SECTION 13202

welded steel water tanks

# general

## description

### The Contractor shall furnish, fabricate, erect, paint and disinfect the steel tank as shown on the Plans and herein specified.

## related work specified elsewhere

### Section 01300 - Shop Drawings and Submittals

### Section 09800 - Painting and Coating

### Section 17200 – Field Mounted Instruments

## standards

### ASTM A128 - Standard Specifications for Steel Castings

### ASTM D1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)

### ASTM D1751 - Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

### AWWA C200 - Steel Water Pipe 6 in. and Larger

### AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe 4 in. and Larger – Shop Applied

### AWWA C651 - Disinfection of Water Mains

### AWWA C652 - Disinfection of Water Storage Facilities

### AWWA D100 - Welded Steel Tanks for Water Storage

### Caltrans Standard Specifications Section 90 “Portland Cement Concrete”

### Standard Methods for Examination of Water and Wastewater

## submittals

### Contractor shall furnish the following submittal:

#### Submit design calculations for the steel tank. The Contractor shall also submit Shop Drawings of the tank and its appurtenances including material lists, catalog cuts and other information for review prior to fabrication. Review of the Plans by the DISTRICT shall extend solely to the general type and layout of the Work and shall not be construed as relieving the Contractor of the full responsibility for the adequacy of the design and the accuracy of details.

#### Submit design calculations for the reinforced concrete foundation ring wall.

#### Submit a current chart of the manufacturer's available colors for exterior surfaces to be painted.

#### Fabrication and erection drawings and details for the reservoir and all accessories.

#### Certified mill tests on steel plate and structural members demonstrating that the physical and chemical requirements of this Specification have been met.

## QUALITY CONTROL

### Factory testing shall include shop inspection of components in accordance with Section 11.1 of AWWA D100. Frequency of inspections shall be as directed by the DISTRICT.

### Welding procedures and welding operators shall have been qualified in accordance with AWS Standard Qualification Procedures.

# MATERIALS

## DESIGN

### The welded steel tank shall have a nominal capacity of ***{Specify Capacity}*** gallons. It shall have a nominal diameter of ***{Specify Diameter}*** feet and a nominal height of ***{Specify Height}*** feet. Provide the reservoir complete with all pipe connections, access openings, nozzles, taps, drains, ladders, vent, and other accessories as shown on the plans or required herein.

[Note to the Engineer: Populate bracketed design criteria above per project requirements]

### The materials, design, fabrication and erection of the tank shall conform to the latest revision of AWWA D100, except as herein modified. The steel tank shall be of welded design. All sharp structural steel edges and burrs and all weld spatter and rough welded seams shall be removed prior to application of the interior protective coatings. If, in the opinion of the DISTRICT, welds contain sharp edges, burrs, or weld spatter or are of unsatisfactory quality, said welds and edges shall be ground smooth to the satisfaction of the DISTRICT.

### Earthquake: Tank above grade shall be designed for hydrodynamic loads in accordance with AWWA D100, Section 13. Particular attention shall be given to the design of a top stiffening ring and to attachment of the shell to the bottom plates and foundation. A portion of the bottom plates near the shell may be required to be thicker than the minimum 1/4-inch.

### Plate Thickness: Minimum plate thickness shall be as supported by calculations signed by a registered engineer but shall not be less than:

|  |  |  |
| --- | --- | --- |
| Floor plates | = | 1/4-inch |
| Roof plates | = | 3/16-inch |
| Shell plate thickness for tank diameter 120' or less | = | 1/4-inch |
| Shell plate thickness for tank diameter between 120' to 200' | = | 5/16-inch |
| Shell plate thickness for tank diameter greater than 200' | = | 3/8-inch |

### Shell Plate Design: In calculating the thickness of the plates stressed by the pressure of water, the pressure at the lower edge of each ring shall be assumed to act undiminished on the entire area of the ring. The following formula shall be used to determine the shell plate thickness:

|  |  |  |  |
| --- | --- | --- | --- |
| t = 2.6 x h x d  15,000 x .85 | t | = | Plate thickness in inches |
| h | = | Height of water in feet above lower edge of ring measured to the overflow level |
|  | d | = | Diameter of the tank in feet |

