DIVISION 13

SPECIAL CONSTRUCTION

SECTION 13136 - ALUMINUM FLAT COVERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Labor, materials, and equipment necessary for fabrication and production of the items specified in this Section as shown on Drawings or listed on Schedule.

1.02 REFERENCES

A. Reference Standards:
   1. ASTM C 509, Standard specifications for cellular elastomeric pre-formed gasket and sealing material.
   2. ASTM C 864
   3. Aluminum Association, Specifications for Aluminum Structures.
   4. Aluminum Association, Aluminum Standards and Data.
   5. ANSI/AWS D1.2, Aluminum Structural Welding Code.
   6. ASCE 8, Specification for the design of cold-formed stainless steel structural members.
   7. ASCE 7, Minimum design loads for buildings and other structures.
   8. ASTM F 593, Standard specification for stainless steel bolts.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:
   1. The flat aluminum covers shall be self-supporting from the peripheral structure without using support trusses, unless supplemental aluminum framing support is shown on plan.
   2. All flat cover systems shall consist of removable panels each weighing no more than 150 pounds. The required lifting force per panel shall not exceed the dead weight of the panel.
   3. Flat aluminum panels shall be made from extruded panels:
      a. Extruded Panel: panels shall be fully extruded with sealed welded or bolted caps on the short end of the cover. The cover shall be interlocking flat panel shape, designed for maximum stresses.
      b. Panels shall be designed and constructed for maximum stresses occurring during fabrication, erection, and operation. All materials shall be new in both workmanship and materials shall be of the very best quality, entirely suitable for the service to which the covers are to be subjected.
   4. All areas are designated for “Regular Foot Traffic”.

B. Areas Designated for Regular Foot Traffic: Areas of the cover, identified as “Regular Foot Traffic” on the contract drawings, must meet the following:
   1. Covers shall be extruded aluminum panels.
   2. The cover shall consist of removable panels each weighing no more than 150 pounds. The required lifting force per panel shall not exceed the dead weight of the panel.
   3. All metal components of the flat cover shall be aluminum or 300 series stainless steel. No galvanized, aluminized, painted, or plated steel shall be used anywhere in the cover. Dissimilar materials in the supporting structure shall be isolated from the aluminum cover by means of a compatible elastomeric gasket.
   4. The aluminum panels shall be designed for a 100 psf uniform live load or 300 pound concentrated live load distributed over one square foot at any location. This load is to be taken as acting separately and not simultaneously with other design loads.
   5. For the above loads and load combinations specified herein, the deflection of all components (structural and cladding) shall not exceed L/240 with L equal to the span of the component. This deflection limit applies to the decking of the cover spanning between the supporting edges of each panel, module, or plate. Calculations stamped by a registered Professional Engineer in the state of Kentucky shall be provided at the time of

submittal to ensure that this requirement has been met and verifying all cover design requirements.

6. Covers shall be extruded panels with slip resistant surface of manufacurers standard design. All necessary walkway supports shall be provided by the cover manufacturer and shall either be integral with the cover itself, mounted to, or embedded in the concrete structure.
7. Extruded panels shall have an integral bi-directional slip resistant surface which extends a minimum of 0.1-inch above the panel surface. For all panels, raised surfaces without the use of texturing to achieve slip resistance are not acceptable. The use of paint, non-skid tape, sandblasting, or other applied systems to achieve the slip resistant surface is expressly prohibited.
8. Walkway components shall be fabricated in easily removable sections where shown and be fabricated to fit with equipment or piping where necessary.Checkered plate is an acceptable surface but must be incorporated as to meet the stated removability, maximum weight for an individual panel and all load conditions.

C. Design requirements to sustain load combinations in accordance with ASCE 7 (ANSI A-58.1) and local building codes shall be according to the structural design criteria on sheet S-0001 and the additional loads specified in the following:
   1. Design requirements for vacuum pressure shall be 2.0 inch water column.

D. The dead load (weight) of the cover shall not exceed 4.5 pounds per square foot of surface area.

E. Snow loads shall calculated in accordance with ASCE 7 and local building codes, refer to sheet S-0001, or use Pg = 15 psf, whichever is higher.

F. The load combinations referred to above shall be considered for a temperature change of 100 degrees F below the installation temperature and 100 degrees F above the installation temperature, and for a material temperature range of –40 to 160 degrees F.

1.04 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawings shall include:
   1. General arrangement drawings.
   2. Sections and details.
   3. Anchor bolt and support bearing detail drawing.
   4. Flashing details.
   5. Component and accessory details.
   6. Material data sheets.
   7. Connection details.

B. Design Data: Structural calculations for all components shall be provided by equipment manufacturer. Design calculations and Drawings must be approved and stamped by a registered Professional Engineer in the state of Kentucky. Calculations submitted shall be for record purposes. Panels should be treated as simple beams and checked for stresses. Panel Mechanical Properties analyzed shall include area, centroid, moments of inertia, and radii of gyration.

C. Test and Inspection Report: A written report shall be submitted to Engineer documenting testing and/or inspection results.
   1. Records certifying the satisfactory inspection of all welds of aluminum structural components shall be submitted prior to delivery of the fabricated materials.

D. Record Drawings: At Project closeout, submit record drawings of installed products, in accordance with requirements of Section 01785.

E. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01780, operation and maintenance manuals for items included under this Section.

F. Warranty: Submit in accordance with requirements of Section 01782, warranties covering the items included under this Section.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of equipment, of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years.

1.06 DELIVERY STORAGE AND HANDLING

A. Packaging and Shipment: Manufacturer shall deliver the cover in the largest pieces practical for field assembly by Contractor. Individual pieces shall be permanently tagged and cross-referenced with information on manufacturer's erection and assembly drawings.

B. Storage and Protection:
   1. Contractor shall be responsible for protecting and maintaining the stored materials in accordance with manufacturer's recommendations.
   2. Materials shall be stored on pallets or other wooden supports providing for proper support and drainage. Pallets or other supports shall be off the ground and level to prevent warping or fracturing of the parts.

C. Product Handling: All components, parts, and accessories of each cover shall be adequately protected during transportation, in storage at the Site, and during subsequent assembly and installation activities. Damaged components will be rejected and shall be replaced with undamaged units or repaired to the satisfaction of Engineer, at no additional cost to Owner.

1.07 PROJECT CONDITIONS

A. Field Measurements: Check actual dimensions of walls, tank size and roundness, and other construction dimensions to which fabrications must fit, by verifying field measurements before fabrication; show recorded measurements on final Shop Drawings.
B. Contractor to field verify that there will be no conflicts with the operation of any equipment or water flow.

