

Section 13210

SPHEROID ELEVATED WATER STORAGE TANK

Note to Contract Specifier

Specification clauses requiring revision or insert are highlighted and underlined. Specification notes are highlighted and italicized. Contact Landmark for technical assistance with project specific modifications and appurtenances not listed - phone 817.439.8888 or email info@teamlandmark.com.

PART 1 – GENERAL

1.01 Summary

A Work Included

This section includes the design, construction, testing, and commissioning of a Spheroid Elevated Tank and related work including foundations, mechanical, and appurtenances.

B Related Documents

Drawings and the general provisions of this document, including General Conditions, Supplemental Conditions and Special Provisions apply to work in this section.

C Related Sections

**** Spec Note – add Sections as required.**

1.02 References

The latest version of the following Specifications, Codes and Standards are referenced in this section.

ACI 301	Standard Specification for Structural Concrete
ACI 318	Building Code Requirements for Structural Concrete
AWWA D100	Welded Steel Tanks for Water Storage
AWWA C652	Disinfection of Water Storage Facilities
AWS D1.1	Structural Welding Code—Steel
NACE RP0178	
NSF 61	Standard for Drinking Water System Components
OSHA 29 CFR	Part 1926 Safety and Health Regulations for Construction

1.03 System Description

A Elevated Tank

The Spheroid Elevated Tank shall consist of the following: foundation, single welded steel support pedestal and a spheroidal shaped welded steel water tank.

B Operating Parameters

Minimum capacity within operating range	_____	gallon
Maximum fill rate	_____	GPM
Elevation - overflow/top capacity level	_____	feet
- top of foundation	_____	feet
- final ground	_____	feet
Inlet/Outlet Riser Diameter	_____	inches

C General Design Standards

Structural design of the elevated storage tank shall conform to the latest edition of the following design standards except as modified by this section.

Foundations	AWWA D100 and ACI 318
Steel Tank	AWWA D100

D Design Loads

Design loads shall be in accordance with AWWA D100

1. Dead load shall be the estimated weight of all permanent construction.
2. Water load shall be the weight of water when the tank is filled to overflow.
4. Roof snow load shall be the larger of 15 psf or the snow load determined in accordance with AWWA D100.
5. Wind loads shall be in accordance with AWWA D100.
6. Horizontal and vertical seismic loads shall be in accordance with AWWA D100.

F Foundation Design - Geotechnical

The foundations shall be designed by the Contractor in accordance with AWWA D-100 to safely support the structure based on the recommendations of the geotechnical report. The Contractor shall be responsible for securing any further geotechnical information required beyond that provided in this report.

1.04 Submittals

A Submit the following with the proposal:

A preliminary section view drawing of the tank proposed for this project. The drawing shall include sufficient detail to illustrate tank geometry, materials of construction, primary dimensions and plate thickness, the high and low water levels, and the details of the foundation.

B Construction Drawings

Provide elevation, plan and sectional view drawings of the foundation, support pedestal, tank and all appurtenant equipment and accessories. Show the location, dimensions, material specifications, and finish requirements. The submission shall be sealed by professional engineer registered in the State of the project.

Foundation details shall include excavation, soil protection and backfill.

Reinforcement shall be clearly indicated on the structural drawings and identified by mark numbers that are used on the fabrication schedule. Location, spacing and splice dimensions shall be shown. Placement and fabrication details shall conform to ACI 318.

C Construction Procedures

Provide shop and field weld procedures for all structural joints on the steel tank and pedestal.

D Design Data

Provide a summary of the design for the foundation, support pedestal, tank and other components. Include the design basis, loads, load combinations and results.

E Product Data

Provide a concrete mix design for foundation concrete.

Provide technical data and color samples of all coating products.

Provide manufacturers descriptive information for appurtenant equipment and accessories that are not detailed on the construction drawings.

F Reports/Certification

Provide documentation of all tests, inspections and certifications required by this section.

Provide qualifications of all welders.

Provide proof of insurance for Professional Liability with a minimum limit of \$1,000,000 each occurrence and aggregate.