#### The above formula is based on a maximum tensile stress of 15,000 psi and a welded joint efficiency of 85%.

### Tank Design: The steel tank design shall indicate the suitability of the tank to resist the loads described in the Specifications. The design shall be based upon recognized engineering principles and the calculations shall be sufficiently detailed to permit ready check of the procedures used. The design of the tank shall be based on the soil bearing values recommended by the DISTRICT's soils consultant. Review of the Shop Drawings by the DISTRICT shall extend solely to the general type and layout of the Work and shall not be construed as relieving the Contractor of the full responsibility for the adequacy of the design and the accuracy of details.

#### Tank Capacity & Dimensions

##### Nominal Capacity ***Specify Capacity***

##### Usable Capacity ***Specify Capacity***

##### Inside Diameter ***Specify Diameter***

##### Tank Height ***Specify Height***

#### Seismic Design Criteria

##### Seismic Use Group ***Specify Per D100 13.2.1***

##### Seismic Importance Factor, IE ***Specify Per D100 13.2.2***

##### Site Class ***Specify Per D100 13.2.4***

##### Ss ***Specify Per D100 13.2.3***

##### S1 ***Specify Per D100 13.2.3***

##### Fa ***Specify Per D100 13.2.5***

##### Fv ***Specify Per D100 13.2.5***

#### Design Wind Loading

##### Design Wind Speed, V ***Specify Per D100 3.1.4.1***

##### Gust Factor, G ***Specify Per D100 3.1.4***

##### Importance Factor, I ***Specify Per D100 3.1.4***

##### Exposure Category ***Specify Per D100 3.1.4.2***

#### Roof Design Loading

##### Roof Live Load ***Specify Per D100 3.1.3.2***

##### Ground Snow Load ***Specify Per D100 3.1.3.1***

#### Liquid to be stored ***Specify Potable or Recycled***

#### Allowable Soil Bearing Pressure ***Specify Bearing Pressure***

### Roof Design Supports: Roof supports shall conform to current Specifications of AISC for the design, fabrication, and erection of structural steel for buildings, except that the roof purlin or rafter depth may be less than 1/30 of the span length, and also except that the maximum slenderness ratio L/r for columns supporting roofs shall be 175, and also except that the ratio LD/BT shall not be restricted for rafters in contact with the roof sheets. All roof columns shall be pipe columns and the base support shall be designed for a maximum loading of 2,000 psf exclusive of pressure due to water. Soil pressure shall not exceed the recommended bearing value (use 2,000 psf unless otherwise specified). Sources of loads shall include roof and column loads with the tank empty.

### The base support shall be designed using steel plate and without the use of structural shapes. Earthquake rods to stiffen roof rafters shall be provided. The design roof load shall be 20 psf. Wind load shall be as provided in Section 3.1.4 of AWWA D100.

### Design of Outlets and Manhole Covers and Flanges: Reinforcing for outlets installed in the tank shell shall conform to requirements of AWWA D100 latest revision. Manhole covers and supporting flanges shall be designed in accordance with Paragraph UG 34 and Appendix II of ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, Division I, latest revision.

### Ring Wall and Oiled Sand Cushion: The reinforced concrete tank foundation ring wall shall conform to the provisions of Section 03310, Cast-in-Place Concrete. Class A concrete shall be cast in one continuous pour. The top surface of the tank foundation ring shall be finished smooth and shall not vary more than 1/8-inch from a straight line in 16-feet and all points on the ring shall be within 1/4-inch of true elevation. The oiled sand cushion shall conform to the requirements for fine aggregate for Portland cement concrete as specified in Section 90 of the State Specifications. The sand shall be thoroughly mixed with Grade SC 250 road oil prior to being placed within the concrete foundation ring wall. Oil content shall be approximately 5% by weight.

### Expansion Joint Filler: Expansion joint filler shall conform to ASTM 1751 and shall be non extruding, resilient bituminous type. Strips using cork are not acceptable. The Contractor shall use cane or other cellular fibers uniformly saturated.

