

**KEFCO INCORPORATED**  
**Specification #200401 For**  
**Polyethylene Upright Open Top Storage Tanks**  
**Revision: A - 03/01/04**

**1. Scope**

- 1.1 This specification covers upright, cylindrical, flat bottom and/or total drain "dished bottom" open top 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.
- 1.2 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 4.1 for material classifications).

**2. Applicable Documents**

2.1 ASTM (American Society for Testing and Materials) Standards:

- D618 Conditioning Plastics and Electrical Insulating Materials for Testing
- D638 Tensile Properties of Plastics
- D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- D883 Definitions of Terms Relating to Plastics
- D1505 Density of Plastics by the Density-Gradient Technique
- D1525 Test Method for Vicat Softening Temperature of Plastics
- D1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics
- D1998 Standard Specification for Polyethylene Upright Storage Tanks
- D2765 Degree of Crosslinking in Crosslinked Ethylene Plastics as Determined by Solvent Extraction
- D2837 Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
- D3892 Practice for Packaging/Packing of Plastics
- F412 Definitions of Terms Relating to Plastic Piping Systems

2.2 ARM (Association of Rotational Molders) Standards:

- Low Temperature Impact Resistance (Falling Dart Test Procedure)

2.3 ANSI Standards:

- B-16.5 Pipe Flanges and Flanged Fittings

2.4 OSHA Standards:

- 29 CFR 1910.106 Occupational Safety and Health Administration, Flammable and Combustible Liquids

2.5 UBC CODE:

- Uniform Building Code 1997 Edition

**3. Chemical Compatibility**

3.1 Chemical compatibility shall be according to the following chemical resistance guides:

Pruett, Kenneth M., "Chemical Resistance Guide for Elastomers",  
Compass Publications.

Pruett, Kenneth M., "Compass Corrosion Guide II", Compass Publications.

3.2 These references shall be considered as general guidelines only. In many cases, combinations of these chemicals are used in such a way that only the customer (by testing molded product samples) can make a determination in regards to acceptability.

## 4. Classification

4.1 Tanks are classified according to type as follows and it is the responsibility of the purchaser to specify Type I or Type II.

4.1.1 Type I - Tanks molded from cross-linkable polyethylene resin.

4.1.2 Type II - Tanks molded from linear polyethylene resin (not cross-linkable resin).

## 5. Materials

5.1 The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer. Type I tanks shall be made from crosslinked polyethylene resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties. Type II tanks shall be made from linear polyethylene resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties.

5.2 All polyethylene resin material shall contain a minimum of a U.V. 8 stabilizer as compounded by the resin manufacturer. Pigments may be added at the purchaser's request, but shall not exceed 0.25% (dry blended) of the total weight.

5.3 Mechanical Properties of Type I tank material:

<u>PROPERTY</u>	<u>ASTM</u>	<u>VALUE</u>
Density (Resin)	D1505	0.938-0.946 g/cc
Tensile (Yield Stress 2"/min)	D638	3000 PSI
Elongation at Break (2"/min.)	D638	>300%
ESCR (100% Igepal, Cond. A, F50)	D1693	>1000 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	>1000 hours
Vicat Softening Degrees F. Temperature	D1525	250
Flexural Modulus	D790	100,000 PSI

5.4 Mechanical Properties of Type II tank material:

<u>PROPERTY</u>	<u>ASTM</u>	<u>VALUE</u>
Density (Resin)	D1505	0.940-0.948 g/cc
Tensile (Yield Stress 2"/min)	D638	2950 PSI
Elongation at Break (2"/min.)	D638	>1000%
ESCR (100% Igepal, Cond. A, F50)	D1693	550 hours
ESCR (10% Igepal, Cond. A, F50)	D1693	48 hours
Vicat Softening Degrees F. Temperature	D1525	235
Flexural Modulus	D790	129,000 PSI

## 6. Design Requirements

- 6.1 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 in. thick.

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

- T = wall thickness  
SD = hydrostatic design stress, PSI  
P = pressure (.433 x S.G. x H), PSI  
H = fluid head, ft.  
S.G. = specific gravity, g/cm<sup>3</sup>  
O.D. = outside diameter, in.

6.1.1 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 is 600 PSI at 73 degrees Fahrenheit for Type I and Type II materials. In accordance with the formula in 6.1, the tank shall have a stratiform (tapered wall thickness) wall.

6.1.2 The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.

6.1.3 The standard design specific gravity shall be 1.9.

- 6.2 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. Flat areas shall be provided to allow locating large fittings on the cylinder straight shell.
- 6.3 The open top shall have an integrally molded top tank flange to provide optimum rigidity and strength.
- 6.4 Tanks shall have molded-in gallon and liter markers to provide permanent gallonage indication for the life of the tank.

