

SECTION 13206

PRESTRESSED CONCRETE TANK (TYPE II)

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

- A. Provide all labor, material, and equipment required to design, construct and test the AWWA D110 Type II prestressed concrete tank with all accessories required for a complete installation, as shown on the Drawings and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 - Concrete Formwork
- B. Section 03200 - Reinforcing Steel
- C. Section 03230 - Stressing Tendons
- D. Section 03250 - Concrete Accessories
- E. Section 03290 - Joints in Concrete
- F. Section 03300 - Cast-In-Place Concrete
- G. Section 03350 - Concrete Finishes
- H. Section 03360 - Shotcrete
- I. Section 03370 - Concrete Curing
- J. Section 02216 - Rock Anchors

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of the Specifications, all work hereunder shall conform to the applicable requirements of the following documents to the extent that the requirements therein are not in conflict with the provisions of this Section.
 - 1. ACI 301 — Specifications for Structural Concrete for Buildings
 - 2. ACI 304 — Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
 - 3. ACI 305R — Hot Weather Concreting
 - 4. ACI 306 — Cold Weather Concreting
 - 5. ACI 318 — Building Code Requirements for Reinforced Concrete

6. ACI 347 — Recommended Practice for Concrete Formwork
7. ACI 350 R — Code Requirements for Environmental Concrete Structures and Commentary
8. ACI 423 — Prestressed Concrete
9. AWWA D110 — Wire-Wound Circular Prestressed Concrete Water Tanks

1.04 INFORMATION FURNISHED BY OWNER

- A. Applicable information to be furnished by Purchaser for one prestressed concrete tank keyed to the respective paragraphs as outlined in the Foreword of AWWA Specification D110 is included in the following Tank Schedule A.

Tank Schedule A
Summary of Information to be Furnished by Purchaser
for a Type II Core Wall Tank per AWWA Specification D110

AWWA ITEM

1. Tank shall be of Type II construction with composite shotcrete-galvanized steel diaphragm walls designed in accordance with AWWA D110, ACI 350 and the South Carolina Building Code. Tank shall be designed by the manufacturer for loadings from all sources, including dead, live, internal fluid, soil, groundwater, wind and seismic in accordance with all applicable state and local codes. These loads shall be stated in the design calculations to be submitted in accordance with Article 1.05 of this Section.
2. One (1) tank with a capacity of one million, four hundred and eighty thousand (1.48 million) gallons.
 Nominal inside diameter = 95'-0"
 Nominal side water depth = 28'-0"
 Design High Water Level = EL 727.30
 Bottom Elevation at Perimeter = EL 698.50.
3. Not used.
4. All design loads and calculations shall be included in the design calculation report required by Section 1.05.d.

Dead load shall be the estimated weight of all permanent construction and fittings. The unit weight of concrete shall be 150 lbs. per cubic foot. The unit weight of steel shall be 490 lbs. per cubic foot.

Tank shall be designed to withstand hydrostatic uplift and sidewall forces associated with a 500-year high water flood elevation of 701.50 with a factor of safety against uplift of 1.25. The tank shall be considered empty

Tank Schedule A
Summary of Information to be Furnished by Purchaser
for a Type II Core Wall Tank per AWWA Specification D110

for the flood case and excess uplift forces shall be resisted by ballast structure concrete and rock anchors as indicated on the contract drawings. At the completion of tank construction, the tank manufacturer shall provide written flood certification bearing a South Carolina seal and the signature of a currently registered professional engineer. Certification shall indicate the structure can resist hydrostatic flood loads to the elevation of 701.50 with a factor of safety against uplift of 1.25.

Live loads shall be the estimated weight of all the liquid when the tank is filled to the maximum water surface elevation designated herein. The unit weight of water shall be 62.4 lbs. per cubic foot.

Internal operating pressure of digester shall range from -2 inches of water column to 15 inches of water column.

The tank shall be designed to account for differential temperature between the tank contents and the ambient air conditions. The design maximum operating temperature of the digester contents shall be 105°F (mesophilic anaerobic digester) range with typical operating temperature of 95°F-100°F. Design average outside ambient air temperature shall be 20°F.

Snow loads shall be included in accordance with the South Carolina Building Code and AWWA D110.

Wind loads shall be computed in accordance with the South Carolina Building Code, and AWWA D110.