1.08 WARRANTY

A. Manufacturer shall furnish a warranty of the fabricated cover for materials and workmanship for no less than 3 years after installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
   1. Aluminum Flat Equipment:
      a. CST Covers Industries, Inc., Conroe, Texas
      b. HMT, Inc. Grand Haven, MI
      c. Hallsten Corporation

2.02 MATERIALS OF CONSTRUCTION

A. All aluminum alloys shall be as defined by the Aluminum Association and published in the Aluminum Standards and Data.

B. All bolts and fasteners shall be 6061-T-6 or 7075-T73 aluminum, or Series 300 stainless steel.

C. Plates and sheet material shall be aluminum alloy 3003-H16, 3105-H154, 6061-T6 or 5052-H32, mill finish AA-M10 as fabricated.

D. Aluminum structural shapes shall be Alloy 6061-T6 or 6063-T6.

E. Miscellaneous aluminum shapes shall be Alloy 6061-T6 or 6063-T6.

F. All gaskets shall be neoprene conforming to ASTM C 509, ASTM C 864, or silicone, resistant to ozone and shielded from exposure to ultraviolet light.

G. All sealants shall be resistant to ozone and ultraviolet light.

H. No galvanized or plated steel shall be used anywhere in the cover.

I. Dissimilar materials in the supporting structure shall be isolated from the aluminum cover by means of a compatible elastomeric gasket.

2.03 CONNECTIONS

A. Standard bolted connections shall be made with locknuts and flat washers and designed to sustain resultant shear and tension stresses of the individual fasteners. Fastener allowable stresses shall not exceed the published yield stress divided by the factor of safety as published by the Aluminum Association.

2.04 WELDS

A. The design and fabrication of welded aluminum parts shall be in accordance with Section 7 of the Aluminum Association's Specifications for Aluminum Structures, and the American Welding Society D1.2-90 Structural Welding Code for Aluminum. All structural welds and weld-affected structural components shall be inspected by the Dye Penetrant method of examination in accordance with AWS D1.2, Section 6. All structural welding of aluminum shall be performed prior to field erection of the cover. A full set of satisfactory examination records shall be delivered to Owner prior to the delivery of the fabricated material.

2.05 FLASHING

A. For formed panel systems that require flashing the aluminum flashing shall be provided at the base of the cover. Flashing shall be of the same material as the cover panels.

2.06 COVER FEATURES

A. Cover design shall allow for easy removal of the cover panels. For the removal of a single panel not more than the two adjacent panel(s) shall be required to be removed.

B. The entire cover and its connection to the periphery structure (tank wall) shall be designed as a substantially watertight and airtight system under all design load conditions and specified temperature conditions. The design shall prevent water pooling at the joints and shall be designed for drainage from the cover surface. Gaskets or insulating compounds shall be used for separation of dissimilar metals.

C. Shop-fabricate cover penetrations. Reinforce around cover penetrations and provide a flanged pipe sleeve extension to 6 inches above the cover. Permanently attach sleeve to cover to produce a

weathertight connection. Limit size of openings to not more than 1 inch greater than the shaft or pipe outside diameter.

D. Duct and piping connections larger than 2” shall be flanged and extend 6 inches above the cover surfacePipe connectoions 2” and smaller shall extend 4 inches above the cover surface with minimum Schedule 10 wall thickness and having diameter as specified on Equipment Schedule or as shown on Drawings. Duct and pipe shall penetrate and be rigidly attached to the cover panel. All joints between the duct and panel shall be reinforced, gasketed, and permanently sealed weathertight and airtight.

E. Provide manufacturer standard hatches and curb. All hatches to be hinged for quick access to the tank. Hatches shall have the same properties and meet the same design criteria as the aluminum panels.

F. Cover shall accommodate all ductwork, access hatches, vents, and access to equipment.

2.07 SOURCE QUALITY CONTROL

A. Shop Tests, Inspections:
   1. All fabrication shall be carefully inspected at the site of fabrication by factory inspectors who shall ensure the proper fit of all field connections and compliance with all material and fabrication requirements of the Specifications.

PART 3 - EXECUTION

3.01 ERECTION

A. Contractor shall furnish all personnel, tools, equipment, and materials required to erect the cover panels using the recommended procedure set forth by manufacturer. Furnish suitable lifting equipment to assemble and install each cover.

B. When installation of cover has been completed and all connections have been made, all exterior surfaces of each cover shall be thoroughly cleaned in accordance with manufacturer's recommendations.

C. Equipment provided under this Section shall be fabricated, assembled, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of manufacturer approved by Engineer.

D. Field refabrication of structural components or panels will not be accepted. Forcing of the structure to achieve fit-up during erection is not acceptable.

E. Interface with Other Products: Cover manufacturer shall provide installation Drawings and instructions to Contractor prior to installation.

F. Contractor shall verify all dimensions with manufacturer of equipment listed on Schedule.

G. Surface Preparation: On tank structures, examine the walls to receive the cover and complete surface preparation, or repair concrete surface as needed to allow proper installation.

3.02 FIELD QUALITY CONTROL

A. Installation and erection shall be performed by the Manufacturer’s employees or by their Certified installers. Manufacturer shall provide a letter of certification that acknowledges that the installer has been fully trained and has installation experience for covers similar to those proposed. Installation

shall be in accordance with OSHA, local safety regulations, and meet the Manufacturer's requirements to insure full product warranty.

B. Third party installers will be permitted provided that the Manufacturer provides full-time, onsite supervision throughout the installation. The Manufacturer's Supervision shall be responsible for instruction of proper erection and installation of the cover and shall supervise the third party work force until the cover installation is complete. The Manufacturer shall perform an onsite inspection and provide written acceptance of the installation. Contractor shall be responsible to repair or replace any item that is deemed unacceptable by the Manufacturer's inspector.

C. The total minimum manufacturer-supplied services shall be 2 days with 1 trip to the Site. Additional trips may be required to aid in the installation, to troubleshoot the system, and provide modifications to bring the system to within specified parameters.

D. Installation Check: Manufacturer shall provide the services of a factory-trained representative to check the installation of all equipment installed in this Section.
   1. The services shall include checking the equipment prior to installation, to review installation procedures, and following installation, to inspect, check, and adjust if necessary, and approve the equipment installation.
   2. Certification that the specified material alloys, sizes, and quantities have been furnished shall be submitted prior to final acceptance of the cover.
   3. The total minimum manufacturer-supplied services shall be 2 days with 1 trip to the Site. Additional trips may be required to aid in the installation, to troubleshoot the system, and provide modifications to bring the system to within specified parameters.

