

SECTION 11236CHEMICAL STORAGE TANKSPART 1 - GENERAL1.1 DESCRIPTION

- A. Work Included: Furnish, install, support, connect and test rotary molded high density polyethylene (HDPE) storage tanks with fittings of the type and size as specified herein at the locations shown on the Drawings.
- B. This specification covers upright, cylindrical, flat and/or cone bottom tanks molded in one-piece seamless construction by rotational molding. The tanks are designed for above-ground, vertical installation and are capable of containing chemicals at atmospheric pressure. Included are requirements for materials, properties, design, construction, dimensions, tolerances, workmanship, and appearance.
- C. This Specification covers tanks made from both cross linked high density polyethylene (XLHDPE) called Type I resins; and linear high density polyethylene resin (LHDPE) called Type II resins. See Chemical Storage Tank Schedule (Paragraph 2.4) for resin type for each tank to be supplied.
- D. This Specification does not cover the design of vessels intended for use at pressures above or below atmospheric conditions. It is also not for vessels intended for use with liquids heated above their flash points, temperatures above 140 degrees Fahrenheit for Type I materials, or temperatures above 130 degrees Fahrenheit for Type II materials (See Section 2.1D for material classifications).
- E. Related Work Specified Elsewhere:
 - 1. Additional general equipment requirements are specified in Sections 01800 and 11000.
 - 2. Corrosion resistant valves and specialties are specified in Section 15118.

1.2 QUALITY ASSURANCE

- A. Codes, Regulations and Standards:
 - 1. ASTM(American Society for Testing and Materials) Standards:
 - a. D618 Conditioning Plastics and Electrical Insulating Materials for Testing
 - b. D638 Tensile Properties of Plastics
 - c. D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - d. D883 Definitions of Terms Relating to Plastics
 - e. D1505 Density of Plastics by the Density-Gradient Technique
 - f. D1525 Test Method for Vicat Softening Temperature of Plastics
 - g. D1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics
 - h. D1998 Standard Specification for Polyethylene Upright Storage Tanks
 - i. D2765 Degree of Crosslinking in Crosslinked Ethylene Plastics as
 - j. Determined by Solvent Extraction
 - k. D2837 Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
 - l. D3892 Practice for Packaging/Packing of Plastics

- m. F412 Definitions of Terms Relating to Plastic Piping Systems
- 2. ARM (Association of Rotational Molders) Standards:
 - a. Low Temperature Impact Resistance (Falling Dart Test Procedure)
- 3. ANSI Standards:
 - a. B-16.5 Pipe Flanges and Flanged Fittings
- 4. OSHA Standards:
 - a. 29 CFR 1910.106 Occupational Safety and Health Administration, Flammable and Combustible Liquids
- 5. UBC CODE:
 - a. Uniform Building Code 1997 Edition
- B. Tank type I shall be exempt from ASTM D 1998 requirements for tanks to be one-piece, seamless construction.
- C. Qualifications of Manufacturer:
 - 1. Minimum of 5 years experience in the manufacture of high density polyethylene tanks.
 - 2. Tanks shall have proven reliable performance in similar applications and environmental conditions.
- D. Workmanship
 - 1. The finished tank wall shall be free, as commercially practicable, of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delaminations that will impair the serviceability of the vessel. Fine bubbles are acceptable with Type II tanks to the degree in which they do not interfere with proper fusion of the resin melt.
 - 2. All cut edges where openings are cut into the tanks shall be trimmed smooth.
- E. Guarantee:
 - 1. Provide three year full warranty (parts and labor) in the name of "Portland Water District", starting from the date of Substantial Completion, for defects in materials or workmanship that result in leakage through the tank surfaces or at fittings; cracking; excessive deformation, structural failure or deterioration. Warranty shall be submitted with shop drawing for approval.
 - 2. Manufacturer shall replace or repair defective tanks at no additional cost to the Owner.
- F. Acceptable Manufacturers:
 - 1. PolyProcessing Company, Inc.
 - 2. Snyder Industrial Products Lincoln Nebraska
 - 3. Or equivalent.

1.3 MANUFACTURERS INSPECTION & TEST PROCEDURES

- A. Test Methods
 - 1. Test specimens shall be taken from fitting location areas or piggy-back test molds.
 - 2. Low Temperature Impact Test
 - a. Test specimens shall be conditioned at -40 degrees Fahrenheit for a minimum of 2 hours.
 - b. The test specimens shall be impacted in accordance with the standard testing methods as found in ASTM D1998. Test specimens less than ½" thickness shall be tested at 100 ft.-lb. Test specimens greater than ½" thickness shall be tested at 200 ft.-lb.