1.05 Quality Assurance

A Experience Requirements of Tank Contractor

The work described in this section shall be performed by a company that specializes in the design and construction of elevated tanks. The tank contractor shall have the following qualifications:

1. A minimum of ten years experience in elevated tank design and construction of tanks of equal or greater capacity.
2. The design, construction and commissioning of a minimum ten elevated tanks of equal or greater capacity, all in satisfactory operation for at least 5 years.

B Pre-Qualification of Tank Contractor

Acceptable contractors pre-qualified to perform the work specified herein are: Chicago Bridge & Iron Company, Caldwell Tanks, Landmark Structures, Maguire Iron, and Phoenix Fabricators and Erectors.

C Quality Assurance

Elevated tank design, fabrication and construction shall not be subcontracted. These items shall be self performed by the contractor.

The contractor shall employ a professional engineer with a minimum five years cumulative experience in the design and construction of steel elevated tanks. The engineer shall be registered in the State the work is being performed and shall be in responsible engineering charge of the work.

A qualified supervisor directly employed by the manufacturer shall be on site at all times during construction of the foundation and steel tank.

D Regulatory Requirements

The specifications, codes and standards referenced in paragraph 1.02 shall govern the work with regard to materials, design, construction, inspection and testing to the extent specified.

The Contractor shall comply with safe working practices and all health and safety regulations of OSHA, state and local health regulatory agencies and Material Safety Data Sheets (MSDS). Provide protective and lifesaving equipment for persons working at the site.

1.06 Delivery, Storage & Handling

A Handling and Shipping

The Contractor shall handle materials and fabricated components in a manner that will protect them from damage. Allow painted materials adequate cure time prior to stacking or shipping.

B Storage and Protection

Protect delivered materials and equipment from damage. Store in well drained areas and provide blocking to minimize contact with the ground.

1.07 Project Conditions

A Permits and Easements

Permits, licenses, and easements required for permanent structures, changes in existing facilities or advancement of the construction as specified shall be secured and paid for by the Owner prior to the start of construction. These include building permits, airspace authority approval, site access easements, highway crossing permits, etc.

Licenses or permits of a temporary nature required by specific trades shall be the responsibility of the Contractor.

B Access

The Contractor shall provide access from public roads to the tank site unless otherwise specified.

1.08 Sequencing and Scheduling

A Schedule

The Contractor shall provide a schedule for design, submittals, site work and the major components of construction including foundation, support pedestal and steel tank. In addition, show tank painting, electrical installation and other significant activities. Update the schedule as required.

B Notification

The Contractor shall provide notification of the intent to start work at least seven days prior to commencing each major phase of work.

1.09 Guarantees

The Contractor shall guarantee the structure, appurtenant equipment and accessories provided under this section against defective design, workmanship or materials for a period of one year from the date of substantial completion. If notified within this period, the Contractor shall repair any defects at no cost to the Owner. Defects caused by damaging service conditions are not covered.

1.10 Insurance

In addition to any requirements specified in the General and/or Supplemental Conditions, the Contractor shall maintain Professional Liability insurance with a minimum limit of \$2,000,000 each occurrence and aggregate.

1.11 Contract Award

Contract award may be based on an evaluated bid analysis. Evaluations will consider capital cost and maintenance costs over a 60 year life cycle. The Owner reserves the right to award the contract based on the evaluation criteria, not on the low bid.

PART 2 - PRODUCTS

2.01 Materials

A Reinforced Concrete

Concrete materials and reinforcement shall comply with ACI 318, except as modified in this section.

B Steel Tank

Steel tank components, including steel plates, sheets, structural shapes and filler metals shall be in accordance with AWWA D100, Section 2, "Materials".

2.02 Concrete Foundation

The structural design of the concrete foundation shall be in accordance with ACI 318. Minimum specified compressive strength shall be 4000 psi at 28 days.

2.03 Steel Pedestal and Tank

A General

The steel pedestal and tank shall be all welded construction and shall be designed in accordance with applicable sections of AWWA D100. Provide butt-welded joints for support structure. All exposed lap joints shall be fully seal welded on both sides. All portions of the tank, including the roof, shall be watertight construction.