E. Field Load Testing. Following completion of cover installation, closure panels of each cover shall be field load tested by Contractor and Manufacturer.
   1. At least 2 closure panels, as selected by Engineer, shall be load tested. One panel shall be subjected to 2 concentrated loads, consisting of cloth sacks of suitable size, containing earth or sand, applied simultaneously on 2 separate 1-square-foot areas of the test panel. Each concentrated load shall be not less than 1.5 times the concentrated closure panel design load specified. The second test panel shall be subjected to a uniform test load of 1.5 times the specified uniform closure panel design load applied over the entire surface of the panel.
   2. The test panels shall withstand the specified field test loads without damage, slippage, or permanent distortion. If either test panel fails to meet the specified requirements, all closure panels shall be removed, replaced with new panels, and selected panels retested. Panel removal, replacement and retesting shall be performed at no additional cost to Owner.

END OF SECTION

SECTION 13200 - PRESTRESSED CONCRETE STORAGE TANK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section specifies the design and construction of an AWWA D110 Type II or III, wire-wound prestressed concrete storage tank with galvanized steel diaphragm complete including all reinforcing, concrete work, accessories, cleaning and testing directly related to the tank.

B. The tank construction company is responsible for furnishing all labor, materials, tools and equipment necessary to design and construct the prestressed concrete storage tank and foundation as indicated on the drawings and as described in this specification.

1.02 REFERENCES

A. ACI 301/301M-10 – Specifications for Structural Concrete for Buildings.

B. ACI 305R-10 – Guide to Hot Weather Concreting.

C. ACI 306R-10 – Guide to Cold Weather Concreting.

D. ACI 347R-04 – Guide to Formwork for Concrete.

E. ACI 350/350R-06 – Code Requirements for Environmental Engineering Concrete Structures and Commentary.

F. ACI 350.3-06 – Seismic Design of Liquid-Containing Concrete Structures and Commentary.

G. ACI 372R-03 – Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures.

H. ACI 506R-05 – Guide to Shotcrete.

I. ACI 506.2-13 – Specification for Shotcrete.

J. ACI SP4: Formwork for Concrete.

K. ANSI/AWWA C652-11 – Disinfection of Water Storage Facilities.

L. ANSI/AWWA D110-04 – Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks.

M. ASCE Standard 7-10 – Minimum Design Loads for Buildings and Other Structures.

N. ASTM A416/A416M-12a – Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.

O. ASTM A615/A615M-12 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

P. ASTM A653/653M-11 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by Hot Dip Process.

Q. ASTM A821/A821M-10 – Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks.

R. ASTM A882/A882M-04(2010) – Standard Specification for Filled Epoxy-Coated Seven-Wire Prestressing Strand.

S. ASTM A884/A884M-12 – Standard Specification for Epoxy Coated Steel Wire and Welded Wire Reinforcement.

T. ASTM A1064/A1064M-12 – Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

U. ASTM C31/C31M-12 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.

V. ASTM C33/C33M-13 – Standard Specification for Concrete Aggregates.

W. ASTM C39/C39M-12a – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

X. ASTM C143/C143M-12 – Standard Test Method for Slump of Hydraulic-Cement.

Y. ASTM C172/C172M-10 – Standard Practice for Sampling Freshly Mixed Concrete.

Z. ASTM C231/C231M-10 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

AA. ASTM C881/C881M-10 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

BB. ASTM D1056-07 – Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.

CC. "Earthquake Induced Sloshing in Tanks with Insufficient Freeboard" by P.K. Malhotra, Structural Engineering International, IASBSE, 3/2006 pp 222-225.

1.03 SUBMITTALS

A. Prequalification Data: Unless the tank construction company is listed in Section 1.04.B.3, provide prequalification data prior to the bid in accordance with Section 1.04 B. of this specification.

B. Shop Drawings: Provide shop drawings with a minimum size of 18" x 24" with a complete plan, elevation, and sectional views showing critical dimensions as follows:

1. Size, location and number of all reinforcing bars.

2. Thickness of all parts of the tank structure including floor, core wall, dome, and covercoat.

3. Prestressing schedule including number and placement of prestressing wires on the tank wall and total applied force per foot of wall height.

4. Location and details of all accessories required.

C. Concrete Data: Submit concrete design mixes including ingredient proportions, minimum cementitious content, and water/cementitious ratio in accordance with Section 2.02 and 2.03 of this specification.

D. Design Data: Submit structural calculations for the tank and foundation, signed and sealed by a professional engineer in accordance with Section 1.04 A.3 of this specification.

E. Coating Data: Submit color charts for review by the engineer and owner. Once a color is chosen, submit actual drawdown samples for final approval prior to application of coating.

F. Test Reports: Submit concrete strength reports for 7-day and 28-day breaks taken in accordance with the requirements of Section 3.03 A.1.

G. Warranty Document: Submit warranty document in Owner's name in accordance with Section 1.05 A. of this specification.

H. Project Record Documents: Record actual location layout and final configuration of tank and accessories on shop drawings and submit to engineer after construction of the tank is complete.

1.04 QUALITY ASSURANCE

A. Qualifications and Experience

1. Tank Construction Company: Shall be a firm with ten years of experience in the design and construction of ANSI/AWWA D110 Type II or III wire-wound, circular prestressed concrete tanks with satisfactory evidence that it has the skill, reliability, and financial stability to build and guarantee the tank in accordance with the quality required by these specifications. The tank construction company shall have built completely in its own name in the past five years, and be presently responsible for, a minimum of five (5) dome-covered prestressed composite tanks of equal or greater size than that required for this project which meet these specifications and are now providing satisfactory service.

2. Construction: The entire tank, including all portions of the floor, wall, and roof shall be built by the tank construction company, using its own trained personnel and equipment.

3. Design: All design work for the tank shall be performed by a professional engineer with no less than five years of experience in the design and construction of ANSI/AWWA D110 Type II or III wire-wound, circular prestressed concrete tanks. The professional engineer shall be a full-time staff member of the tank construction company and shall be licensed to work in Kentucky.

4. The diaphragm design and epoxy injection procedure shall have been used in the five tanks required in Section 1.04 A.1 of this specification.

B. Prequalification

1. All tank construction companies must be prequalified and meet the criteria stated in Section 1.05 A.1 of this specification to be considered an acceptable tank construction company.

2. A complete prequalification package shall be submitted to the Engineer for consideration 14 days prior to the date set for receipt of bids. The prequalification submittal shall include the following items:

a. Complete construction drawings showing the principal sizes, thicknesses, reinforcing size and spacing for all structural members including: floor, wall, dome shell and dome edge.

b. Complete details of other structural appurtenances as required by the project drawings showing principal sizes, thickness and reinforcing sizes and spacing.

c. Complete design calculations which address applicable loads provided in Section 1.06 B. of this specification.

d. Complete experience record for the tanks used to meet the experience requirement of Section 1.04 A. of this specification that have been designed and built in the tank

construction company's own name. The record shall include the size of the tank, Type (II or III), name, address and telephone number of the Owner, the year of construction and the name and telephone number of the Engineer for the project.

e. Construction schedule which details the duration for tank construction.