The Contractor shall compute the seismic design loads per AWWA Standard D110. The Contractor shall also compute the seismic design loads in accordance with the South Carolina Building Code. The most stringent design loads from the two codes shall be used to design the tank and foundations.

All live, snow, wind and seismic loads and factors for use on the tank shall be determined by the tank manufacturer in accordance with the South Carolina Building Code with minimum loads as indicated on the Structural Notes Sheet, Sheet S1, of the contract drawings.

5. The tank is to be located on the property of the Owner at the location indicated on the Drawings.

6. a) Concrete Dome Roof: Where a concrete dome roof is shown, it shall be cast-in-place concrete of spherical shape with a rise between 1:8 and 1:14 per the manufacturer's design, subject to this Specification. Dome shall be clear span, supported by the tank wall with no interior columns or supports with a circumferentially prestressed concrete ring beam designed to withstand all induced loads. Dome thickness shall be governed by buckling resistance, by minimum thickness for practical construction or by

Tank Schedule A
Summary of Information to be Furnished by Purchaser
for a Type II Core Wall Tank per AWWA Specification D110

corrosion protection.

7. The tank shall be constructed as a composite shotcrete-steel core wall with a continuous galvanized steel diaphragm embedded in the core wall and wire wound prestressing and shall be designed in accordance with AWWA D110, ACI 350 and the South Carolina Building Code. Where these specifications are in conflict, the more stringent requirements shall apply except where stated otherwise herein.
8. Subsurface investigation reports provided by the Owner are included as an Appendix to these Specifications.
9. Accessory equipment as detailed in Section 2.10 of this specification shall be provided in accordance with AWWA D110 and the Contract Documents. Locations shall be as indicated in the Contract Documents.
10. Piping shall conform to Division 15 - Mechanical. Piping includes, but is not limited to, inlet, outlet, and overflow piping. Earth cover over pipes shall be as indicated in the Contract Documents. Pipe material shall be as detailed in Contract Documents.

Pipe Connections: The tank shall be furnished with the following pipe connections:

- a) (1) 8" sludge feed connection
- b) (2) 6" sludge recirculation connections
- c) (1) 6" sludge transfer connection
- d) (1) 6" digested sludge return connection
- e) (1) 8" digested sludge outlet connection
- f) (1) 8" digested sludge overflow connection
- g) (2) 3" temperature probe connection
- h) (1) 4" level transmitter connection

All pipe connections shall be made in a manner that will provide absolutely watertight connections and shall be in accordance with standard practices of the industry and applicable AWWA and NSF specifications.

11. Design fill rate and maximum fill, overflow and withdrawal rates shall be as follows:
 - Design Fill Rate: 70 gpm
 - Max Fill Rate: 300 gpm
 - Max Overflow Rate: 105 gpm
 - Max Withdrawal Rate: 300 gpm
12. Not Used
13. Digester walls shall be insulated with 1" thickness insulation above grade. Reference Specification 07240 – Exterior Insulation Finish System (EIFS) for

Tank Schedule A
Summary of Information to be Furnished by Purchaser
for a Type II Core Wall Tank per AWWA Specification D110

insulation requirements. Digester dome shall be insulated with 1.5" thickness of spray foam insulation; reference Specification 07750 – Spray Foam Roofing System for insulation requirements.

14. Seismic joints shall be Type B – Anchored Flexible Base joints. Seismic cables, shall be designed in accordance with Section 5.8 of AWWA D110.
15. The maximum allowable stresses and reinforcement requirements shall be in accordance with Section 4.6 of AWWA D-110 and Sections 2.06, 2.07 and 3.04 herein.
16. The maximum allowable coefficient of friction requirements shall be in accordance with Section 4.7 of AWWA D-110.
17. Foundations: A subsurface investigation report provided by the Owner is included as an Appendix to these Specifications. Foundations shall be designed and furnished by the Contractor as follows:
 - a) The foundation mat for the Prestressed Concrete Tank shall be designed by the Prestressed Concrete Tank manufacturer in accordance with Article 3.02 herein and based on the data contained in the sub-surface investigation report provided by the Owner. The foundation construction drawings shall be prepared by the Contractor and submitted for review and final approval by the Engineer. Contractor shall submit details and calculations on foundation design.
 - b) The design of the concrete foundation, the specifications for the cement and aggregate, and the mixing of the aggregate shall be in accordance with the latest revision of Standard 318 of the American Concrete Institute and Section 03300 of these Specifications. Concrete for the tank base mat and pipe encasement shall have a minimum compressive strength of 4,500 pounds per square inch at 28 days and meet requirements of Section 03300 for Class A1 concrete. Reinforcement shall comply with the latest revision of ASTM A615, Grade 60, and Section 03200 of these Specifications.
18. The required elevation of the overflow piping shall be as shown on the Contract Drawings.
19. The Contractor shall be responsible for designing for any dynamic seismic forces caused by the backfill surrounding the tank.
20. Finished grade shall vary from approximately elevation 710' to elevation 699',
21. It shall be the responsibility of the Contractor to determine whether seismic cables are required between the base of the wall and the footing. If required, seismic cables, shall be designed in accordance with Section 5.8 of AWWA D110.

