 inches but less than 0.10 inches to determine if any remediation or repair is required. RCP with crack width less than 0.10 inches and located in a non-corrosive environment (pH 5.5) are generally acceptable. Repair or replace any pipe with crack exhibiting displacement across the crack, exhibiting bulges, creases, tears, spalls, or delamination.

b. Reports: The deflection results and final post installation inspection report shall include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, deflection and deformation of flexible pipe systems, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

-- End of Section --

SECTION 35 22 26.00 18

SLIDE GATES (SLUICE GATES) AND FLAP-GATES

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A126	(2004; R 2014) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A276/A276M	(2016) Standard Specification for Stainless Steel Bars and Shapes
ASTM A582/A582M	(2012; E 2012) Standard Specification for Free-Machining Stainless Steel Bars
ASTM B98/B98M	(2013) Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
ASTM B138/B138M	(2011) Standard Specification for Manganese Bronze Rod, Bar and Shapes
ASTM B148	(2014) Standard Specification for Aluminum-Bronze Sand Castings
ASTM B150/B150M	(2012) Standard Specification for Aluminum Bronze Rod, Bar, and Shapes
ASTM B584	(2014) Standard Specification for Copper Alloy Sand Castings for General Applications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

ANSI/AWWA C542	(2016) Electric Motor Actuators for Valves and Slide Gates
ANSI/AWWA C563	(2014) Fabricated Composite Slide Gates

1.2 GENERAL REQUIREMENTS

The name Slide Gate used herein under this specification is often commonly referred to as Sluice Gate shall in effect have the same meaning and intent. The work to be performed under this Section shall include all labor, materials, tools and equipment necessary to install and test all:

a. Slide Gate - consisting of, but not only limited to frames, disc, seals, stems, operators, floor stands stem guides, anchorage, and all

other appurtenances, in place and complete as intended by the product manufacturer for its use; Basis of Design is Alfa Laval Inc. - Coplastix.

b. Flap-Gate - consisting of all rigid flap valves, from here after being refer to as "Flap-Gate" but not limited to frames, discs, seals, hinge links, pins, bushes, anchorage, and all other appurtenances, in place and complete as intended by the product manufacturer for its use; Basis of Design is Alfa Laval Inc. - Coplastix.

1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Slide and Flap gates shall be the product of one manufacture.

1.2.2 Namaplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model, serial number, and catalog number on a plate secured to the item of equipment. Nameplate for each electric motor shall show the horsepower, speed in revolutions per minute, full load current, voltage, frequency, phase, time rating, maximum ambient temperature, insulation class code letter, and service factor.

1.2.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and shall advise the Contraction Officer of any discrepancy before performing the work.

1.2.4 Warranty and Guarantee

The Manufacturer shall guarantee the slide gates, when installed and operated as recommended by the Manufacturer with a documented maintenance program, trouble-free operation for a period of ten (10) years. If the Government Engineer or Owner/Customer is not completely satisfied with the performance of the product, the Manufacturer shall remedy the problem at no cost or refund the materials and installation cost upon the return of the equipment. The Manufacturer shall guarantee the following:

a. Leakage for both, Slide Gate and Flap-Gate shall be no more than that allowed by the ~~AWWA C563~~ANSI/AWWA C563 Standard during the guarantee period. Under normal operating conditions both Slide Gates and Flap-Gates shall be near watertight.

b. Slide Gate Door (disc), and Flap of Flap-Gate shall be free of sticking or binding as judged by the Government Engineer/Customer Engineer (move freely via operator provided) with no exercising required, exercising shall NOT be part of the maintenance program. Slide Gate operators are to be warranted by the operator manufacturer for their standard warranty period.

c. Head losses for provided Flap Gates shall be LESS than comparable conventional cast iron flap valves.

d. There shall be no exception/deviation to this warranty.

1.2.5 Other Requirements for Slide Gates

a. All gates shall be fully assembled in their frames except for operators, guides, stem-extension, and stem covers or concrete-mounted pedestals. Where shipping constraints require it, frame may be partially assembled such that the top may be easily mounted to the bottom containing the disc.

b. Where square-to-circular or bell-lip conversion is required the Contractor shall provide a bell-end pipe insert of suitable diameter and water stop.

c. P-Bulb or J-Bulb type seals attached to the Disc / mounted to the frame, or any seal that needs replacement in less than 20 years shall not be acceptable. No part of the seal shall protrude into the clear opening.

d. All slide gates shall be supplied by the same manufacturer, who shall be fully experienced, reputable and qualified in the manufacturing of the equipment furnished and who has been building said equipment for a minimum period of ten (10) years.