3. The following are preapproved as acceptable tank construction companies:

a. The Crom Corporation, Gainesville, Florida.

b. Precon Corporation, Newberry, Florida.

c. Preload, Incorporated, Louisville, Kentucky.

C. Tank Type

1. The tank construction company shall construct the type of tank (Type II or III) for which they meet the qualifications and experience listed in Section 1.04.A above.

1.05 WARRANTY

A. Provide a warranty document for workmanship and materials on the complete structural portion of the tank for a five-year period from the date of acceptance of the work. In case leakage or other defects appear within the five-year period, the tank construction company shall promptly repair the tank at its own expense upon written notice by the Owner that such defects have been found. Leakage is defined as a stream flow of liquid appearing on the exterior of the tank or areas on the wall or footing where moisture can be picked up on a dry hand, the source of which is from the inside of the tank. The tank construction company shall not be responsible for, nor liable for, any subsurface condition. This warranty shall not apply to any accessory, equipment or product that is not a structural part of the tank and is manufactured by a company other than the tank construction company.

1.06 DESIGN CRITERIA

A. The design shall be in conformance with applicable portions of American Concrete Institute (ACI) 372R Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, ANSI/AWWA D110 Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks, and currently accepted engineering principles and practices for the design of such structures.

B. The following loadings shall be utilized in the design:

1. Capacity: 22 Million Gallons

2. Dimensions: 260 ft Inside Diameter
57.7 ft Water Depth

3. Fluid Loads: Shall be the weight of all liquid when the reservoir is filled to capacity. The unit weight of the liquid material shall be 62.4 lbs/ft^3.

4. Roof Live Loads: Consideration shall be given to all applicable roof design live loads in accordance with ANSI/AWWA D110, Section 3.03 and ASCE 7. The minimum roof live load for the structure shall be 20 psf, non-reducible.

5. Roof Snow Loads: Consideration shall be given to all applicable roof design snow loads in accordance with ANSI/AWWA D110, Section 3.03 and ASCE 7. The minimum roof snow load for the structure shall be 19 psf.

6. Dead Loads: Consideration shall be given to all permanent imposed loads including concrete and steel.

7. Seismic Loads

    a. Seismic forces and moments resulting from water sloshing and seismic accelerations of the tank dome, wall, and water loads shall be calculated in accordance with ACI 350.3 or ANSI/AWWA D110.

    b. If sufficient freeboard height is not provided to prevent uplift forces due to sloshing, the impulsive participation shall be increased due to the constrained motion of liquid, and the tank roof and its connection shall be designed to resist the uplift forces in accordance with P.K. Malhotra's "Earthquake Induced Sloshing in Tanks with Insufficient Freeboard".

8. Soil Pressure: Earth loads shall be determined by rational methods of soil mechanics. Soil pressure shall not be used in the design of the core wall to counteract hydraulic loads or provide residual compression in the wall.

9. Differential Backfill Loads: Forces from differential backfill loads shall be considered in the design and shall be based on the at-rest coefficient. Passive resistance shall not be used to resist differential backfill loads.

10. Wind Loads: Wind loads shall be considered in the design in accordance with ASCE 7.

C. Tank Foundation and Membrane Slab: The design of the concrete wall foundation and membrane slab for the prestressed concrete tank shall conform to the following:

1. Concrete slab shall contain a minimum reinforcing steel amount equal to 0.50% of the gross cross sectional area, unless noted otherwise on the Contract Drawings. Slab reinforcing steel shall be placed orthogonally.

2. Minimum reinforcing bar size shall be #4 bar.

3. Maximum spacing of reinforcing steel for the wall foundation and membrane slab shall be 12 inches.

4. In no case shall the dimensions and reinforcing steel for the wall foundation and slab be less than the following:

    a. Minimum wall foundation thickness at slab perimeter: 28 inches
    b. Minimum slab thickness: 6 inches
    c. Minimum slab reinforcing steel: #5 @ 10” o.c. (2” from top)

5. Circumferential steel shall be added to the wall foundation and transition to membrane slab as required. Circumferential steel required shall be calculated by any rational analysis with a minimum required amount of 0.75% placed in a minimum width of 5'4". Minimum circumferential steel shall be distributed with 2/3 of the total area in the top face and 1/3 in the bottom face.

6. Radial steel shall be added to the top and bottom mats of the wall foundation and transition to membrane slab to account for edge effects in the circular plate. Edge effects shall be calculated by any rational analysis which considers these effects, but in no case shall be less than:

    a. Top radial bar: #5@12” o.c.

    b. Bottom radial bar: #5@12” o.c.

D. Core wall

1. The wire-wound, prestressed concrete tank core wall shall be designed as a thin shell cylindrical element using shotcrete and an embedded, mechanically bonded, galvanized steel shell diaphragm.

2. The design of the core wall shall take into account appropriate edge restraint. To compensate for bending moments, shrinkage, differential drying, and temperature stresses, the following minimum reinforcing steel shall be incorporated into the design:

    a. The top 2' of core wall shall have not less than 1% circumferential reinforcing.

    b. The bottom 3' of core wall shall have not less than 1% circumferential reinforcing.

    c. Inside Face

        (1) The inside face of the core wall shall utilize the diaphragm as effective reinforcing.

        (2) Additional vertical and horizontal reinforcing steel bars shall be used as required by design computations.

    d. Outside Face

        (1) Vertical reinforcing steel in the outside face of the core wall shall be: minimum of #4 bars at 12" center to center.

        (2) Additional vertical and horizontal reinforcing steel bars shall be used as required by design computations.

3. The minimum core wall thickness shall be 3½" (Type II) or 4" (Type III).

4. Reinforcing steel used in the core wall shall be designed using a maximum allowable design tensile stress, f_s, of 18,000 psi.

5. Allowable compressive stress in the core wall due to initial prestressing force, f_{gi}, shall meet the requirements of AWWA D110 for the type of core wall proposed (Type II or III) and in no case exceed 2250 psi.

6. Allowable compressive stress in the core wall due to final prestressing force, f_g, shall meet the requirements of AWWA D110 for the type of core wall proposed (Type II or III) and in no case exceed 2025 psi.

E. Dome

1. The dome roof shall be constructed of reinforced concrete and shall be circumferentially prestressed.

2. Dome shell reinforcement shall consist of reinforcing bars or welded wire fabric meeting ASTM A1064/A1064M, not galvanized. Bolsters for wire fabric and reinforcing bars shall be plastic. Wire ties shall be galvanized.

3. The dome ring girder shall be prestressed with sufficient wire to withstand the dome dead load and design live loads. The ring girder shall have cross section suitable to accept the applied prestressing forces.

4. The high water level in the tank shall be permitted to encroach on the dome shell no higher than the upper horizontal plane of the dome ring girder.

5. Overflow outlets or the overflow pipe shall be capable of providing an overflow open area three times the area of the largest influent pipe.