## 7. Dimensions and Tolerances

- 7.1 All dimensions will be taken with the tank in the vertical position, unfilled. Tank dimensions will represent the exterior measurements.
- 7.1.1 The tolerance for the outside diameter, including out of roundness, shall be per ASTM D1998.
- 7.1.2 The tolerance for fitting placements shall be +/- 0.5 in. in elevation and 2 degrees radial at ambient temperature.

## 8. Test Methods

- 8.1 Test specimens shall be taken from fitting location areas or piggy-back test molds.
- 8.2 Low Temperature Impact Test
- 8.2.1 Test specimens shall be conditioned at -40 degrees Fahrenheit for a minimum of 2 hours.

8.2.2 The test specimens shall be impacted in accordance with the standard testing methods as found in ASTM D1998. Test specimens < 1/2" thickness shall be tested at 100 ft.-lb. Test specimens > 1/2" thickness shall be tested at 200 ft.-lb.

### 8.3 Degree of Crosslinking Test (% Gel - Type I Only)

8.3.1 The test method used is to be the o-xlene insoluble fraction (gel test) per ASTM D2765 Method C. This test method is for determination of the ortho-xlene insoluble fraction (gel) of crosslinked polyethylene.

8.3.2 The percent gel level for Type I tanks on the inside 1/8 in. of the wall shall be a minimum of 65%.

### 8.4 Ultrasonic Tank Thickness Test

8.4.1 Open top tanks from 30 to 500 gallons are only periodically measured at the start of a production run or after any design changes. Customers can place an order for tank wall thickness measurements on smaller tank sizes when placing the original order. A copy of the test report will be provided if ordered.

### 8.5 Hydrostatic Water Test

8.5.1 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. A hydrostatic water test will be conducted if ordered by the customer.

8.6 The tank shall be visually inspected to determine such qualities as are discussed in Section 9.

## 9. Workmanship

9.1 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.

9.2 All cut edges where openings are cut into the tanks shall be trimmed smooth.

## 10. Tank Fittings (Nozzles)

### 10.1 Fittings – Welded Threaded Half Couplers

10.1.1 Welded threaded half couplers are available for below liquid installation in the bottom of type II open top tanks or in the top cover of type II open top tanks. Welded threaded half couplers are available in 1/2, 3/4, 1, 1 1/2, 2, and 3 in. sizes.

10.1.2 Fitting shall be constructed of polyethylene material and spin-welded to the tank.

### 10.2 Fitting – Bolted Double Flange Total Drain Fittings

10.2.1 Bolted double flange total drain fittings are available for below liquid installation in the bottom of type I and type II open top tanks. Bolted double flanged total drain fittings are available in 2 and 3 in. sizes.

10.2.2 The bolted double flange total drain fitting shall be constructed with 2 ea. polypropylene threaded flanges, one flange to be fully drainable style, 2 ea. flange gaskets, and the correct number and size of all-thread bolts for the flange specified by the manufacturer. The flanges shall be constructed of polypropylene material. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton® or other specified material. There shall be a minimum of 4 ea. full thread bolts. The bolt head shall be ultrasonically sealed in the inner flange and shall be designed to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation.

10.3 Fittings - Threaded Bulkhead

10.3.1 Threaded bulkhead fittings are available for installation on the bottom and top of the tank and on the sidewall depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult KEFCO for placement questions. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

<u>Tank Diameter</u>	<u>Maximum Sidewall Bulkhead Fitting Size Allowable</u>
18 in.	1 in.
22 in.	1.5 in.
30 in.	1.5 in.
36 in.	2 in.
42 in.	2 in.
48 in.	2 in.

10.3.2 The bulkhead fittings shall be constructed of PVC, PP, or other specified material. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton®, or other specified material.

10.4 Fittings - Bolted Polypropylene Fittings

10.4.1 Bolted polypropylene fittings are available for installation on the bottom and top of the tank and on the sidewall depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult KEFCO for placement questions. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

<u>Tank Diameter</u>	<u>Maximum Sidewall Bolted Fitting Size Allowable</u>
18 in.	2 in.
22 in.	2 in.
30 in.	2 in.
36 in.	3 in.
42 in.	3 in.
48 in.	3 in.

10.4.2 The bolted polypropylene fittings shall be constructed with 2 ea. Polypropylene threaded flanges, 2 ea. flange gaskets, and the correct number and size of all-thread bolts for the flange specified by the manufacturer. The flanges shall be constructed of polypropylene material. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton® or other specified material. There shall be a minimum of 4 ea. full thread bolts. The bolt head shall be ultrasonically sealed in the inner flange and shall be designed to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation.