## TANK FEATURES

### The welded steel tank shall be equipped with the following appurtenances:

#### Inside Ladders: The inside ladder of the manufacturer's design shall conform to the requirements of the California Division of Industrial Safety. The interior ladder shall be equipped with stainless steel rungs and with stainless steel "Saf T Climb" fall prevention system. If square rungs are called for on the Plans, the edges of the rungs shall be slightly rounded to insure no sharp edges.

#### Overflow Pipe: The exterior of the piping, outside of the tank, shall be painted in accordance with coating specifications for the exterior of the tank. The exterior of the overflow pipe inside the tank and all sides of the internal rectangular weir box shall receive the same protective coating as the interior of the tank. The CONTRACTOR shall install a 1” threaded fitting for installation of an overflow sensor on the overflow pipe. Configurations shall be per the design guidelines. A 316 stainless steel screen shall be installed on the overflow pipe.

#### Roof Vent: The roof vent shall be combined with the roof finial and shall be round with a diameter as shown on the Plans. The screen shall be stainless steel.

#### Roof Hatch: The roof hatch shall be 48-inches square and hinged. It shall be provided with a hasp to receive a large padlock. A rubber gasket and intrusion alarm shall be installed on the roof hatch.

#### Roof Manhole (Optional at DISTRICT's request): The welded steel tank shall be equipped with a 24-inch diameter roof manhole as shown on the Plans. Fall protection and a rubber gasket are required to be installed on the roof manhole.

#### Flush-Type Cleanout Manhole: The Contractor shall install one 36-inch diameter manhole and one 36" x 48" flush type cleanout manhole as shown on the Plans. Flush-type cleanout manways shall have a minimum dimension of 36-inches. A nozzle shall be furnished within the flush type cleanout manway to drain the reservoir. Nozzle shall be appropriate for the given reservoir. All access manways to the reservoir must be installed with rubber gaskets.

#### Shell Manways: Two shell manways shall be provided and shall be of the type specified on the Plans. Access manways shall be 36-inch diameter. A rubber hatch shall be provided on all manways.

#### Nozzles: The inlet, outlet, and drain connections shall be of sizes as shown on the Plans. The inlet, outlet, and drain shall be mortar lined on the inside and shall be coated on the outside with corrosion resisting coatings when buried in contact with the soil and/or concrete. Exterior surface of the inlet pipe inside the tank shall be coated to the same specification as the tank interior. The exterior surfaces of the inlet and outlet piping above ground outside the tank shall be painted the same as the tank exterior.

#### Mounting Brackets: Appropriate brackets shall be installed as required for the mounting of equipment in accordance with the mounting recommendations of the equipment manufacturer.

#### Sample points: Four (4) 1” threaded connections shall be provided for installation of sampling lines.

#### Transducer:

### Ability to drain the tank: The tank shall be constructed to allow for completed drainage of the tank.

### Silt Stops: A removable silt stop shall be provided for all pipe penetrations through the floor plate. The silt stop shall be of a design commonly used by the tank fabricator.

## Roof perimeter railing

### The Contractor shall be solely responsible for the installation of the winding staircase. The Contractor shall submit design calculations, drawings, and specifications designed and stamped by a registered structural engineer in the state of California meeting the design criterion described herein to the Owner for review prior to fabrication and installation.

### The design of the roof perimeter railing shall be in accordance with OSHA requirements and all other applicable standards.

### The top rail and the intermediate rail shall be a minimum of 42” in height from the top of the tank.

### The vertical posts supporting the handrail shall be positioned at maximum horizontal spacing of 6’.

### The vertical posts shall have a bottom plate and a weep hole at the bottom of the post for draining.

### Roof railing shall be 4’ from the knuckle of the tank around the entire perimeter

### Railing shall be welded to top of tank per AWS Guidebook.

## winding staircase

### The Contractor shall be solely responsible for the design and installation of the winding staircase. The Contractor shall submit design calculations, drawings, and specifications meeting the design criterion described herein to the Owner for review prior to installation. Design shall be prepared and stamped by a structural engineer registered in the State of California.