3. Degree of Crosslinking Test (Percent Gel - Type I Only)
 - a. The test method used is to be the Ortho-xylene insoluble fraction (gel test) per ASTM D2765 Method C. This test method is for determination of the ortho-xylene insoluble fraction (gel) of crosslinked polyethylene.
 - b. The percent gel level for Type I tanks on the inside 1/8 inch of the wall shall be a minimum of 65 percent.
 4. Ultrasonic Tank Thickness Test
 - a. All tanks 2000 gallons or larger shall be measured for tank wall thickness at 6", 1ft., 2ft., 3ft. and each foot to the top of the tank on the tank sidewall height at 0° and 180° around the tank circumference, with 0° being the tank manway and going counter-clockwise per ANSI standard drafting specifications. The top and bottom wall thickness shall be measured at four equally spaced location. A copy of this test report shall be provided prior to shipping the tanks. All tanks shall meet design thickness requirements and tolerances.
 - b. Tanks smaller than 2000 gallons shall be measured three places along the wall height 6-inch from the bottom midway and 6-inch from the top. Two top and bottom thickness measurements shall be provided. A copy of the test report will be provided prior to shipping the tank.
 5. Hydrostatic Water Test
 - a. Tanks shall be hydrostatically tested for leaks at the factory.
 - b. The hydrostatic water test shall consist of filling the tank to brim full capacity for a minimum of four hours and conducting a visual inspection for leaks. After the hydrostatic water test is conducted certified test results shall be provided prior to shipping the tanks.
 6. The tank shall be visually inspected to determine that the tank construction conforms to the workmanship specifications noted above.
- B. Certified Certificates of Compliance shall be provided by the manufacturer for all specified manufacturer testing prior to shipping the tanks to the job site.

1.4 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings, warranty, testing certificates, inspection reports and Operation and Maintenance manuals in accordance with Section 01340 and 11000.

PART 2 - PRODUCTS

2.1. MATERIALS

- A The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer.
1. Type I tanks shall be molded for Grade I metallocene high density crosslinked polyethylene with an integral, internal lining molded from oxidation resistant polymer. The resin shall be Paxon 7004, as manufactured by Exxon/Mobil Company with the anti-oxidant resistant liner being OR-1000 as provided by PolyProcessing Company or powders of equal physical and chemical properties.

2. Type II tanks shall be made from linear polyethylene resin as manufactured by Exxon Chemical, or resin of equal physical and chemical properties.
- B. All polyethylene resin material shall contain a minimum of a U.V. 8 stabilizer as compounded by the resin manufacturer.
- C. Pigments may be added at the Owner's request, but shall not exceed 0.25% (dry blended) of the total weight.
- D. Mechanical Properties of Type I cross linked high density polyethylene tank material:

<u>PROPERTY</u>	<u>ASTM</u>	<u>VALUE</u>
Density (Resin)	D1505	0.938-0.944 g/cc
Tensile (Yield Stress 2"/min)	D638	2600 PSI
Elongation at Break (2"/min.)	D638	400%
ESCR (100% Igepal, Cond. A, F50)	D1693	>1000 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	>1000 hours
Vicat Softening Degrees F. Temperature	D1525	248
Flexural Modulus	D790	100,000 PSI

ESCR = Environmental Stress Cracking Resistance

- E. Mechanical Properties of Type II linear high density polyethylene tank material:

<u>PROPERTY</u>	<u>ASTM</u>	<u>VALUE</u>
Density (Resin)	D1505	0.940-0.947 g/cc
Tensile (Yield Stress 2"/min)	D638	2700 PSI
Elongation at Break (2"/min.)	D638	350%
ESCR (100% Igepal, Cond. A, F50)	D1693	400-1000 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	200-500 hours
Vicat Softening Degrees F. Temperature	D1525	235
Flexural Modulus	D790	97,000 - 103,000 PSI
ARM Impact (-40° C), ft-lbs		1/8" specimen-48 1/4" specimen -145
Heat Distortion Temperature degrees C	D648	@66 psi 54 @ 264 psi 42

2.2 DESIGN REQUIREMENTS

- A. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation, but shall not be less than 0.187-inch thick.

$$T = (P \times O.D.) / (2 SD) = (0.433 \times S.G. \times H \times O.D.) / (2 SD)$$

Where:

T = wall thickness

SD = max allowable hydrostatic design stress, PSI Shall be not greater than 600 PSI

P = pressure (.433 x S.G. x H), PSI

H = fluid head, ft.

S.G. = specific gravity, g/cm³ 1.9 shall be used for all tank designs

O.D. = outside diameter, in.