1.05 SUBMITTALS

A. Shop Drawings

1. The Contractor shall submit the following in accordance with the requirements of Section 01300 – Submittals:
 - a. Complete record of experience of proposed prestressed concrete AWWA D110 Type II tank manufacturer, including names of Owners and dates of construction for no less than five installations designed and constructed in the name of the manufacturer, of comparable size or larger now in service.
 - b. Shop Drawings of the tanks and foundations including erection, installation, and adjustment instructions. Included with the Shop Drawings shall be all material certifications, mill test reports, etc., which are required by this and other applicable sections of the Specifications.
 - c. Certification signed and sealed by a Professional Engineer registered in the State of South Carolina that the tank design conforms to the requirements of the Specifications, Codes, and Standards referenced herein.
 - d. Design calculations for the tank walls shall be signed and sealed by a Professional Engineer registered in the State of South Carolina, with design loads listed at the beginning of the calculations. Submittal of calculations and subsequent review by the Engineer shall not relieve the Contractor from full responsibility for the accuracy and completeness of his design.
 - e. Copies of Shotcrete Nozzlemen certificates.
 - f. Operation and Maintenance Manuals.
 - g. Tank design calculations shall include a finite element model of the bottom cone (floor). Such model shall consider the shape of the floor and forces generated from design of the empty tank with an exterior water surface elevation (flood) of 701.50. Additional reinforcing steel required by this analysis shall be included in the tank design.

1.06 QUALITY ASSURANCE

- A. Contractor shall be solely responsible for the adequacy of design and safety of the completed structure, and shall provide the services of the prestressed concrete tank manufacturer for the design and construction of the structure to meet the requirements stated herein. The entire tank, including all portions of the bottom slab, walls, and roof shall be constructed by the prestressed concrete tank manufacturer. This stipulation applies even when design of bottom slab is included on Contract Drawings.
- B. The prestressed concrete tank manufacturer shall be a specialist in the design and construction of prestressed concrete tanks with at least ten years experience which shall include no less than five installations of comparable size or larger now in service.
- C. The prestressed concrete tank manufacturer shall have on its staff a full-time Professional Engineer registered in the State of South Carolina who will be in responsible engineering

charge of the work and who has been the Design Engineer of Record for a minimum of five (5) similar structures of equal or greater capacity within the last 10 years, in successful service for at least five (5) years. All design calculations shall be sealed and signed by such Professional Engineer. **At the completion of tank construction, the tank manufacturer shall provide written flood certification bearing a South Carolina seal and the signature of a currently registered professional engineer. Certification shall indicate the structure can resist hydrostatic flood loads to the elevation of 701.50 with a factor of safety against uplift of 1.25.**

1.07 WARRANTY

- A. Contractor shall guarantee the design, workmanship, and materials for a period of five years from date of acceptance of the work. In case leakage or other defects appear within the five-year period, he shall promptly make required repairs at his own expense upon written notice by the Owner that such defects have been found. Leakage through the side walls shall be defined as the appearance of free liquid showing stream flow on the exterior surface, the source of which is from the inside of the tank.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Prestressed concrete tank(s) shall be of shotcrete –galvanized steel diaphragm corewall and wire-wound construction.
- B. The AWWA D110 Type II tank(s) shall be as manufactured by Crom, LLC, Gainesville, Florida; Precon Corporation, Newberry, Florida; or equal.
- C. Experience in the design and construction of AWWA D110 Type I, Type III, or Type IV tanks is not an acceptable substitute for the specified Type II tank.