### The design of the winding staircase shall be in accordance to all applicable safety standards. The winding stairs shall be positioned within the range of 30 degrees to 50 degrees to the horizontal with uniform riser height and tread width throughout each run and be capable of a minimum loading of 100 pounds per square foot (445 N) and a minimum concentrated load of 300 pounds (1,334 N) at the center of any treadspan. Riser height shall be from 6 to 7.5 inches (15.24 to 19.05 cm), stair width a minimum of 22 inches (55.88 cm) between vertical barriers, tread depth a minimum of 12±2 inches (30.48±5.08 cm), and tread nosing shall be straight leading edges.

### The below noted design criterion is predicated on the assumption that the side wall courses of the tank are capable of withstanding all loads exerted by the staircase during maximum use. Verification of side wall strengths must be determined for each side wall course and the extent of corrosion degradation on existing tank structures must be factored into this determination. The contractor shall field verify tank condition and dimensions prior to design and installation. Areas with localized corrosion with 50% or greater wall thickness degradation shall be repaired prior to installation of winding staircase.

### Width of the staircase steps shall be 30”.

### The riser height and tread depth shall be uniform throughout the staircase with a maximum allowable variance of 0.10”.

### The tread shall be comprised of a non-skid surface with adequate drainage to prevent water accumulation and pooling.

### The tread shall be perpendicular (90 degree angle) to the side wall of the tank.

### The leading edge of each tread shall bend downward with a bend radius of 0.25” minimum and flange width of 1”.

### The landing (platform) shall maintain the width of the staircase and shall be a minimum of 20” in length as measured in the direction of travel. The landing (platform) shall conform to the characteristics of the tread including non-skid, leading edge and drainage requirements.

### A landing (platform) must also be present at the upper termination point of the staircase and shall, at a minimum, comply with the above noted design criterion. Additionally, this landing shall provide horizontal (level) access to the roof of the tank. In cases where the tank possesses a knuckle transition area from the roof to the side walls, this landing shall be capable of safely bridging the knuckle while maintaining all of the above noted load considerations.

### The open side of the staircase and landings shall possess a rail system that is compliant with OSHA 29 CFR 1910.23. This rail system shall consist of a top rail, intermediate rail and hand rail with a total height not less than 42” from the leading edge of the stair tread to the top surface of the top rail. The hand rail may serve as the top rail of the rail system if the hand rail is not less than 36” and not more than 38” from the leading edge of the stair tread to the top surface of the top rail.

### The top rail and the intermediate rail shall be smoothly surfaced through the length of the staircase.

### The intermediate rail shall be positioned approximately equal distance from the top rail and the treads/landings.

### The vertical posts supporting the handrail shall be positioned at maximum horizontal spacing of 6’.

### The top rail, intermediate rail and posts shall be comprised of 1.5” diameter tubing. The tubing and related attachment points shall be capable of withstanding a 200 pound load applied in any direction.

### The top rail and intermediate rail shall not overhang the vertical posts in such a way to constitute a projection hazard.

### The termination point at the top of the staircase shall be located at the position adjacent to the tank access hatch.

### The bottom of the staircase shall include a gate and additional railing and roof system with a self-closing and locking mechanism to prevent access to the staircase to unauthorized personnel.

## coating, painting and disinfection

### Coating systems for welded steel water tanks shall be in conformance with Section 09800.

### Materials for disinfection of welded steel water tanks shall be in conformance with AWWA C652. Disinfection shall be performed by the CONTRACTOR.

# execution

## preparation

### Make field measurements needed to install Steel Water Tanks and appurtenances before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

## installation

### Install steel water tanks at the location shown on the Plans and Submittals in accordance with the requirements of the specifications.

### Grade ring shall be cast in one continuous pour.

### Oiled sand cushion shall be at least 6 inches thick and shall be placed on the subgrade between the tank and within the confines of the ring wall. Mix sand thoroughly with Grade SC250 road oil before placing within concrete grade ring foundation. Oil content shall be approximately 5% by weight.