1.2.6 Other Requirements for Flap-Gates

a. All Flap-Gates shall be fully assembled for Contractor installation. Where shipping constraints require it, frame and door may be shipped separately.

b. Where square-to-circular or bell-lip conversion is required, the Contractor shall provide a bell-end pipe insert of suitable diameter and water stop.

c. Seals attached to the Disc, or any seal that needs replacement in less than 10 years shall not be acceptable. No part of the seal shall protrude into the clear opening.

d. All Flap-Gates shall be supplied by the same manufacturer, who shall be fully experienced, reputable and qualified in the manufacturing of the equipment furnished and who has been building said equipment for a minimum period of ten (10) years.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Slide Gates; G, DO
Flap-Gates; G, DO
Electric Motor Actuators; G, DO

Detail drawings consisting of a complete list of equipment and materials. Detail drawings containing complete wiring and schematic diagrams and any other details required to demonstrate

that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Slide Gates; G, DO
Flap Gates; G, DO

Material Shop Drawing - Copies of all materials required to establish compliance with specifications shall be submitted to the Government for Review. Submittals shall include the following:

a. Certified Shop Erection drawings and data regarding Slide Gates and Flap-Gates

b. Literature on Drawings describing the equipment and showing all important details of construction and dimensions.

Electric Motor Actuators; G, DO

Spare parts data; G, RDO

Manufacturer's descriptive data and technical literature, catalog cuts, and installation instructions

SD-06 Test Reports

Testing; G, DO

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-08 Manufacturer's Instructions

Slide Gates; G, DO
Flap Gates; G, DO

Provide the following:

a. Operating Instructions: Operating Instructions for each type of Slide Gate and Flap-Gate shall be furnished.

b. Installation: The manufacturer shall provide installation instructions. The installation and adjustment of Slide Gates and Flap-Gates, operators and all accessories shall be in full accordance with these instructions. Both, the Slide Gates and Flap-Gates shall be installed by the best practice and methods. The manufacturer approved installation shall be specific and identified for the specific conditions of this project with analysis and data as necessary or required shall be submitted for approval.

Electric Motor Actuators; G, RO

Proposed diagrams, instructions, and other sheets, prior to posting.

SD-10 Operation and Maintenance Data

Slide Gates; G, RO
Electric Motor Actuators; G, RO

Six complete copies of operating manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six complete copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include simplified wiring, layout, and control diagrams of the system as installed.

1.4 SPARE PARTS DATA

Submit two copies of the Spare Parts Data list.

a. Spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than two months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 and 10 year(s) of service. Slide gates shall need no spare parts for 10 years.

1.5 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity, and temperature variations, dirt and dust, or other contaminants. All equipment shall be delivered in suitable packaging, cases, or crates, and stored or placed in an appropriate manner. Each packaging shall have identifying mark and a complete list showing content. Gates shall be complete when shipped and the manufacturer shall use all due and customary care in preparing them for shipment to avoid damage in handling or in transit. Care shall be taken to see that the parts are completely closed and locked in position before shipment. Parts that are to be embedded in concrete may be shipped separately. Gates of 24 inches and larger shall be bolted securely or otherwise fastened to skids in such in such a manner that they may be safely handled.

PART 2 PRODUCTS

2.1 Performance Requirements for Slide Gate

a. Slide Gates shall be designed for the seating and unseating heads as listed in the Slide Gate Schedule. Slide gates shall exceed the standard of ~~AWWA C563~~ANSI/AWWA C563. Exceeding the conformance to ~~AWWA C563~~ANSI/AWWA C563 applies to discs and frames with a safety factor of five (5) with regard to tensile, compressive, and shear strength and with the requirement that all gates will yield no more leakage than shown in Section 6.8 (AWWA) Field Leakage Test. Materials of construction shall be suitable for the environment in

which the slide gates shall be installed and operated.

b. Frames - 316LSS with 5/16" minimum metal thickness for all items. Frames are wall mounted against 1" nominal grout base; no thimbles or flanges are needed; however, see Contract Drawing Details or Schedule if they are to be included.