2.02 CONCRETE

- A. Concrete materials including cement, aggregate, water, admixtures, and mix design shall conform to Section 03300 - Cast-In-Place Concrete. Concrete for the tank dome construction shall have a minimum compressive strength of 4,500 psi at 28 days. Concrete for the tank floor, footings, pipe encasement, and other work associated with construction of the tank shall have a minimum compressive strength of 4500 psi at 28 days. All cast-in-place concrete used for construction of the Prestressed Concrete Tank shall meet the requirements of Class A1 concrete in accordance with Specification Section 03300.
- B. Concrete for tank wall and dome construction shall be air entrained.
- C. Concrete or shotcrete in contact with prestressing steel shall have a maximum water soluble chloride ion concentration of 0.06 percent by weight of cement.
- D. Curing materials shall conform to Section 03370, "Concrete Curing".

2.03 FORMWORK

A. Formwork for concrete work shall conform to Section 03100 - Concrete Formwork.

2.04 REINFORCING STEEL (OTHER THAN PRESTRESSING WIRE)

A. Reinforcing bars, welded wire fabric, bar supports, bolsters, chairs, spacers, and tie wire shall conform to Section 03200 - Reinforcing Steel.

2.05 GALVANIZED STEEL DIAPHRAGM

A. Galvanized steel diaphragm used in construction of the core wall shall be 26 gauge with 0.017 min. thickness conforming to the requirements of ASTM A653/A653M. Weight of zinc coating shall not be less than G 90 of Table 1 of ASTM A653/A653M. Steel diaphragm shall be 26 gauge steel complying with ASTM A1008 for commercial quality cold rolled steel.

B. Steel sheet shall be ribbed to provide a mechanical bond to the concrete.

2.06 PRESTRESSING WIRE

A. Circumferential prestressing wire shall conform to ASTM A821 Type B with:

1. Diameter shall be equal to or larger than 0.162 inches (8 gauge), up to a maximum of 0.250 inches
2. f_s wall = 115,000 psi
3. f_{si} = 145,000 psi or no greater than 0.70 f_{su}
4. f_{su} shall be equal to or greater than 231,000 psi

B. Splices and anchor clamps for prestressing wire shall be ferrous material compatible with the wire and shall develop the full strength of the wire. Wire splice and anchorage accessories shall not nick or otherwise damage the prestressing.

C. Contractor shall furnish certified statement from approved independent testing laboratory for wire used.

2.07 SHOTCRETE

A. Shotcrete shall conform to Section 03360 - Shotcrete, and shall have a compressive strength as required by the design, but no less than that stated in Article 3.01, "Design Criteria" of this Section.

B. Shotcrete:

1. f_c shall be equal to or less than 2,000 psi
2. f'_c shall be equal to or greater than 4,000 psi
3. f_{ci} shall be equal to or less than 0.55 f'_c at winding

2.08 WATERSTOP AND BEARING PADS

- A. Waterstop between foundation and core wall shall be PVC, conforming to Section 03250 - Concrete Accessories. Splices shall be made in accordance with the manufacturer's recommendations subject to the approval of the Engineer.
- B. Bearing pads shall be PVC or other material which does not degrade in the presence of chloramines.

2.09 INSULATION

- A. Exterior of precast dome roof shall have 1.5-inch thick spray foam insulation. See Specification 07750 – Spray Foam Roofing System for insulation requirements.
- B. Exterior digester walls shall have 1-inch thick insulation. See Specification 07240 – Exterior Insulation Finish System (EIFS) for insulation requirements.
- C. Tank wall and dome colors shall be coordinated with the Owner. The manufacturer shall provide the Owner with color samples and coordinate the final color selection with the Owner prior to application.

2.10 MISCELLANEOUS TANK ACCESSORIES

- A. The following accessories shall be furnished by the Contractor as indicated on the Drawings:
 - 1. Aluminum stairway approaching the Aluminum center platform (Aluminum center platform to be provided by the mixer manufacturer) at the roof dome. Stairway shall be designed by the tank manufacturer and the platform structural calculations shall be included with the tank structural calculations and shall be signed and sealed by an engineer currently registered in the state of South Carolina. Contractor shall coordinate stairway geometry to create a seamless transition to the mixer-manufacturer-supplied center platform.
 - 2. Aluminum exterior stairs as shown on the drawings, complete with cantilevered intermediate landings. All stairs shall meet the requirements of the standard details and specifications.
 - 3. Aluminum handrail shall be as specified in Section 05520 - Handrails and Railings and shall be located as shown on the drawings.
 - 4. Roof hatches and covers shall be as specified in Section 05531 - Gratings, Access Hatches, and Access Doors.
 - 5. Pipe Connections. Pipe connections through the walls and dome shall be as indicated on the Drawings. Pipe and fittings shall be as specified in the respective piping sections. Extra reinforcement shall be provided around pipe connections, as indicated on the standard concrete details drawing