### Finished surface of oil sand cushion shall be true to grade and shall meet grade ring at an elevation of approximately ¼ inch above top of ring. Compact to 95% relative density.

### Fabricate and install steel water tanks in accordance with the requirements of AWWA D100. Provide weld inspection as required by AWWA D100 and furnish documentation as needed to support Written Field Inspection Report per AWWA D100 Section 11.2 and 11.3.

### Complete penetration and fusion of butt-welded shell joints is required. Completed welds shall be free of slag and all finish steel surfaces free from weld spatters.

### Install steel water tanks and appurtenances according to manufacturer’s installation and warranty requirements. Manufacturer’s requirements for installation, application, connection, erection, maintenance, operating, cleaning, conditioning and startup of products shall be strictly followed.

### After tank erection, provide and emplace temporary cut-to-fit 10 gauge minimum metal, or form-grade plywood covers over tank openings not fitted with valves, hatches or manhole covers. Secure with three or more bolts. Maintain covers in place as needed to exclude dust, animals, insects and intruders before and after painting and after disinfection.

### Before coating, remove all sharp structural steel edges, burrs and all weld spatter and rough welded seams. Grind sharp edges smooth to satisfaction of Owner’s Representative.

## coatings

### Coatings prior to and after tank erection shall be in accordance with Section 09800. Contractor shall note items to be shop coated and items to be field coated.

## disinfection

### Disinfection shall be accomplished after all applied coatings have completely cured and after cleaning has occurred as described in Section 09971 “Coating System for Steel Water Tank.”

### Disinfection for the interior of the reservoir shall be in accordance with AWWA C652, Chlorination Method 2. The interior of the tank and yard piping shall be in accordance with AWWA C651.

## field quality control

### Field testing shall include the following:

| **Item** | **Test for** | **Test Standard**  **(ASTM or other test standard)** | **Frequency** | **First test paid for by** | **Retests paid for by** |
| --- | --- | --- | --- | --- | --- |
| Grade Ring | Concrete Strength | See Concrete Specifications  (Caltrans) Class A 4000 psi | As directed | Owner | Contractor |
| Level | Maximum variation of 1/8-inch from straight line in 16 feet  Maximum deviation of +/- ¼ inch from plan elevation | As directed | Owner | Contractor |
| Oiled sand | Compaction | 95% minimum per ASTM D1557 | As directed | Owner | Contractor |
| Welding | Absence of sharp edges, weld spatters and burrs | Visual inspection by Owner’s Representative | As directed | Owner | Owner |
| Spot tests of welded joints | Cutting and testing sectional segments per AWWA D100 Section 11.8 or radiographic testing per AWWA D100 Section 11.6 at Contractor’s option | As described in AWWA D100 Section 11.5 | Contractor | Contractor |
| Leakage in Tank Bottom Welded Joints | AWWA D100 Section 11.12 (Vacuum Method) | 1 inspection | Contractor | Contractor |
| Tank | Field Performance | Demonstrate compliance to Contract Documents and Manufacturers’ printed Literature | 1 test | Contractor | Contractor |
| Disinfection | AWWA C652 Section 4.4 | As required by Standard Methods for Examination of Water and Wastewater | Contractor | Contractor |
|  | Water Quality Testing | As required by Standard Methods for Examination of Water and Wastewater | Set of VOC samples following coating. 2 sets of samples 24 hours apart | Contractor | Contractor |
| Tank Piping | Disinfection | AWWA C651 Section 5 | 2 sets of samples 24 hours apart | Contractor | Contractor |
|  | Water Quality Testing | As required by Standard Methods for Examination of Water and Wastewater | 2 sets of samples 24 hours apart | Contractor | Contractor |
|  | 11 month Warranty Inspection | Demonstrate compliance to Contract Documents and Manufacturers printed Literature | 1 test | Owner | Contractor |

### Provide services of factory authorized representative on-site for a minimum of three man-days (travel time excluded) to provide the following:

#### Installation assistance, inspection and startup of the complete Steel Water Tank system.

#### Field testing and adjustment.

#### Instruction of Owner’s personnel in operation and maintenance.

end of section