c. Slide (Disc): Shall be constructed with a reinforced rigid composite skin, having a minimum thickness of 1/8-inch on the outside. Slide (disc) shall have an internal matrix of carbon steel of suitable strength for the specified service. The total minimum slide thickness should not be less than 2". The slide (disc) outer surface skins shall be a homogeneous composite material having extremely high tensile and impact strength, be nontoxic and shall be stabilized against ultraviolet light. The composite material shall be an Aramid fiber type from the KEVLAR family of fibers, and shall have the following minimum properties and shall be designed to limit the deflection to a maximum of 1/1000 of the span under design head conditions based upon horizontal internal support members only. Manufacturer shall submit drawings and comprehensive design criteria to substantiate that the required deflection figure for each disc has been achieved. Safety factors shall be calculated for the disc under maximum head, and shear at the disc/seal interface.
The following shall not be acceptable: solid core FRP, solid core GRP, plastic coated steel, any surface with a gel coat, or externally reinforced slide (disc). All welds on the slide shall be continuously welded and no stitch welding to be allowed.

2.1.1 Performance Requirements for Flap-Gate

Flap-Gates shall be designed for the seating head listed in the schedule. Conformance to properties of ~~AWWA C563~~ANSI/AWWA C563 applies to door and frame with a safety factor of five (5) with regard to tensile, compressive, and shear strength and with the requirement that all flap valves will yield no more leakage than shown in (~~AWWA C563~~ANSI/AWWA C563) Field Leakage Test. Materials of construction shall be suitable for the environment in which the flap valves shall be installed and operated.

a. Frames - 316SS with a 5/16" minimum metal thickness for all items. Frames are wall mounted against a 1" nominal grout base; no thimbles or flanges are needed or included. Frames shall have a minimum 3° slope on the front.

b. Flap-Gate (Door): Shall be constructed from a reinforced rigid composite plastic material, having a minimum thickness of 1/8-inch. Door shall have an internal matrix of carbon steel of suitable strength for the specified service. Door outer surface skins shall be a homogeneous composite plastic material having extremely high tensile and impact strength, be nontoxic and shall be stabilized against ultraviolet light. The plastic material shall be an Aramid fiber type from the KEVLAR family of fibers, and shall have the following minimum properties and shall be designed to limit the deflection to a maximum of 1/750 of the span under design head conditions based upon support members only. Manufacturer shall submit drawings and comprehensive design criteria to substantiate that the required deflection figure for each door has been achieved. Comprehensive safety factor calculations shall include bending moments, buckling stress, and bonding stress with thermal expansion factors suitable for reference in NASA CR-1457, "Manual for Plates and Shells", et al. Safety

factors shall be calculated for the door under maximum seating head.

The following shall not be acceptable: solid core FRP, solid core GRP, plastic coated steel, any surface with a gel coat, or externally reinforced slide (disc). All welds on the slide shall be continuously welded and no stitch welding to be allowed.

2.2 MATERIALS

2.2.1 Physical and Chemical Properties

PROPERTIES TABLE	
Tensile Strength	15,400
Young's Modulus	1,756,000 psi
Flexural Strength	28,000 psi
Flexural Modulus	1,497,000 psi
Compressive Strength	30,200 psi
Impact Strength	9.65 ft-lb/in
Water Absorption	0.09 %
Specific Gravity	1.72
Coefficient of Thermal	1.6 x 10-5 per C
Expansion	80 degrees C ASTM D648
Heat Distortion Point	93% @ -20 C
Low Temperature Impact	Not notch sensitive
Strength	Excellent
Notch Sensitivity	Class 1 Spread of Flame
Weathering Properties	Rating BS476: Part 1: 1953
Fire Resistance	self-extinguishing, ASTM D635 - 56R
Chemical Resistance	Organics, Alkaline, Ozone (2 to 3 PPM)

Polyurethane foam shall be used as filler between any steel grid when steel grid reinforcing system are used and shall be a min. of 7 LB density/cu.ft.

a. Seals for Slide Gate: The sealing arrangement for the reinforced plastic slide gates shall comprise of sealing faces and side guides constructed of ultra high molecular weight polyolefin having an extremely low coefficient of friction and a backing constructed of highly resilient expanded neoprene. Guides and seating of the gate

shall be easily adjustable (min. 5/8-inch). All moving contact surfaces shall be compatible to each other thereby minimizing sticking / jamming and making the operation easy. Initial leakage rates shall be one-half that allowed by ~~AWWA C563~~ANSI/AWWA C563.

b. Seals for Flap-Gate: The Flap-Gate shall be fitted with fixed sealing faces on the frame that surround the clear opening. Sealing shall be sensitive Flap-Type and be fitted to the frame with 316 stainless steel fasteners and 316 stainless steel seal retaining strips. Seals shall have a shore hardness of 60/70 on Durometer "A" scale, design of seal shall accommodate for sealing around small objects in the flow.