6. Overflow outlets plus the dome ventilator shall be capable of providing an open area three times the area of the largest pipe.

7. The dome shall be designed as a free-span, spherical thin shell with one-tenth rise in accordance with the following:

   a. Typical Dome Design: The typical dome thickness and steel reinforcement shall meet the requirements of ANSI/AWWA D110.

   b. In all cases, the thickness of the dome shall be no less than 6".

   c. Dome Edge Design: The dome edge and upper wall shall be designed to resist the moments, thrusts, and shears that occur in this region due to dome and wall prestressing and loading conditions. The design of the edge region shall conform to the following:

      (1) Dome Edge Thickness

         (a) A determination of the buckle diameter shall be made, as defined by:

$$d_b = 2.5 \cdot \sqrt{r_d \cdot t_d}$$ rounded up to the next foot

Where: d_b = buckle diameter in feet

r_d = dome radius in feet

t_d = typical dome thickness in feet

         (b) Dome edge thickening shall begin at a radial location on the dome, defined as s_2 which is at least one buckle diameter away from the tank wall.

         (c) A springline haunch shall be provided, which extends radially from the inside face of the tank wall to radial location s_1 which is defined as:

$$s_1 = 0.6 \cdot \sqrt{1.5 \cdot r_d \cdot t_d}$$ rounded up to the next foot

Where: s_1 = distance from inside face of wall to haunch in feet

s_2 = distance from inside face of wall to typical dome thickness in feet.

This springline haunch shall begin at the inside face of the tank wall with a springline thickness as required by paragraph (f) below and shall end at radial location s_1 with the following thickness:

$$t_{d1} = 1.33 \cdot t_d$$

Where: t_{d1} = minimum thickness at s_1 in feet

t_d = typical dome thickness in feet at one buckle diameter from tank wall

         (d) Beginning at s_1 and continuing to s_2 the dome shell shall have a uniform straight line taper.

         (e) Parameters (b), (c), and (d) above are not required for domes where the calculated typical dome thickness is less than 75% of the actual typical dome thickness.

(f) Sufficient concrete thickness at the springline of the dome shall be provided so that no more than 2' of the springline haunch is considered in calculating the effective dome edge ring cross sectional area. Compressive stress in this area shall not exceed 1000 psi when subjected to initial prestressing, offset by dead load only.

(2) Dome Edge Steel Reinforcement

(a) Throughout the dome edge, the percentage of steel reinforcement, both radially and circumferentially, shall be no less than 0.25% of the gross cross sectional area of concrete.

(b) Along the dome edge, steel reinforcement shall be distributed between the upper and lower layers unless finite element analysis calculations indicate that tensile stress does not exist in the concrete along the bottom face of the dome edge. In that case, only top bars are required radially and circumferentially. In addition, radial and circumferential reinforcing bars will not be required along the bottom face of the dome edge where the calculated typical dome thickness is less than 75% of the actual typical dome thickness.

(c) Where reinforcing bars are required in the bottom layer, they shall be placed near the tank wall to insure adequate development at the intersection between dome and wall.

(d) In all cases, the percentage of circumferential steel reinforcement in the effective dome ring shall be no less than one percent of the gross cross sectional area of concrete. The effective dome ring is defined as ¼ of the haunch length not to exceed 2'.

(e) Where bottom dome edge steel reinforcement is required, vertical steel reinforcement along the inside face of the tank wall shall be no less than 0.5% of the cross sectional area of wall shotcrete.

F. Prestressing

1. Circumferential prestressing of the tank shall be achieved by the application of cold-drawn, high-carbon steel wire complying with ASTM A821/A821M Type B, placed under high tension.

2. The prestressing design shall conform to the following minimum requirements of AWWA D110 for the type of core wall proposed (Type II or III).

G. Wall Openings

1. When it is necessary for a pipe to pass through the tank wall, the invert of such pipe or sleeve shall be no less than 18" above the floor slab, and the prestressing wires required at the pipe elevation shall be distributed above and below the opening leaving an unbanded strip around the entire tank.

2. Unbanded strips shall have a vertical dimension of no more than 36" unless an axi-symmetric shell analysis is performed to account for compressive forces plus shear and moments caused by displacement of the prestressing wires into adjacent bands.

PART 2 PRODUCTS

2.01 PERFORMANCE

A. Performance of the materials used in the tank construction shall conform to the minimum requirements of this specification.

B. Substitutions to the materials in this specification may only be made if submitted in writing and approved by the engineer.

2.02 CONCRETE

A. Concrete shall conform to ACI 301/301M.

B. All concrete shall utilize Type I/II Portland cement.

C. A maximum of 25% of cementitious material may be fly ash.

D. Admixtures other than air-entraining and water reducing admixtures will not be permitted unless approved by the engineer.

E. Coarse and fine aggregate shall meet the requirements of ASTM C33/C33M.

F. Concrete mixes used in the construction of the tank shall conform to the following:

Mix	Compressive Strength (psi)	Minimum Cement Content (lbs)	Maximum Aggregate Size (in)	Maximum W/C Ratio	Air Content (%)	Slump (in)
Floor	4000	560	¾	0.45	6 +/- 1.5	4"+/-1"
Dome	4000	600	⅜	0.45	6 +/- 1.5	4"+/-1"

2.03 SHOTCRETE

A. Shotcrete shall conform to the requirements of ACI 506.2 except as modified herein.

B. All shotcrete mixes shall utilize Type I/II cement.

C. A maximum of 25% of cementitious material may be fly ash.

D. All shotcrete in contact with diaphragm or prestressing wire shall be proportioned to consist of not more than three parts sand to one part Portland cement by weight. All other shotcrete shall be proportioned to consist of not more than four parts sand to one part Portland cement by weight.

E. Admixtures will not contain more than trace amounts of chlorides, fluorides, sulfides or nitrates.

F. Shotcrete mixes used in the tank construction shall conform to the following:

Mix	Compressive Strength (psi)	Maximum W/C Ratio	Air Content (%)	Slump (in)	Fiber Reinforcement (lbs/cyd)
Core Wall	4000	0.42	6 +/- 1.5	4"+/-1"	-
Covercoat	4000	0.42	6 +/- 1.5	4"+/-1"	

2.04 PRESTRESSED REINFORCEMENT

A. The prestressing wire shall conform to the requirements of ASTM A821/A821M, Type B.

B. The prestressing wire size shall be 0.162" (8 gauge), 0.192" (6 gauge) or larger, but no larger than 0.250".

C. The ultimate tensile strength, fu shall be, 231,000 psi or greater for 8 gauge wire, 222,000 psi or greater for 6 gauge.

D. Splices for horizontal prestressed reinforcement shall be ferrous material compatible with the reinforcement and shall develop the full strength of the wire.