6. Wall Access Manway: Two 36-inch diameter manways shall be installed in the side wall of each digester as indicated on the Drawings. Each manway, including bolting and cover, shall be designed to withstand the weight and pressure of the tank contents. The manway shall provide a watertight seal. The opening shall be suitably reinforced
7. Roof Manway. Three 30 inch manways shall be installed in the roof of each digester as indicated on the Drawings. The manway shall provide a watertight seal. The opening shall be suitably reinforced.
8. The roof shall include a gas dome with 8-foot, 6-inch linear motion mixer compression ring, 8-inch digester gas connection, (3) 8-inch sample ports and (3) 30-inch manways and (1) 4-inch level transmitter connection as indicated on the Drawings.
9. Pressure relief valves shall be installed on the roof of each digester as indicated on the drawings and as specified in the Digester Gas Safety and Control Equipment section.

PART 3 -- EXECUTION

3.01 GENERAL

- A. Dimensions and structural details shown on the Drawings and specified herein are minimum requirements. The Contractor shall provide whatever additional thicknesses, reinforcing, etc necessary to meet code and structural requirements.

3.02 TANK FLOOR AND FOUNDATION

- A. The concrete tank floor and foundation shall be constructed of Class A1 reinforced cast-in-place concrete containing not less than 0.5 percent reinforcing steel and conforming to all applicable sections of the Contract Documents for concrete and reinforcement as listed herein.
- B. The floor slab shall be designed as a concrete mat foundation not less than 18" thick and shall be placed monolithically. The floor slab shall be thickened as required beneath baffle walls, at sumps, and in other locations specified by the tank manufacturer. Wall footings, if necessary, shall be floor grade and shall be placed monolithically with the floor slab.
- C. The minimum concrete cover over steel reinforcement shall be 2 inches. Where cast directly against grade, the cover shall be increased to 3 inches
- D. The Contractor shall repair all cracks in the tank floor slab at his own expense using a method approved by the Engineer. Concrete floor finish shall be type "E" – Broom or Belt as outlined in specification section 3350.

3.03 CORE WALL

- A. The core wall shall consist of shotcrete placed over a galvanized steel diaphragm and vertical reinforcing.

- B. The diaphragm shall be continuous throughout the core wall providing a positive waterstop.
1. The diaphragm shall be erected plumb and securely anchored and aligned to serve as a shooting form for the shotcrete mortar. The diaphragm shall be so formed and erected that a strong mechanical key between shotcrete and shell will be created.
 2. The diaphragm shall be lapped, interlocked, and completely sealed with an approved epoxy bonding material. Only vertical diaphragm joints shall be used. Lap and interlock all vertical joints using a mechanical crimper. All vertical joints shall be sealed water tight by epoxy injection. This epoxy injection shall be carried out from bottom of the wall to top of wall, using a pressure pumping procedure, after the steel diaphragm has been fully encased, inside and outside, with shotcrete. The diaphragm, crimper, and the epoxy bonding material must have demonstrated suitability through successful use in at least five comparable installations. The final determination of suitability shall be determined solely by the Engineer.
 3. No holes, including nailholes, shall be made in the diaphragm for any purpose, including the purpose of erection, before, during, or subsequent to erection, except for those required for inserting pipe sleeves, reinforcing bolts, or other special appurtenances.
- C. Vertical reinforcing to compensate for shrinkage, temperature, and vertical bending moments in the core wall shall be as follows:
1. The inside face shall consist of the continuous steel diaphragm and reinforcing steel bars as required by design computations.
 2. The outside face shall be as required by design computations, but not less than #4 bars at 12 inches center to center.
- D. A shotcrete coat conforming to Section 03360 - Shotcrete, shall cover and protect the steel diaphragm with a minimum of one inch cover. The final layer of shotcrete on the interior of the tank shall be finished smooth. A broom finish is not acceptable.
- E. Core wall thickness at the top of the tank shall be not less than 3 1/2-inches. Base-of-wall thickness shall be determined by design calculations to resist the initial compressive stresses of the prestressing wire, backfill, and other applicable loads. The wall may taper uniformly on the outside face from top to bottom as required by design thicknesses. Horizontal sections of the wall shall form true circles without flats, excessive bumps, or hollows. Maximum dimension tolerances for core wall construction (including diaphragm as applicable) shall be as follows:

Thickness $\pm 1/4$ inch

Height $1/4$ inch in 100 ft. not to exceed a total of $1/2$ inch

Out-of-plumb $1/4$ inch in 10 ft. of height

Out-of round ± 1 inch per 100 ft. diameter

- F. Unless specifically authorized in writing by the Engineer, concrete shall not be placed without special protection during cold weather when the ambient temperature is below 35 degrees Fahrenheit or when the concrete is likely to be subjected to freezing temperatures before initial set has occurred and the concrete strength has reached 500 psi.
- G. Not used.
- H. Prior to the placement of the mat foundation concrete, all piping that penetrates the floor shall be set.

3.04 HORIZONTAL PRESTRESSING

- A. Circumferential prestressing of the tank walls shall be accomplished by applying continuously and uniformly a prestressing steel wire to the core wall in a helix of such pitch as to provide an initial predetermined force and unit compressive stress in the core wall per lineal foot of height equivalent to that derivable from the Drawings. Splicing of the wire shall be permitted only when terminating an application of one complete coil of wire or in the event a defective section of wire must be removed during application. A machine shall be used for applying the wire, capable of continuously inducing a uniform initial force in the wire as it is laid on the tank wall. Force in the wire shall be induced by methods not dependent on cold working or re-drawing the wire. Only the aggregate force of all stressed wires per foot shall be considered rather than the force per individual wire, and such aggregate force shall not be less than required by the Drawings or specified herein. No circumferential movement of the wire along the tank wall will be permitted during or after stressing of the wire. The steel wire bands on the core wall and dome ring shall be so placed that the prestress "working force" per foot of wall height shall exceed the hydraulic ring tension forces by not less than 5 percent. The "work force" shall be defined as the force determined by multiplying the area of steel wire by the unit wire stress after a substantial allowance for prestress losses due to shrinkage and plastic flow in the shotcrete, relaxation in the steel, creep, etc has been made from the initial unit wire stresses. Such initial unit wire stress readings shall be made the same day the wire is placed, or if made later and after some stress losses have already occurred due to creep of wire, plastic flow, and shrinkage of core wall, allowances shall be made for such losses. The clear space between adjacent wires is to be no less than one wire diameter.
- B. At all openings through the sidewalls, the wires shall be placed equally above and below the opening. The displaced wires will be added to those for a foot or two above and below the opening, leaving an entire strip around the tank which is unbanded. Such unbanded strip shall be no more than 30-inches high. A stress plate shall be required at all above grade locations where prestress wires are displaced 24 inches or greater. The stress plate shall be designed to transfer stress across the opening.
- C. No prestressing wire shall be installed until the shotcrete mortar core wall has been shown by test to have attained 75 percent of the 28-day design compressive strength specified herein. No prestressing wire shall be applied when weather conditions are unfavorable.
- D. Where more than one layer of wire is required, underlayers shall be covered with shotcrete of sufficient thickness to provide approximately 1/8-inch cover over the wire.
- E. Finish covercoat shotcrete shall be applied as soon as practical after the last application of wire coat, see Article 3.07.

- F. Attention is directed to the fact that prestressing wire is susceptible to failure through corrosion. Extreme care shall be used to protect the wire against leakage of water both from within and without the tank.

3.05 STRESS MEASUREMENT

- A. The Contractor shall supply, at his own expense, special equipment at the job site capable of measuring the stress in the wire after it is in placed on the wall. This stress-measuring equipment shall consist of an electronic direct-reading stressometer accurate to within 2 percent, complete with calibrated dynamometers and a test stand to calibrate the stressometer from time to time if necessary.
- B. At least one stress reading per wire wrap, shall be taken immediately after the wire has been applied on the wall. All readings shall be recorded and shall refer to the applicable height and layer of wire for which the stress is being taken. If applied stresses fall below the design stress in the steel, additional wire will be provided to bring the force on the corewall up to the required design force. If the stress in the steel is more than 7% over the required design stress, the wrapping operation should be discontinued, and satisfactory adjustment made to the stressing equipment before proceeding.