2.2.2 Testing

Whenever gate components are to be made in conformance with ANSI, ASTM, or other standards that include test requirements or testing procedures, such requirements or procedures shall be met by the Slide Gate and Flap-Gate manufacturer.

The records of such tests shall be made available to the Contracting Officer for Review and Conformance Validation.

2.3 Slide Gates and Flap-Gates

Slide gates shall be of the sizes indicated and shall conform to the requirements specified. Cast iron Slide Gates and Flap-Gates shall not be allowed

2.3.1 Slide Gate: Frame, Guides, and Slide

2.3.1.1 Slide Gates and Flap-Gates

Reinforced Composite Slide Gates, Standard For Composite Slide Gates, ANSI/AWWA C563

2.3.2 Pedestal and Gear Housing

Carbon steel and epoxy coated

2.3.3 Gears

Bronze, ASTM B148 or ASTM B584; or steel, AISI 8620 OR 4140.

2.3.4 Bearings

Bronze, ASTM B148 or ASTM B150/B150M.

2.3.5 Thrust Nut

Bronze, ASTM B584.

2.3.6 Slide Gate: Seating Faces

2.3.6.1 Reinforced Composite Slide Gate seals

Comprised of Ultra high molecular weight polyolefin and a backing constructed of highly resilient expanded neoprene.

2.3.7 Stems, Stem Guide, and Guide Liner.

Stainless Steel, ASTM A582/A582M, type 303 or ASTM A276/A276M, type 316.

All stems shall be the rising types. The entire stem, including extension stem, shall be Type 316 Stainless Steel solid bar. The sections of extension stems shall be joined together by solid couplings, threaded and keyed to the stems. All couplings of the same size shall be interchangeable. Stems shall be furnished with adjustable, stem guides, spaced as necessary to maintain a slenderness ratio L/R of less than 100. Stems shall be of ample cross section to prevent distortion and shall have stub acme threads. Stems shall be designed to withstand tensile and compressive loads that occur under maximum operating conditions. ~~Design for compressive loading shall meet AISC code where K=1 with a minimum safety Factor of 2 to 1. These requirements exceed AWWA standards.~~ Stems shall be cold rolled or cut with a double start stub acme thread and a finish of 32 microns or less.

Stems shall be fixed to the disc by a threaded and keyed assembly into a lifting nut attached to the disc in a lifting bracket, which is bolted to the disc. The bolts securing the bracket shall be in tension and not shear. Bolts in shear will not be acceptable as they will bind against the outer material causing stress.

Provide capped and weatherized Stem cover and Pedestal Base cover - material to be corrosion resistant steel; stem cover shall cover full rise/extension of stem; the cover shall be slotted so that visual observation can be made to confirm gate position and be protected from outdoor elements and be shielded from weather and breathable to prevent condensation buildup and nesting birds and wildlife. The stem and Pedestal Base cover shall be secured and fasten to motor actuator assembly; stem Pedestal Base shall also be bolted to the pedestal base or the unit's concrete mounting surface per manufacturer's recommendation. The Pedestal Base shall be 12" x 12" minimum; it is the Contractor's responsibility to verify load rating if there is deviation from basis of design.

2.3.8 Fasteners for Slide Gates and Flap-Gates; and Hinges Assemblies for Flap-Gates

2.3.8.1 Fasteners

Fasteners for Slide Gates and Flap-Gates shall be Stainless Steel type 316; ASTM A276/A276M and type 316; and ASTM A582/A582M, type 316. All anchor bolts, assembly bolts, screws, nuts, etc. shall be of ample section to safely withstand the forces created by operation of the gate while subjected to the heads specified.

2.3.8.2 Hinges Assemblies

Hinge Assemblies for Flap-Gates shall be side frame and side door mounted Double Hung Hinge arrangements with external adjusting points. All parts shall be manufactured from 316 stainless, and oil impregnated bronze bushes and washers. All Flap-gates shall be already fully factory adjusted ready for installation when received at the job-site.