2.05 NON-PRESTRESSED REINFORCEMENT

A. Non-prestressed mild reinforcing steel shall be new billet steel meeting the requirements of ASTM A615/A615M-12 with a minimum yield strength, f_y, of 60,000 psi.

B. Welded wire reinforcing shall be plain wire conforming to the requirements of ASTM A1064/A1064M with a minimum yield strength, f_y, of 65,000 psi.

2.06 GALVANIZED STEEL DIAPHRAGM

A. The galvanized steel diaphragm used in the construction of the core wall shall be 26 gauge with a minimum thickness of 0.017 in. conforming to the requirements of ASTM A653/A653M. Weight of zinc coating shall be not less than G 90 of Table 1 of ASTM A653/A653M.

B. The diaphragm shall be formed with re-entrant angles and erected so that a mechanical key is created between the shotcrete and diaphragm.

C. The diaphragm shall be continuous from bottom to top of wall; horizontal joints or splices will not be permitted.

D. All vertical joints in the diaphragm shall be rolled seamed, crimped and sealed watertight using epoxy injection.

E. In all tanks designed to use a waterstop at the floor/wall joint, the steel shell diaphragm shall be epoxy bonded to the waterstop.

2.07 PVC WATERSTOPS, BEARING PADS AND SPONGE FILLER

A. Plastic waterstops shall be extruded from an elastomeric plastic material of which the base resin is virgin polyvinyl chloride.

B. The profile and size of the waterstop shall be suitable for the hydrostatic pressure and movements to which it is exposed.

C. Bearing pads used in floor/wall joints shall consist of neoprene, natural rubber or polyvinyl chloride.

D. Sponge filler at the floor/wall joint shall be closed-cell neoprene.

2.08 EPOXY

A. Epoxy Sealants

1. Epoxy used for sealing the diaphragm shall conform to the requirements of ASTM C881/C881M.

2. Epoxy used for sealing the diaphragm shall be, Type III, Grade 1, and shall be a 100% solids, moisture insensitive, low modulus epoxy system.

3. When pumped, maximum viscosity of the epoxy shall be 10 poises at 77°F.

4. The epoxy sealants used in the tank construction shall be suitable for bonding to concrete, shotcrete, PVC and steel.

B. Bonding Epoxy

1. Epoxy resins used for enhancing the bond between fresh concrete and hardened concrete shall conform to the requirements of ASTM C881/C881M.

2. Epoxy resins shall be a two-component, 100% solids, moisture-insensitive epoxy and shall be Type II, Grade 2.

2.09 SEISMIC RESTRAINT CABLES

A. When required by design, seismic restraint cables shall be seven-wire strand conforming to ASTM A416/A416M.

B. The strand shall be protected with a fusion-bonded, grit-impregnated epoxy coating conforming to ASTM A882/A882M.

C. The minimum yield strength of the seven-wire strand shall be 270,000 psi.

2.10 TANK ACCESSORIES

A. Rectangular 1' 5" x 4' 4" Type 316 stainless steel wall manhole for access to the interior of the tank. The cover and the bolts shall also be of Type 316 stainless steel. The wall manhole shall be designed to resist hydraulic loading without excessive deflection. Quantity and location shall be as shown on the Plans.

B. Exterior ladder shall be fabricated from 6061-T6 and 6063-T6 aluminum with Type 316 stainless steel fasteners and shall conform with all applicable OSHA standards. The ladder shall have an aluminum safety cage and lockable security gate and/or a safety climbing device as required to meet applicable OSHA standards. Safety climbing device shall be provided in the center of the ladder.

C. Roof hatch cover shall be fabricated from fiberglass with Type 316 stainless steel fasteners.

D. Through-wall pipe sleeves shall be Type 316 stainless steel sleeves with neoprene modular seal units using stainless steel tightening bolts.

E. A total of two (2) dome 10” PVC dome probes curbs.

F. Aluminum perimeter handrail per OSHA requirements shall be fabricated and installed around the entire perimeter on top of the tank.

2.11 COATINGS

Exterior coating system shall be in accordance with Section 09961.

PART 3 EXECUTION

3.01 EXAMINATION

A. All subgrade elevations shall be verified prior to starting tank construction.

3.02 INSTALLATION

A. Floor:

1. The subgrade shall be prepared by fine grading to ensure proper placement of reinforcing steel with proper bottom cover.

2. A 10-mil polyethylene vapor-barrier shall be placed after subgrade preparation has been completed.

3. Form and screed boards shall be of proper thickness and sufficiently braced to ensure that the floor is constructed within proper thickness tolerances.

4. Plate bolsters shall be used to support reinforcing steel in the construction of the floor to ensure positive control of placement of reinforcing steel.

5. The floor shall be vibratory screeded to effect consolidation of concrete and proper encasement of floor reinforcing steel.

6. The floor shall be water cured for a minimum of 7 days after casting.

7. The floor shall receive a light broom finish.

B. Core Wall, Type II

1. The wall shall be constructed in a predesigned manner utilizing diaphragm and layers of shotcrete with each conforming to the following:

a. Diaphragm Erection

(1) The diaphragm shall be protected against damage before, during, and after erection. Nail or other holes shall not be made in the diaphragm for erection or other purposes except for inserting wall pipes or sleeves, reinforcing steel, bolts, or other special appurtenances. Such penetrations shall be sealed with an epoxy sealant which complies with Section 2.08 Epoxy.

b. Shotcrete

(1) All shotcrete shall be applied by or under direct supervision of experienced nozzlemen certified by the American Concrete Institute (ACI) as outlined in ACI certification publication CP-60.

(2) Each shotcrete layer shall be broomed prior to final set to effect satisfactory bonding of the following layer.

(3) No shotcrete shall be applied to reinforcing steel or diaphragm that is encrusted with overspray.

(4) No less than ⅛" thick shotcrete shall separate reinforcing steel and prestressing wire.

(5) The diaphragm shall be encased and protected with no less than 1" of shotcrete in all locations.

(6) The interior shotcrete shall receive a light broom finish.

(7) Temperatures shall be forecast to be 36°F or above (for three days) and the ambient temperature shall be 40°F and rising for shotcrete placement to occur.

c. Curing

(1) Interior and exterior portions of the shotcrete wall shall be water cured for a minimum of 7 days or until prestressing is completed and 70% design strength has been reached.

(2) Ambient temperature cannot drop below 36°F during the curing period until 70% design strength is reached.

C. Core Wall, Type III

1. The core wall shall be constructed of precast panels and vertical joints filled with shotcrete, mortar or cast-in-place concrete.

2. A continuous watertight steel diaphragm shall be provided throughout and within the tank wall, and shall be located between the stored tank contents and the prestressing wires. The steel diaphragm shall be full length without horizontal joints. Vertical diaphragm joints shall be mechanically seamed except where located between wall panels, in which case joints shall be sealed with polysulfide or other suitable sealant. All vertical diaphragm joints shall be sealed to be fully watertight. Piercing of the diaphragm shall not be permitted except by design.