B Plate Thickness

All members shall be designed to safely withstand the maximum stress to which they may be subjected during erection and operation. The minimum thickness of any steel plate in contact with water shall be 1/4 in.

C Transitions

The transition between pedestal and tank and between pedestal and base (if incorporated) shall be smooth continuous double curved sections. Discontinuous transitions are not acceptable.

D Materials

All materials utilized in the construction of the storage tank and related appurtenances shall be new and shall be delivered and erected in good condition.

2.06 Appurtenances and Accessories

A General

Accessories shall comply with the minimum requirements of the Specifications, Codes and Standards listed in 1.02, current applicable safety regulations, and the operating requirements of the structure.

B Ladder Access

Ladders shall be provided from grade within the base of the support pedestal to the condensate platform located below the tank floor. The tank floor opening shall be provided with ladder access from the condensate platform. A ladder shall extend from the condensate platform, through the access tube interior to the roof. A ladder mounted on the access tube exterior shall be provided for access to the tank interior, extending from the roof manhole to the tank floor.

Ladders that terminate at platforms or landings shall extend a minimum of 48 in. above the platform elevations.

Ladders located in the pedestal and access tube interior shall be galvanized steel or aluminum. Tank interior ladders shall be galvanized steel or aluminum. Galvanized steel

tank interior ladders shall be provided with 1 in. diameter rungs and 1/2 in. x 2 in. side rails and shall be fully seal welded.

Ladder side rails shall have a 16 in. clear spacing and rungs shall be spaced at 12 in. centers. Ladders shall be secured to the adjacent structure by brackets located at intervals not exceeding 10 ft. Brackets shall be of sufficient length to provide a minimum distance of 7 in. from the center of rung to the nearest permanent object behind the ladder. Ladder brackets located on the access tube exterior shall be reinforced at the access tube shell so that potential ice damage is confined to the ladder and bracket and not the access tube shell.

C Safe Climbing Device

High strength aluminum, rigid rail safe climbing devices shall be provided on all ladders. Rails shall be center mounted and extend from 3 ft. above the ladder bottom to the top of the ladder section. Mounting brackets, fasteners and splice bars shall be provided as required for a rigid installation.

Three trolleys with snap hooks shall be provided that are designed to be operated with the aluminum rail. A safety body harness with front and side rings shall be supplied for each trolley.

A caution sign shall be provided at the lowest point of access to the ladder requiring safe climbing devices. The sign shall read "CAUTION – Safety Equipment Required When Climbing Ladder ". The sign shall be secured to the wall.

D Condensate Platform

Provide a condensate platform located in the pedestal below the tank floor. It shall be reinforced as required to act as a personnel platform. The platform shall be pitched to drain and fitted with sufficient curbs and covers to keep condensate from entering the base of the tank. Provide a drain complete with backflow preventer from the low point of the platform to the overflow pipe.

E Personnel Door

Doorway shall be 36" x 80" in size minimum with a flush threshold located in the base of the pedestal. A step-over threshold is not acceptable. The door shall be metal with weather tight construction with suitable handles, hinges, and a keyed lock.

F Tank Openings

1. Floor - Provide an 18 in. x 24 in. elliptical opening through the tank floor. The cover shall be operable from a ladder located on the condensate platform and shall be designed to withstand the pressure of the tank contents without leakage. The assembly shall include a steel cover and ring, stainless steel threaded components, and rubber gasket seals.
2. Roof - Provide two 30 in. square (minimum) weather proof access hatches on the roof of the tank. One hatch shall allow egress from the access tube to the roof. The second hatch, located adjacent to the first, shall allow access to the interior of the tank via the ladder mounted on the exterior of the access tube. The opening shall have a minimum 4 in. curb. Provide aluminum covers with a 2 in. down turned edge, stainless steel hardware, hold open arm and a locking mechanism.

G Access Tube

Provide a minimum 48 in. diameter centrally located access tube through the steel tank to provide access to the tank roof from the condensate platform.

H Roof Railing

A 42 in. high roof handrail with kick-plates shall be provided to enclose all centrally located roof accessories. The roof railing shall be a minimum of 16 ft. in diameter and comply with all OSHA requirements.