- B. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress shall be not less than 600 PSI at 73 degrees Fahrenheit for Type I and Type II materials. In accordance with the wall thickness formula above, the tank shall have a tapered wall thickness wall.

- C. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.
- D. The standard design specific gravity shall be 1.9.
- E. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support.
- F. Flat areas shall be provided to allow installing large fittings on the cylinder straight shell.
- G. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall.
- H. The bottom must be integrally molded with the cylinder shell. The radius of the bottom knuckle of a flat bottom tank shall not be less than 1-inch for tanks with a 6-foot diameter or less and not less than 1.5-inch for tank diameters larger than 6-foot.
- I. Tanks with 2000 or more gallons of capacity shall have a minimum of 3 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of an empty tank.
- J. The tank shall be designed to provide a minimum of 4 tie-down lugs integrally molded into the top head. The tie-down lugs shall be designed to allow tank retention in wind and seismic loading situations without tank damage.

2.3 DIMENSIONS AND TOLERANCES

- A. All dimensions will be taken with the tank in the vertical position, unfilled. Tank dimensions will represent the exterior measurements.
 - 1. The tolerance for the outside diameter, including out of roundness, shall be per ASTM D1998.
 - 2. The tolerance for fitting placements shall be +/- 0.5 in. in elevation and 2 degrees radial at ambient temperature.
 - 3. The knuckle radius at the bottom to wall shall be a minimum of 1-inch.
 - 4. Minimum wall thickness shall be as specified above in design requirements 2.2.A.

2.4 CHEMICAL STORAGE TANK SCHEDULE

- A. Provide HDPE storage tanks in accordance with the following table.

Tank ID	Chemical Stored	Resin Type	Min Vol. Gallons	Max Diam.	Max Height	Gasket Material	Resin Color
Sodium Hypochlorite Tanks 1,2,3 & 4	12.5% Trade Strength NaOCl	Type I with a linear low density polyethylene liner or Type II	5,100 gallons each	120"	138"	Viton	Translucent
Sodium Bisulfite Tanks 1&2	38% NaHSO ₃	Type I or Type II	4,100 gallons each	120"	138"	EPDM	Translucent

2.5 CHEMICAL STORAGE TANKS

- A. The chemical storage tanks shall be rotary molded of high density polyethylene with vertical cylindrical walls, flat bottom, domed closed top, a top access cover and all other fittings for piping connections as shown on the Drawings.
1. Product storage requirements:
 - a. Sodium Hypochlorite Tanks shall be suitable for the storage of 12.5% trade strength sodium hypochlorite solutions with specific gravity of 1.2 at 100 degrees F and atmospheric pressure.
 - b. Sodium Bisulfite Tanks shall be suitable for the storage of 38% trade strength sodium bisulfite solutions with specific gravity of 1.4 at 100 degrees F and atmospheric pressure.
 2. Dimensional requirements:
 - a. The sodium hypochlorite and sodium bisulfite storage tanks shall have a straight wall capacity, maximum diameter, and maximum height of that listed in the Chemical Storage Tank Schedule.
 3. Appearance: The finished surface shall be free from visual defects such as foreign inclusions, air bubbles, pin-holes and craters. Tanks color shall be as specified in the Chemical Storage Tank Schedule.
 4. Cut edges: All cut edges shall be trimmed to have smooth edges.
 5. Weight of tank shall be submitted with shop drawings.

B. Tank fittings:

<u>Chemical</u>	<u>Bolts</u>	<u>Gaskets</u>
Sodium Hypochlorite	Hastelloy-C or Titanium	Viton
Sodium Bisulfite	316 SS	EPDM

1. Orientation, number and size of fittings shall conform to piping as shown on the Drawings.
2. Tanks shall have molded flat areas 90 degrees apart at the base of the tank to facilitate the installation of bulkhead style piping connections as indicated on the Drawings. Integrally molded flanged outlets may be used in place of molded flats.
3. Outlets: Shall be at the base or bottom of tank. Acceptable methods are as outlined below:
 - a. Integrally Molded Flanged Outlets (IMFO's) shall be located at the lowest possible point to allow for maximum drain capability. The IMFO shall be a PVC 150 lb. ANSI companion flange. The companion flange assembly shall have 316 stainless steel bolts and a gasket which will be compressed between the integrally molded flanged outlet and the NPT companion flange.
 - b. Snyder Unitized Molded Outlet (SUMO™) - Patent #5,374,026
 - 1) The SUMO fitting shall be an integral part of the tank and provide complete drainage of liquid through the sidewall of a flat bottom container without the use of a special support structure or concrete pad. The outlet shall allow solvent weld PVC pipe attachments at the tank pad level and shall include a metal reinforcement(titanium only) completely isolated from any chemical attack.
 - 2) The tank attachment shall be constructed from a PVC schedule 80 male adapter and shall be available in 2,3,4 or 6 in. sizes as indicated on the Drawing. The SCH 80 PVC male adaptor shall be

fitted with a PVC 150 lb. ANSI bolted gasketed flanges for connection with the piping with 316 stainless steel bolts. Flanged connections shall be used to facilitate tank and piping replacement.