3. Precast panels shall be fabricated to the curvature of the tank radius. The tolerance in panel wall thickness shall be - 0 to + 1/4 inch. Concrete for each panel shall be placed in one continuous operation.

4. After each precast panel has firmed sufficiently, it shall be covered with polyethylene sheet for curing.

5. The interior of precast wall panels shall be given a fine broom finish.

6. The precast panels shall be erected around the circumference of the tank and aligned to proper tolerances.

7. Bearing pads shall be located and held in their proper position prior to erection of wall panels. Nailing of pads shall not be permitted.

8. Sponge filler pads shall be properly secured. All voids around the bearing pads and the sponge shall be caulked with an approved nontoxic sealant to prevent mortar seepage.

D. Epoxy Injection

1. Epoxy injection shall be carried out from bottom to top of wall using a pressure pumping procedure.

2. Epoxy injection shall proceed only after the diaphragm has been fully encased, inside and outside, with shotcrete.

E. Dome

1. All concrete shall be consolidated by means of a vibrator for proper encasement of reinforcing steel and welded wire fabric.

2. All surfaces at the joint between the wall and the dome shall be coated with bonding epoxy which complies with Section 2.08 Epoxy.

3. Plastic bolsters shall be used to support reinforcing steel and welded wire reinforcement to ensure positive control on placement of steel.

4. The exterior surface of the dome shall receive a light broom finish.

5. The dome shall be water cured for a minimum 7 days after casting or until dome band prestressing is completed.

F. Prestressing

1. The initial tension in each wire shall be read and recorded to verify that the total aggregate force is no less than that required by the design. Averaging or estimating the

force of the wire on the wall shall not be considered satisfactory evidence of correct placement of prestressing wires.

2. Placement of the prestressing steel wire shall be in a continuous and uniform helix of such pitch as to provide in each lineal foot of core wall height an initial force and unit compressive force equal to that shown on the design drawings. Splicing of the wire shall be permitted only when completing the application of a full coil of wire or when removing a defective section of wire.

3. Shotcrete shall be used to completely encase each individual wire and to protect it from corrosion. To facilitate this encasement, the clear space between adjacent wires is to be no less than one wire diameter.

4. Prestressing shall be accomplished by a machine capable of continuously inducing a uniform initial tension in the wire before it is positioned on the tank wall. Tension in the wire shall be generated by methods not dependent on cold working or re-drawing of the wire. In determining compliance with design requirements, the aggregate force of all tensioned wires per foot of wall shall be considered rather than the force per individual wire, and such aggregate force shall be no less than that required by the design and as shown on approved drawings.

5. The tank construction company shall supply equipment at the construction site to measure tension in the wire after it is positioned on the tank wall. The stress measuring equipment shall include: electronic direct reading stressometer accurate to within 2%, calibrated dynamometers and a test stand to verify the accuracy of the equipment.

6. After circumferential prestressing wires have been placed, they shall be protected by encasement in shotcrete. This encasement shall completely encapsulate each wire and permanently bond the wire to the tank wall.

7. When multiple layers of wire are required, shotcrete cover between layers shall be no less than ⅛" thick.

G. Covercoat

1. After all circumferential prestressing wires have been placed, a shotcrete cover having a thickness of no less than 1" shall be placed over the prestressing wires.

2. Horizontal sections of the wall shall form true circles without flat areas, excessive bumps or hollows.

3. The covercoat shall receive a sliced trowel finish.

H. Wall Openings

1. All wall pipes, sleeves and manholes passing through the wall shall be sealed to the diaphragm by epoxy injection.

H. Coatings

1. All coatings shall be applied a minimum of 28 days after final application of concrete or shotcrete.
2. All application procedures for coatings shall be in accordance with manufacturer's recommendations.

3.03 FIELD QUALITY CONTROL

A. Inspection and Testing

1. Concrete and Shotcrete Testing

a. Compression Tests

(1) Compression test specimens shall be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications. At least one set of test specimens shall be made for each 50 yards of concrete/shotcrete placed. Each set of test specimens shall be a minimum of 5 cylinders.

(2) During cold weather shotcrete/concrete placement, 5 additional cylinders will be prepared and field cured to verify 70% design strength is reached prior to ambient air temperature falling below 36°F. One cylinder is to be broken daily.

(3) Compression test specimens for concrete/shotcrete shall conform to ASTM C172/C172M for sampling and ASTM C31/C31M for making and curing test cylinders. Test specimens shall be 6-inch diameter by 12-inch high or 4-inch diameter by 8-inch high cylinders.

(4) Compression test shall be performed in accordance with ASTM C39/C39M. Two test cylinders will be tested at 7 days and two at 28 days. The remaining cylinder will be held to verify test results, if needed.

b. Air Content Tests

(1) Air content tests shall conform to ASTM C231/C231M (Pressure Method for Air Content).

(2) Tests for air content shall be made prior to concrete placement and whenever compression test specimens are made.

c. Slump Tests

(1) Slump tests shall be made in accordance with ASTM C143/C143M.

(2) Slump tests shall be made whenever compression test specimens are made.

2. Hydrostatic Testing

a. On completion of the tank and prior to any specified backfill placement at the footing or wall, the tank shall be tested for watertightness.

b. The testing for watertightness shall be completed as follows:

(1) Test the floor waterstop connection with air pressure and soapy water to determine if leaks are present.

(2) If no leaks are found in test item No.1, fill the tank with potable water or groundwater to a depth of 1 foot above the sidewall access manholes and let it stand for a minimum of 24 hours.

(3) Inspect the exterior of the tank wall and footing for damp spots. Damp spots shall be defined as spots where moisture can be picked up on a dry hand, the source of which is from inside the tank.

(4) If no leaks are found in test item No. 2, fill the remainder of the tank with screened raw sewage to the point of overflow and let it stand for an additional 24 hours. Re-inspect as detailed in item No. 3.

(5) Leakage through the wall or wall-base joint shall be repaired and the tank shall be retested using the above procedure.

3.04 CLEANING

A. The interior of the tank shall be cleaned to remove debris, construction items, and equipment prior to testing.

END OF SECTION

SECTION 13321 – FIBER OPTIC EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Work of this Section includes providing a fiber optic patch, panels, and terminations.

1.02 RELATED WORK

A. Process Instrumentation and Control System in Section 13300.

1.03 SUBMITTALS

A. Submit to Engineer, in accordance with Section 01300 and 01730, the following:

1. Catalog Data: Catalog data on fiber-optic termination devices, patch panels, breakout enclosures, splice kits, pigtails, and fan-outs where applicable. Product data sheets shall include the manufacturer's name and catalog number for each item, the manufacturer's descriptive literature, catalog cuts, and any power supply requirements.