I Rigging Access & Rails

Provide two exterior access rails or rings. Locate one at the top of the cylindrical pedestal and one near the top of the transition knuckle. A 24 in. diameter hinged access door shall provide access from the platform below the floor of the tank to the exterior access rails.

Provide two circular continuous galvanized tank interior access rails suitable for use with a beam trolley. Rails shall be configured and designed to safely support a horizontal scaffold system that will provide access to all interior surfaces for coatings and maintenance. Rails shall be mounted to the underside roof such that a minimum of 6 in. clearance is provided from the top flange to the roof plate. Bottom of rails shall be minimum 6 in. above the overflow elevation. All hangers and connections shall be fully seal welded plate. Bolted connections are not permitted. Provide a sealed roof hatch for access to the rails.

J Piping

1. Inlet/Outlet Pipe - Provide an inlet/outlet pipe (refer to 1.03-B for diameter) that extends from the base of the support structure to the tank floor elevation. Provide a minimum 6 in. high removable silt stop where the inlet/outlet pipe enters the tank. The bottom capacity level of the tank's operating range shall be at or above the elevation of the top of the silt stop. Pipe material shall be minimum standard weight wall thickness, carbon steel.

Pipe and fittings below grade slab shall be flanged cement lined ductile iron in accordance with AWWA C110 and AWWA C115. Provide restraint to prevent movement.

The inlet/outlet pipe shall be designed and constructed to accommodate any differential movement caused by settlement and by thermal expansion and contraction over the range of extreme temperature differences expected for the support wall and pipe. The required flexibility shall be provided by an expansion joint located near grade in the vertical section of pipe.

2. Overflow Pipe - Provide an overflow sized for the maximum inlet flow rate specified in 1.03B. Pipe material within tank shall be minimum standard weight wall thickness, carbon steel. Pipe material within pedestal shall be steel with minimum ¼" wall thickness.

The entrance to the overflow pipe shall be located at the top capacity level elevation and designed for the maximum inlet flow rate specified in 1.03B. Provide a weir box with vortex prevention device if the entrance capacity of the overflow pipe diameter is not adequate.

3. Steel Pipe Material - Pipe and fittings shall be carbon steel fabricated from material meeting the requirements of ASTM A-53 and AWWA C200. All fittings shall be smooth flow.

Pipe, fittings and flange thickness shall be in accordance with the manufacturers certified pressure rating for the applicable service pressures. Design pressure rating shall be minimum 150 psi.

K Ventilation

Tank Ventilation - A tank vent shall be provided, located centrally on the tank roof above the maximum weir crest elevation. It shall consist of stainless steel or aluminum components, including a support frame, screened area and cap. The support shall be fastened to a flanged opening in the tank roof. The vent cap shall be provided with sufficient overhang to prevent the entrance of wind driven debris and precipitation. A minimum of 4 in. shall be provided between the roof surface and the vent cap.

The tank vent shall have an intake and relief capacity sized to prevent excessive pressure differential during the maximum flow rate of water, either entering or leaving the tank. The overflow pipe will not be considered as a vent. The maximum flow rate of water entering the tank is specified in 1.03B. The maximum flow rate of water exiting the tank shall be calculated assuming a break in the inlet/outlet at grade when the tank is full. The vent shall be provided with an insect screen.

In addition to the tank vent, a pressure/vacuum relief mechanism shall be provided that will operate in the event of vent failure. The mechanism shall be designed to return automatically to its original position after operation. The pressure/vacuum relief mechanism shall be located on the tank roof above the maximum weir crest elevation, and may be incorporated in the vent assembly.

L Grade Slab

If top of the concrete foundation does not provide a solid surface that will serve as an interior floor within the pedestal, provide a 6 in. thick concrete floor slab. The slab shall be supported on compacted granular fill and shall be reinforced with #4 reinforcing steel at 12 in. centers each way. Provide 1/2 in. expansion joint between floor slab and support wall and at pipes and supports that extend through the floor. Place cap strip and sealant over the expansion joint. The slab shall incorporate a floor drain or be sloped at 0.5% toward the door for drainage.