- 3) Provide each tank with a Flexmaster tank-pipe isolator.
4. Tank Top Fittings:
 - a. Tank top fittings shall consist of fill, vent, overflow and level sensing penetrations, and shall be Schedule 80 PVC. Fitting sizes shall be as indicated on the drawings. Level elements shall have a 6" flange for transducer mounting.
 - b. Tank top fittings 1.50-inch and larger shall be mounted on molded flats using PVC threaded universal ball bulkhead style fittings with internal gaskets.
 - c. All tank fittings 1.25-inch and smaller shall be PVC threaded universal ball bulkhead style with gasket inside and may be mounted on slightly curved top surfaces provided the gaskets seat tightly to the tank.
 - d. All tank fittings shall include PVC 150 lb. ANSI bolted gasketed flanges for connection with the field piping with 316 SS bolts. Flanged connections shall be used to facilitate tank and piping replacement.
5. Tanks shall include an adhesive gallonage indicator secured to the side of the tank in a readable location.
- C. Tank Manway Cover for each Tank
 1. The manway opening shall be 18 inch diameter
 2. Manway cover shall be liquid tight.
 3. The sealed manway shall be constructed of polyethylene material. The bolts non-corrosive compatible with the contained fluids. The gaskets shall be closed cell, crosslinked polyethylene foam and specified materials from Chemical Storage Tank Schedule,
- D. Piping connection to the tank.
 1. All piping to tank fitting attachments shall be equipped with flexible couplers supplied and installed by the piping installer or other movement provisions provided by the Contractor.
 2. The tank will deflect based upon tank loading, chemical temperature, and storage time duration.
 3. Tank piping flexible couplers shall be designed to allow 4% design movement. Movement shall be considered to occur both outward in tank radius and downward in fitting elevation from the neutral tank fitting placement.

2.6 TANK ACCESSORIES

- A Ladder Tank Accessories - Provide tank access ladders to the manway opening for each tank.
 1. Ladders shall be constructed of FRP.
 2. Safety cages shall be provided with ladders as required by OSHA standards.
 3. All ladders shall be designed to meet applicable OSHA standards. Reference: OSHA 2206; 1910.27; fixed ladders.
 4. Ladders must be mounted to the tank to allow for tank expansion and contraction due to temperature and loading changes. All top ladder mounts shall be connected to integrally molded in attachment lugs that allow for tank movement.

PART 3 - EXECUTION

3.1 MARKING, PACKING AND PACKAGING

- A. The tanks shall be marked to identify the product, date (month and year) of manufacture, capacity, and serial number. The tank shall be shipped with a label containing tank description, manufacturing order number, part number, serial number, manufacturer, and date.
- B. The proper caution or warning signs as prescribed by OSHA standard 29 CFR 1910.106 shall be supplied with the tank and installed by the Contractor to be in the most readily visible location.
- C. All packing, packaging, and marking provisions of ASTM Practice D3892 shall apply to this standard.
- D. Tanks shall be labeled and identified as indicated on the Drawings.
- E. Tank shall be shrink wrapped and protected from damage during shipping.
- F. All fittings shall be installed, removed, labeled and shipped separately. All fittings shall be reinstalled at the job site by the Contractor.

3.2 INSTALLATION

- A. In accordance with Section 11000.
- B. Tanks shall be completely inspected upon delivery and any damage identified with both the shipper and manufacturer notified. Tanks will be rejected if damaged or defective. Tanks shall be installed as soon as possible to minimize the potential for damage or stored in an acceptable location where they can not be damaged.
- C. Tanks shall be installed according to manufacturer's recommendations and as shown on the Drawings.
- D. Tank base pads and tank bottom shall be clean prior to placing tank. Concrete surface shall be level, smooth and flat. Stands shall be secured and leveled.
- E. After the tanks and piping is installed and prior to any chemical deliveries the system shall be tested hydrostatically by filling the tanks system piping with water to the maximum fill level. Record and fix any leaks, and submit test documentation for project records. All the test water shall be removed prior to adding chemicals to the system.

3.3 START UP AND TESTING

- A. In accordance with Sections 01800 and 11000.

END OF SECTION