## 10.5 Fittings - Bolted Double 150 lb. Flange Fittings

10.5.1 Bolted double flange fittings are available for installation on the bottom and top of the tank and on the sidewall depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult KEFCO for placement questions. Bolted double flange fittings provide the best strength and sealing characteristics of any tank fitting available. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

<u>Tank Diameter</u>	<u>Maximum Sidewall Bolted Fitting Size Allowable</u>
18 in.	1 in.
22 in.	1.5 in.
30 in.	2 in.
36 in.	2 in.
42 in.	2 in.
48 in.	3 in.

10.5.2 The bolted double flange fitting shall be constructed with 2 ea. 150 lb. flanges, 2 ea. 150 lb. flange gaskets, and the correct number and size of all-thread bolts for the flange specified by the flange manufacturer. The flanges shall be constructed of PVC Type I, Grade I, or other specified material. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton<sup>®</sup> or other specified material. There shall be a minimum of 4 ea. full thread bolts. The bolts may have gasketed flanged metal heads or bolt heads encapsulated in Type II polyethylene material. The encapsulated bolt shall be designed to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation. The polyethylene encapsulation shall fully cover the bolt head and a minimum of 1/4" of the threads closest to the bolt head. The polyethylene shall be color coded to distinguish bolt material (white - 316 S.S., yellow - Hastelloy C276, red - Monel, green - Titanium). Each encapsulated bolt shall have a gasket to provide a sealing surface against the inner flange.

10.5.3 Standard orientation of bolted double flange fittings shall have bolt holes straddling the principal centerline of the tank in accordance with ANSI/ASME B-16.5 unless otherwise specified.

## 10.6 Fittings - Bolted Stainless Steel Fittings

10.6.1 Bolted stainless steel fittings are available for installation on the bottom and top of the tank and on the sidewall depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult KEFCO for placement questions. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

<u>Tank Diameter</u>	<u>Maximum Sidewall Bolted Fitting Size Allowable</u>
18 in.	1.5 in.
22 in.	2 in.
30 in.	2 in.
36 in.	3 in.
42 in.	3 in.
48 in.	3 in.

10.6.2 The bolted stainless steel fittings shall be constructed with a minimum of 4 fully threaded 3/8 in. studs. Each fitting shall have two gaskets and two flanges. One gasket shall be compressed between the inside of the tank wall surface and the inside flange of the fitting. The other gasket shall be compressed between the outside tank wall surface and the outside flange of the fitting. The stainless steel fittings come standard with female pipe threads on both the inner and outer flanges. Other threading arrangements may be specified. The fittings shall be constructed of Type 316 stainless steel. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton® or other specified material.

#### 10.6 Fittings - Siphon Tube Fittings

10.6.1 Siphon tubes may be added to the fittings specified in sections 10.3, 10.4, 10.5 and 10.6. Siphon tubes will allow these fittings, when used as drainage fittings, to provide better tank drainage.

10.7 All tank fitting attachments shall be equipped with flexible couplers or other movement provisions provided by the tank customer. The tank will deflect based upon tank loading, chemical temperature, and storage time duration. 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.

## 11. Tank Attachments

#### 11.1 Tank Attachments - Sight Level Gage

11.1.1 The sight level gage shall be constructed of flexible PE tubing to allow for tank contraction and expansion due to loading and temperature changes. The level gage shall be connected to the tank with 2 Ea. appropriate 3/4" fittings as described in section 10. Each fitting can have valves installed for isolation or drainage purposes.

#### 11.2 Tank Attachments – Ultrasonic Level Indicator

11.2.1 The ultrasonic level indicator shall consist of a 2 or 3 in., 4 – 20 mA output PVC sensor and a 3-1/2 digit display unit. The sensor may be equipped with male pipe threads and be connected to the tank with a PE bulkhead fitting, or the sensor may be Teflon® faced and flange bolted to the tank with encapsulated 316 S.S. bolts. The sensor is connected to a display unit that is mounted to the containment tank. The display unit box shall be Nema 4 rated and factory pre-wired for 110 VAC power. All connections shall be labeled to prevent errors in field installation. The display unit is preprogrammed for the tank ordered. The display will show hundreds of gallons (display x 100 = gallons).

#### 11.3 Tank Attachments - Cover

11.3.1 Tanks come standard with a loose cover for each tank size. Covers for tanks with diameters 30" to 36" shall have one top stiffening ribs integrally molded in to provide additional strength to support top-fitting installations. Covers for tanks with diameters 42" to 48" shall have two top stiffening ribs integrally molded in to provide additional strength to support top-fitting installations.