2.3.9 Sluice Gate, Flush-Bottom Retainer Bar

Cast-iron, ASTM A126; Stainless Steel, ASTM A276/A276M, type 302 or 304, or ASTM A582/A582M type 303; Bronze, ASTM B98/B98M, ASTM B150/B150M, or ASTM B138/B138M.

2.3.10 Electrical Work

The motor-operated slide gate shall include (as one integral component) but not limited to, the electric motor, reduction gearing, drive bushing or top entry stem nut, torque switches, position limit switches, gear case and auxiliary hand-wheel or crank-handle.

2.3.10.1 Electric Motor Actuators

The electric motor-operated slide gates shall be designed for slide gate service and shall be totally enclosed, non-ventilated. The electric motor enclosure shall meet NEMA 4X weatherproof construction. Motor shall be capable of operating through one complete cycle, open-close-open or close-open-close, under the maximum specified operating condition when voltage to the motor is +/-10 percent of the specified voltage. Motors shall have Class F insulation with Class B temperature rise. Overload protection shall be by means of inherent motor thermal sensors embedded in the windings. Operator shall have a de-clutch lever and hand-wheel or crank-handle for manual operation. Comply with ANSI/AWWA C542

2.3.10.2 Limit Switches

Limit switches shall be geared to the drive mechanism and in step at all times, whether the unit is operating electrically or manually. The switches shall be capable of being set to trip at the fully open and fully closed gate positions or at any point between. All electrical interconnections between limit switches, torque switches, indicator lights, and so forth, shall be factory-wired and ready for operation. All gearing used in connection with limit switches shall be factory-lubricated.

2.3.10.3 Torque Switches

The operating mechanism shall include an adjustable torque limit switch arrangement to break the control power circuit when the gate reaches the open or closed position, or an obstruction has been encountered in either direction of travel.

2.3.10.4 Electrical Control

The electrical controls shall include but not be limited to:

a. Motor protector
b. Motor starter
c. Control power transformer 120V single-phase where required
d. Reversing controller
e. Open-stop-close push buttons in NEMA 4 weatherproof enclosure
f. Indication lights, red for open, green for close
g. Thermostat-controlled space heater to prevent condensation

2.3.10.5 Hand-wheel/Crank-handle

Gate lifts shall be hand-wheel or geared crank type for manual operation. Lifts shall operate the gate with a maximum pull of 40 lb on the hand-wheel or crank-handle. The unit shall be connected in such a way that operation by motor shall not cause the hand-wheel/crank-handle to rotate, and operation by handwheel shall not cause the motor to rotate. The hand-wheel/crank-handle shall have an arrow and the word "Open" indicating required rotation. The hand-wheel/crank-handle shall operate in the clockwise direction to close.

2.3.10.6 Enclosure

All electrical controls, limit, torque switches and all electrical accessories shall be housed in a single enclosure meeting NEMA 4X weatherproof construction. The enclosure shall have a padlockable cover to prevent unauthorized accessibility.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS: SLIDE GATES AND FLAP-GATES

3.1.1 Seating Faces for Cast Iron Sluice Gates and Flap Gates

Do not provide cast iron sluice gates or flap gates in this project.

3.2 GENERAL REQUIREMENTS: SLUICE GATES

3.2.1 Stems and Stem Couplings

~~The operating stem shall be designed for a tensile strength to withstand a 200-lb effort on the crank or a 250-ft-lb effort on a wrench nut and shall be designed for a critical bucking compressive load assuming an 80-lb effort on the crank, or a 100-ft-lb torque on a wrench nut. The critical buckling load shall be determined by using the Euler Column Formula, using C=2. Where electric-motor-driven lifts are used, the stem design force shall not be less than 1.25 times the output thrust of the unit in the stalled motor condition.~~The operating stem shall be rising and shall be designed to withstand both tension and compression loads. For manual actuators (or electric-motor-driven actuators in manual mode), the tension and compression design loads shall be those caused by the application of an 80-lb effort on a crank or hand-wheel, or 100 ft-lb torque on a wrench nut. The stem design force shall not be less than 1.5 times the output thrust of the unit in the stalled-motor condition. The tension design load shall not exceed one-fifth (1/5) of the ultimate tensile strength of the stem material. The compression design load shall be less than the critical buckling load as determined by using the Euler Column formula, where C=2; per ANSI/AWWA C563