3.06 TESTING

A. Leakage Testing

1. The prestressed concrete tank shall be tested for air and water leakage. For tanks containing potable water, leak testing may be concurrent with tank disinfection and shall be as defined herein. For tanks containing non-potable water, leakage testing shall be performed in accordance with Section 01470 Watertightness Testing of Concrete Structures. Air leakage testing shall be performed concurrent with the water leakage test. Compressed air shall be introduced and held stable to within 2 inches of water column of the blowoff valve release pressure. This pressure shall be held for a duration of 2 hours with negligible pressure loss (no compressor connection during hold period). If there are any visible/audible leaks, they shall be repaired and the test shall start over again. Testing should be performed after the application of the MIC coating on the tank interior and prior to the installation of the insulation on the roof exterior. At the engineer's discretion the contractor may be required to apply soapy water to the dome surface to aid in the identification of any leaks.
2. Water for the initial leakage testing, cleaning and, rinsing shall be paid for and provided by the Owner. Water for all subsequent leakage testing should it be required, shall be paid for by the Contractor and provided by the Owner. The Contractor shall reimburse the Owner for all water used at the current rates for water usage. The costs for all chemicals and equipment (pumps, testing kits, etc.) associated with leakage testing, cleaning, or rinsing, of the tank shall be the responsibility of the Contractor. Disposal of water for leak testing, cleaning and, rinsing, shall be the responsibility of the Contractor, performed under the City's General Permit, and shall be performed in accordance with all federal, state and

local requirements in such a manner as to cause no adverse environmental effects such as fish kills or erosion. A water disposal plan shall be submitted to the Engineer prior to tank cleaning and filling.

3. The wire-wound prestressed concrete tank shall be tested for watertightness in accordance with AWWA D110 Section 5.13 upon completion of the tank.
4. The following test shall be applied to determine water tightness:
 - a. Fill the tank with potable water (at the Owner's option) to the maximum liquid level indicated.
 - b. At least 95 percent of the maximum wetted surface area shall be wetted for at least 72 hours to allow for moisture absorption by the concrete or pneumatic mortar.
 - c. The drop in liquid level shall be measured over the next 24 hours. The liquid-volume loss shall not exceed one twentieth of one percent of the tank capacity. Evaporative effects shall be taken into consideration in determining leakage. If leakage exceeds the maximum allowable, the tightness test shall be extended to a total of five days. If at the end of five days, average daily leakage does not exceed the maximum allowable, the test shall be considered satisfactory. If the average daily leakage exceeds the maximum allowable, the Contractor shall repair the tank and retest it at no additional cost to the Owner. The method of repair shall be submitted to the Engineer for approval.
 - d. Damp spots on the exterior wall surface shall not be permitted. Damp spots are defined as spots where moisture can be picked up on a dry hand. The source of water movement through the wall shall be located and permanently sealed in an acceptable manner. No leakage that includes visible flow through the wall-floor joint shall be permitted.

3.07 EXTERIOR COVERCOAT

- A. After circumferential prestressing wires have been placed by a wire winding machine, the wires shall be covered with shotcrete conforming to Section 03360 - Shotcrete, or equivalent, that will provide a minimum thickness over the wire of 1 inch. The shotcrete shall be applied such that shotcrete does not build up or cover the front face of the wire until the spaces behind and between the prestressing elements are filled.

- B. The exterior overcoat shall have a smooth finish meeting the following tolerances:

Vertical alignment in any 10 feet of length	1/8 in.
Horizontal curvature in 10 feet	1/4 in.

3.08 TANK ACCESSORIES

- A. Tank accessories shall be furnished by the Contractor as shown on the Drawings and specified in other sections of the Specifications.

3.09 MIC Coating

- A. The interior of the prestressed concrete tank shall be coated in conformance with specification section 09802 – Polyurethane MIC Coatings at locations indicated on the structural drawings.

3.10 START-UP SERVICES

- A. The Contractor shall furnish the services of the manufacturer's technical representative to inspect and correct or supervise correction of any defects or malfunctions and furnish start-up services. The Contractor shall provide qualified technical representative(s) to inspect the completed installation. Costs to check the installation shall be included in the purchase price of the equipment. The manufacturer's technical representative shall be available for system start-up, performance tests, and operating instructions for not less than a 2-day period.

3.11 FINAL INSPECTION

- A. On or near the one-year anniversary date of initial tank use the manufacturer's representative shall make a visual inspection of the tank exterior and appurtenances and the immediate area surrounding the tank. A written summary of this inspection shall be filed with the tank owner and the tank manufacturer.

- END OF SECTION -