2. Detailed bill of materials for fiber-optic cable terminations, patch panels, breakout enclosures, spice kits, connectors, pigtails, and fan-outs.

B. O & M manuals.

1.04 REFERENCE STANDARDS

B. The optical fiber patch cable shall conform to the latest issue of the following standards documents, which are incorporated by reference into this specification:

1. EIA-455: Standard Fiber Optic Test Procedures (FOTPs) Devices.

2. EIA-598-A: standard Colors for Color Identification and Coding.

3. National Electrical Manufacturer's Association (NEMA).

4. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. The fiber optic patch cabling materials furnished under this Section shall be provided by fiber optic suppliers who have been providing these types of materials for the past three years. The fiber optic suppliers shall provide personnel capable of providing technical assistance during installation.

1.06 REFERENCE STANDARDS

A. Spare Parts

1. Provide a minimum five percent spares of ST connectors and dust covers, but not less than 20 spare ST style connectors and 20 dust covers.

2. Provide a minimum five percent spare 36" spare multimode patch cables with connectors (both ends) terminated, but not less than ten 36" spare multimode patch cables with connectors (both ends) terminated.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS

A. Cabinets: Cabinets shall be provided as indicated on the contract drawings.

B. Manufacturers

1. Corning Cable Systems Corp.

2. CommScope.

3. Belden Cable.

4. Or equal.

2.02 FIBER CABLE TERMINATIONS, CONNECTORS, AND CABLE ASSEMBLIES

A. Connectors (Cable Assemblies)

1. Factory-Installed Connectors: All patch cable assemblies shall have connectors installed at the factory. The connectors shall provide tight-fitting termination to the cladding and buffer coating. Epoxy-based or “hot melt” adhesives shall be used to bond the fiber and buffer to the connector ferrule and body prior to polishing the endface.

B. Fiber Optic Patch Cables

1. Fiber optic patch cable shall be two-fiber zipcord 50/62.5/125 core/clad micron multimode riser rated cable.

2. Installation of patch cables shall include all spares and observe the minimum fiber bend radius and strain relief.

2.03 FIBER OPTIC TERMINATION PATCH PANELS

A. General

1. Patch panels shall be suitable for wall mounting, comprised of internal mounting plate, cable holders, slack cable take up/organizer blocks, patch block with connectors, and ground lugs as indicated. Panels shall be NEMA 4X, 316 stainless steel construction for outdoors; and NEMA 12, 316 stainless steel or fiberglass for indoor use. Patch panels shall be suitable for multimode system operation at 800 and 1300 nanometers. Patch panels shall be suitable for ST or LC connectors. The patch panels shall be sized to handle the number of fibers as required. All fibers shall be terminated in the patch panel.

2. Where shown on the plans or in the related specification sections, the fiber optic cable shall terminate inside a communications cabinet on a termination patch panel. All fiber sub-cables within the exposed buffer tube shall be terminated with fan-out kits with preconnectorized pigtails. The patch panel shall have a fiber capacity equal to the total number of fibers (connected and spare) for all cables to be connected.

3. Unused buffer tubes shall be uncut and looped within the patch panel for continuous routing of the fiber buffer tube within the cable assembly.

4. Patch panels shall be designed for either rack mounting on a standard equipment rack or housed in an enclosure for direct wall mounting. The patch panel shall contain “ST” type bayonet or LC couplings. All unused couplings shall have protective dust covers. All panels shall be furnished with locking doors.

5. Factory-terminated, tight-buffered, aramid-reinforced fiber optic jumper assemblies or interconnect cables, standard 3.0-mm O.D., shall connect the optical cable terminations to the patch panel couplings.

6. The termination patch panel shall be equipped with a suitable means for routing and securing of cables, and shall provide a suitable means of protection for the mounted fiber connectors to prevent damage to fibers and connectors during all regular operation and maintenance functions. All cables shall be provided with strain relief. Bend diameters on cable fibers and jumpers must be greater than four inches at all times to ensure optical and mechanical integrity of the optical fibers.

7. Termination panels shall be equipped with splice trays (where applicable) and holders for pigtail and through fiber splicing.

8. Termination panels shall be provided with all hardware, options, and accessories to provide for a complete installation of the fiber optic system.

9. Panels shall be as manufactured by Corning Cable Systems LANscape or equal.

B. Rack Mount Fiber Distribution Center (FDC) Splice Housing

1. A rack-mountable Fiber Distribution Center splice housing shall be provided for pigtail splicing and through fiber splicing equipment.

2. The splice housing shall be compatible with the FDC for interconnection of the splicing equipment with the fiber cable management, termination and distribution rack equipment.

3. Splice trays shall be provided for pigtail splicing.

4. The splice housing shall be sized and equipped with sufficient capacity to terminate and feed through all required fiber cable, plus an additional 20 percent.

5. Provide one spare splice tray.

6. Splice housing shall be corning Cable Systems LANscape CSH series.

C. Rack Mount Fiber Distribution Center (FDC)

1. The Fiber/Network equipment rack shall be supplied with two rack-mountable Fiber Distribution Centers (FDCs) capable of 48 ST fiber termination points each. The connector center shall be 19” rack-mountable and provide for internal fan-out, splicing, and connection of the fiber optic cable to front panel ST connection patch panel.

2. The FDC shall provide backbone and intermediate connects and cable strain relief for a maximum of five fiber cable systems. The front shall be swing-open construction with keyed latch mechanism.

3. The FDC shall be compatible for interconnection with the FDC Splice Housing and provide space and support the addition of fiber cable splice trays for future cable connection and termination.

4. The Fiber connection Center shall be Corning Cable Systems LANscape CCH series.

D. Wall/Panel Mount Fiber Distribution Center (WDC)

1. The field-mounted fiber termination enclosures shall be supplied with a Wall Mount Fiber Distribution Center (WDC) capable of 48 ST fiber termination points. The distribution center shall be panel-mounted and provide for internal fan-out, splicing, and connections

of the fiber optic cable to the patch panel assemblies.

2. Splice trays shall be provided for pigtail splicing. The WDC shall be provided with pass-through s0plice trays for continuation of the fiber cable system to additional sites.

3. Provide one spare splice tray.

4. The WDC shall provide space and support the addition of future fiber cable splice trays.

5. The Wall Mount Fiber Distribution Center shall be Corning Cable Systems LANscape (WCH) series.

PART 3 - EXECUTION

3.01 GENERAL

A. Fiber optic cables shall be continuous from component to component. Intermediate fiber splices shall not be allowed.

3.02 IDENTIFICATION

A. Label each termination point.

B. Label each patch cable with permanent waterproof typewritten tags.

3.03 WARRANTY

A. Refer to Section 13300.

END OF SECTION