3.2.2 Stem Guides

Bracket stem guides (including both the guide housing and the bracket) shall be constructed so that when properly spaced they will hold the stem in alignment and yet allow it enough play to permit easy operation. The inside diameter of the guide shall not be greater than 1/8 inch larger than the outside diameter of the stem. The guides shall be spaced in accordance with the manufacturer's recommendations for each stem size. The 1/r ratio shall not be greater than 100. The guides shall be adjustable with regard to the bracket to provide proper concentric

alignment with the stem and shall be designed so that alignment will be maintained after adjustment. The guides shall be lined and provisions shall be made to hold the lining in place. Brackets shall be attached to the wall by sufficient anchor bolts to prevent twisting or sagging under load.

3.2.3 Electric Lifting Devices

The operating unit for the motor-operated lift mechanism shall include, but not be limited to, the electric motor, reduction gearing, stem nut, pedestal, torque and limit switches, reversing magnetic starter, pushbutton control, indicator lights, shop wiring, gear case, and hand crank or hand-wheel for operation in case of power failure. The crank shall be non-removable and fitted with a corrosion resistant rotation handle. The maximum crank radius shall be 15 inches.

3.2.4 Gear Case

The gear case shall be of ductile iron or cast-iron. Flanges for motor attachment and pedestal attachment shall be integrally cast, fully machined, and template drilled. Bearing and grease seal seats shall be machined using jigs and fixtures to ensure proper positioning of the parts in the assembled unit. Other surfaces requiring precision fit shall be machined or jig drilled, or both.

3.2.5 Pedestal

The pedestal shall be of sufficient section to withstand the full load encountered in the gate operation, maintaining a structural safety factor of 5 with regard to tension, compression, or shear.

3.2.6 Gears

The reduction gearing shall consist of helical gears, spur gears, or worm gears of the proper ratio for transferring the full torque of the motor to the stem nut and for operating the gate against the operating head. Helical and spur gears shall be of alloy steel accurately machined. Torque requirements shall be computed on the basis of an efficiency of not greater than 50 percent. Worm gears shall be made of bronze.

3.2.7 Bearings

Roller bearings shall be provided on the stem nut to endure the thrust developed during opening and closing of the gate. All other gears and shafting shall be mounted on antifriction bearings throughout.

3.2.8 Stem Nut

The stem nut shall engage the threads of the stem and shall be rotated by power to raise or lower the gate. The stem nut may be of one or two-piece construction but function as a single piece unit with top entry design to permit installation and removal without complete disassembly of the lifting device.

3.2.9 Rate of Operation

All parts of the lift mechanism shall be designed to move the gate slide at a rate of approximately 12 inches/min (minimum) under the specified operating head condition.

3.2.10 Electric Motor Actuators

Motors shall be high torque with sufficient power to operate the gate through one complete cycle: open-close-open or close-open-close, under the specified operating head when voltage to motor terminals is within 10 percent of specified voltage. The motors shall be totally enclosed, non-ventilated, and wired for the specified current characteristics. They shall be capable of a running torque equal to 40 percent of the maximum motor torque required without exceeding a temperature rise of 167 degrees F over an ambient temperature of 104 degrees F.

3.2.11 Torque Protection and Limit Switch

Torque Switch operating unit shall include an adjustable torque or thrust-limited switch capable of stopping the power to the motor when the gate has reached the stops in the open or closed position or when an obstruction has been encountered in either direction of travel. Torque switches shall be factory-set to satisfy the calculated value corresponding to the maximum operating conditions, and detailed instructions shall be furnished to the purchaser for final setting after installation.

Limit Switch shall be geared to the drive mechanism and in step at all times, whether the unit is operating electrically or manually. The switches shall be capable of being act to trip at the fully open and fully closed gate positions or any point in between. All electrical interconnections between limit switches, torque switches, indicator lights, and so forth, shall be factory-wired and ready for operation. All gearing used in connection with limit switches shall be factory-lubricated.

3.2.12 Lubrication

All gearing and bearings shall be grease or oil lubricated to permit year-round operation in temperature ranging from -20 degrees F through 140 degrees F. Oil or grease seals shall be provided above and below the bearing on the stem nut and on other exterior openings in the gear case where grease or oil can escape.