M Level Monitoring

1. General - Provide two 3/4 in. couplings welded to the inlet/outlet pipe 5 ft. above grade. Each coupling shall be provided with a steel nipple and an isolation valve.
2. Pressure Gauge - Provide a pressure gauge in accordance with ASME B40.1 Grade 2A. The dial shall be 4 1/2 in. diameter with black markings on white background. Pressure range is 0-100 psi.

N Lightning Protection

Provide lightning protection for the elevated tank structure and any roof mounted equipment that may be damaged by lightning.

Minimum requirements include two 28 strand by 14 gauge copper conductors bonded to the steel tank base plate 180 degrees apart. The conductors shall terminate with buried 5/8 inch diameter by 8 foot long copper clad ground rods.

Lightning protection for obstruction lights shall consist of an air terminal mounted on the support and formed to fit around the fixture. The 1/2 inch diameter copper air terminal shall extend a minimum of 10 inches above the light fixture and shall connect to a copper conductor that terminates in a bonding plate secured to the tank roof.

2.07 Electrical and Lighting

Electrical work shall be in accordance with contract drawings.

2.08 Steel Tank Painting

Refer to Section 09900 for tank coatings.

2.09 Source Quality Control

A Tests

Review mill test certifications of all steel plate, structural components and reinforcement to ensure compliance with specification requirements.

B Inspections

Provide inspection of shop fabricated components in accordance with AWWA D100.

PART 3 - EXECUTION

3.01 Foundation

A Excavation

The foundation bearing surface and excavation shall be inspected by a representative of the geotechnical engineer prior to foundation construction. Verification of the applicable design and construction recommendations is required. The geotechnical engineer shall be retained by the Contractor. After verification of the foundation bearing surface, provide a 2 in. thick concrete working slab within the lower excavation limits.

If conditions are encountered that change the design parameters, appropriate changes will be made to construction schedule and compensation.

Grade the site to prevent runoff from entering the excavation.

B Concrete Construction

Concrete construction shall be in accordance with the requirements of ACI 301. Reinforcement placed adjacent to a concrete working slab shall have a 2 in. minimum cover. Earth cuts shall not be used as forms for vertical surfaces.

C Finish

Formed surfaces shall have a smooth form finish when exposed and a rough form finish when not exposed.

Unformed surfaces shall have a trowel finish when exposed and floated finish when not exposed.

3.02 Steel Tank and Pedestal

A Welding

Welding procedures and general welding requirements shall be in accordance with AWWA D100, Section 8 - Welding.

Grinding of weld contour shall approximate Condition "D" of NACE Standard RP0178.

B Fabrication

Layout, cutting, forming, edge preparation and workmanship for steel tank components and fabrications shall be in accordance with AWWA D100, Section 9 - Shop Fabrication.

C Tank Erection

Steel tank erection procedures and general requirements shall be in accordance with AWWA D100, Section 10 - Erection.

D Tolerances

Tolerances shall be in accordance with AWWA D100. Plates shall be fabricated and erected such that the proper curvature is maintained. Weld procedures employed shall minimize distortion.

E Grouting

The interface between the steel tank base plate and the supporting structural concrete foundation shall be constructed with a minimum 1 ¼" in. void. The void shall be filled with a flowable or packable non shrink grout mix in accordance with the manufacturers' requirements.

3.03 Field Quality Control

A Concrete Testing and Inspection

The evaluation and acceptance of concrete shall be in accordance with ACI 318.

B Steel Tank Testing & Inspection

Inspection procedures for the steel tank shall be as required by AWWA D100, Section 11 - Inspection. Radiographic inspection of full penetration butt-welded joints shall be made by an independent inspection company retained by the Contractor.

3.04 Cleaning

A Site

The project site shall be kept in a clean and safe condition at all times. The Contractor shall remove all construction equipment and debris at project completion.

B Tank Disinfection

Water and sufficient pressure for flushing, cleaning, initial testing and disinfection shall be supplied by the Owner at no cost to the Contractor. Disinfection shall be in accordance with AWWA C652. Tank leakage test shall be performed during disinfection.

END OF SECTION