11.3.2 All covers shall be constructed of the same polyethylene material as the tank.

#### 11.4 Tank Attachments - Bolted Sealed Top Cover

11.4.1 Sealed covers are available for 22, 30, 36, 42 and 48 in. diameter size tanks.

11.4.2 The sealed cover shall be constructed of polyethylene material. The bolts shall be stainless steel or other specified material. The gaskets shall be closed cell, crosslinked polyethylene foam material.

#### 11.5 Tank Attachments – Hinged Lid Assembly

11.5.1 Hinged lid assemblies are available for 30, 36, 42 and 48 in. diameter size tanks.

11.5.2 The hinged lid assembly shall be constructed of polyethylene material and allow access to the tank interior without having to remove the entire lid. The polyethylene hinged lid shall be attached to the tank with two stainless steel bolts connecting to embedded threaded inserts in the raised rib section of the tank cover.

#### 11.6 Tank Attachments – Flange Adapters

11.6.1 Flange adapters may be purchased as optional equipment to adapt threaded or socket fitting outlets to 150 lb. flange connections for connection to piping system components. Flange adapters are available in PVC, CPVC or other specified materials. Flange adapter construction shall utilize schedule 80 components in sizes ranging from ¾” to 8” depending on material required.

## 12. Tank Accessories

#### 12.1 Tank Accessories - Polyethylene Tank Stands

12.1.1 Stands shall be made of corrosion resistant polyethylene material.

12.1.2 Polyethylene tank stands shall be offered in 12 and 18 in. height styles and designed to withstand the weight of 1.9 specific gravity material (16 lbs. per gallon) material in both flat and cone bottom configurations.

12.1.3 Polyethylene tank stands shall be designed for both flat bottom and total drain “dished bottom” tanks.

12.1.4 Polyethylene stands shall have a center opening to allow access to the bottom of the tank for fitting installations in the bottom of the tank.

#### 12.2 Tank Accessories – Mixer Mount Assembly

12.2.1 The mixer mount assembly shall be constructed of galvanized steel and be connected to the polyethylene tank stand. The mixer mount assembly shall have an adjustable height mixer support bracket to accommodate a variety of mixer brands and dimensions.

## 13. Marking, Packing and Packaging

13.1 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 3 of 9, HRI bar code label containing tank description, manufacturing order number, part number, serial number, manufacturer, and date.

13.2 The proper caution or warning signs as prescribed by OSHA standard 29 CFR 1910.106 shall be customer determined and supplied.

- 13.3 All packing, packaging, and marking provisions of ASTM Practice D3892 shall apply to this standard.
- 13.4 Customer specified labeling is available.
- 13.5 Tanks shall be shrink wrapped or bagged for added protection during shipment.
- 13.6 All fittings that do not interfere with tank shipment shall be installed unless otherwise specified. Fittings and accessories that interfere with tank shipment or could be broken during shipment shall be shipped separately.

## 14. Shipping

- 14.1 Since there are variations in methods of shipping, KEFCO's instruction shall be followed in all cases.
- 14.2 Consult the KEFCO "Guidelines for Use and Installation" booklet available online at [www.snydernet.com](http://www.snydernet.com) for unloading and instructions on specific tanks.
- 14.3 Upon arrival at the destination, the purchaser and/or his agent shall be responsible for inspection for damage in transit. If damage has occurred, a claim should be filed with the carrier by the purchaser, and the manufacturer should be notified prior to the tank being put into service.

### KEFCO Vertical Open Top (VOT) Tank Sizes Available

<u>Gallons</u>	<u>Nominal Diameter</u>	<u>Nominal Height</u>	<u>Overall Diameter</u>	<u>Overall Height</u>
30	18"	31"	21.34"	31.25"
55	22"	37"	25.75"	37.25"
90	30"	32.5"	33.75"	36.25"
120	30"	43"	33.75"	46.75"
150	30"	53.5"	33.75"	57.25"
200	36"	49"	39.75"	52.75"
250	36"	60.75"	39.75"	64.5"
275	42"	49.5"	47"	53.25"
330	42"	59"	47"	62.75"
360	48"	49.5"	53"	53.25"
440	48"	60"	53"	63.75"
500	48"	67.75"	53"	71.5"

Polyethylene stands are available for each tank size listed above in both a 12" and 18" height for both flat bottom and total drain "dished bottom" open top designs.

KEFCO INCORPORATED  
P.O. Box 126  
Perkasie, PA 18944 USA

800-457-0440  
FAX 215-453-7990  
[www.kefco.com](http://www.kefco.com)