3.2.13 Hand-crank or Hand-Wheel

Hand-Crank or Hand-Wheel shall be provided if there is no other alternative means to operate the device in the event of electrical power failure the operating unit shall be equipped with a non-removable hand-crank or Hand-Wheel for manual operations. The crank shall be connected so that operation of the motor will not cause the crank to rotate and the operation of the crank shall not cause the motor rotor to rotate. The crank shall be engaged by an exterior lever or an automatic clutch. The action of the lever shall also declutch the motor if there is no device to accomplish this automatically when the power supply to the motor ceases. Should the power return to the motor while the crank is in use, the design of the unit shall prevent the power from being transmitted to the crank. The crank shall require an effort of no more than 50 ft-lbs to lift the gate after the slide is unseated from its wedges under the maximum specified unbalanced head. An arrow and the word "open" or "closed" shall be placed on the crank to indicate direction or resultant gate movement. The crank shall be removable and fitted with a corrosion resistant rotating handle. The crank radius shall be 15 inches.

3.2.14 Hammer Blow

The operating unit shall include a built-in lost motion device that will permit the motor to attain full speed before providing the hammer blow necessary to initiate gate motion in either opening or closing of the gate.

3.2.15 Electrical Control Enclosure

All controls shall be mounted in an enclosure to be located in an Electrical Panel. The cover shall be secured by adequate fasteners and a gasket shall be provided. "Open", "stop", and "close" indicator lights shall be located on the cover. Red and green lights shall also be provided to indicate gate positions: red for open and green for closed. Both lights shall remain on when the gate is in intermediate position between closed and open. All controls including those specified in this section, together with limit switches, torque switches, and appurtenances, shall be factory-wired. (See other sections for complete operating requirements and interfaces for the system).

3.2.16 Stem Cover

Each unit shall be provided with a stem cover.

3.2.17 Indicator

Each unit shall be provided with a dial position indicator to show the following gate positions: fully closed, quarter open, half open, three-quarter open, and fully open. The indicator shall be connected at all times regardless of manual or power operation. The assembly shall be totally enclosed.

3.3 INSTALLATION FOR SLIDE GATE AND FLAP-GATE

Installation of all gates and guides shall be done by the Contractor in a manner acceptable to the Manufacturer and Owner. It shall be the responsibility of the Contractor to handle, store, and install the equipment specified in this Section in strict accordance with the Manufacturer's drawings and recommendations. Frames and guides shall be installed in a true vertical plane with 90-degree corners.

3.3.1 Switch Setting

After installation of gates with motor-operated lift mechanisms, torque switches shall be adjusted and limit switches set in accordance with the manufacturer's recommendations. The gate shall then be operated through one complete cycle, open-closed-open or close-open-close.

3.4 FIELD INSPECTION AND LEAKAGE TESTING

A field inspection and leakage test shall be performed after installation of the gates. The manufacturer shall be notified of the test in sufficient time to enable him to have a representative present at the test site. After all adjustments have been made and the mechanisms properly lubricated, each gate slide shall be operated through one complete cycle as a final check for proper operation before starting the leakage test. Seating and unseating heads shall be measured from the top surface of the water to the center of the gate.

a. Furnish the services of a factory representative for one (1) day who

has complete knowledge of proper operation and maintenance to inspect the final installation and supervise a test run of the equipment.

b. Maximum gate leakage shall be as defined in the General Design Criteria of this Specification, herein. If gates, operators, and appurtenances do not meet specified requirements, corrective measures shall be taken by the Contractor, or the equipment shall be removed and replaced with equipment that satisfies the conditions specified.

3.4.1 Seating Head

Under the design seating head listed in the schedule, the leakage shall not exceed 0.05 gpm per foot of seating perimeter.

3.4.2 Unseating Head

Under the design unseating head listed in the schedule, the leakage shall not exceed 0.10 gpm per foot of seating perimeter.

3.5 PAINTING AND FINISHING

Non-Ferrous Components need not be painted. Ferrous component shall be epoxy coated finish with ultra-violet resistant finish from factory or finished with double-coat marine grade paint per manufacturer's recommendation. No factory finished equipment or appurtenances shall need to be painted except that damage factory finishes shall be retouched in accordance with manufacturer requirements and with paint obtained from the manufacturer. Nameplates shall not be covered with paint but shall be cleaned and legible at completion of the work. Stainless steel and bronze surfaces shall not be painted.

-- End of Section --