Hayward Gordon Ltd.
Pumps • Mixers • Strainers • Engineered Systems and Controls

Storage and Mixing Tanks – Information Guide

Hayward Gordon designs and constructs a variety of tank & mixing systems for a range of applications in pulp & paper, mining, chemical, oil & gas and other industries.

Chemical mixing and storage tanks come in a assortment of sizes and materials. HDPE (high density polyethylene) is used for most small chemical services where storage is the primary function.

In larger chemical storage tanks, or where agitation is required, construction materials tend to be from FRP (fiberglass reinforced plastic), lined steel and stainless steel. Chemical and temperature compatibility play a critical role in selecting tank material.

Designs can be horizontal or vertical orientations with flat or dished ends, skirts, feet or saddles.

Tanks are often incorporated into larger system packages.

Please note: A tank that is under pressure (or vacuum) is a pressure vessel and comes under ASME sect VIII design code with specific fabrication requirements.

Tank Categories by Materials of Construction

1) High Density Polyethylene (HDPE) tanks (storage of a multitude of chemical and process applications).
2) Fiberglass tanks (storage of a multitude of chemical and process applications)
3) Steel tanks (storage tanks that are API STD 650)
4) Stainless Steel (for use in the food and chemical industry)

Typical Tank Accessories

A list of accessory considerations includes:

- Mixers & mixing bridges
- Baffles
- Overflows, vents, drains
- Level transmitters and switches
- Pressure transmitters and switches
- Temperature transmitters and switches
- Lids with hinges
- Instrument and isolation valves
- Heating and Insulation
- Manways
- Secondary containment
- Larger fiberglass and steel tanks often have ladders with cages and safety railings around the top

Although steel and stainless steel tanks are available, they tend to be a custom fabrication that can get more involved. For these types of tanks contact your Hayward Gordon Systems Engineer. This information package will focus primarily on HDPE and FRP tank configurations.

Hayward Gordon Ltd.
Pumps • Mixers • Strainers • Engineered Systems and Controls

High Density Polyethylene (HDPE) Tanks

HDPE tanks are manufactured to strict ISO 9002 quality guidelines to ensure years of customer satisfaction. Impact-resistant, non-corrosive, one-piece seamless linear polyethylene construction allows the tanks to be used for the storage of most liquid fertilizers, herbicides, insecticides and fungicides, as well as a wide range of industrial chemicals. The tanks are manufactured using food grade approved resin to ensure safe storage of potable water.

Applications

- Sodium Hypochlorite (Bleach)
- Sodium Hydroxide (Caustic Soda)
- Calcium Chloride
- Phosphoric Acid
- Deionized water
- Waste oils & Lubricants
- Ferric Chloride
- Polymer

Specifications

- Tanks shall be virgin polyethylene, natural white in color as compounded by manufacturer.
- Tanks shall have a UV stabilizer in the polyethylene resin as compounded by the manufacturer.
- Tanks are available in 1.5 or 1.9 Specific Gravity.
- Tanks are manufactured in accordance to ASTM D1998-93 Specification (for the manufacture of Linear Polyethylene Upright Storage Tanks).
- Finished tank walls shall be free of visual defects such as foreign inclusions, air bubbles, pin holes, pimples, crazing and delaminating. Fine bubbles are acceptable as long as they do not interfere with the proper fusion of the resin melt.
- Flanged connections shall be in accordance with ASME B-16.5 for 150 psi pressure class.

Mechanical Properties of High Density Linear Polyethylene are:

Property	ASTM Test Method	Value
Density (resin)	D1505	0938-0944 g/cc
Tensile (yield stress 2" min)	D638	2600PSI
Elongation at break (2" min)	D638	350%
ESCR (100% lgepal,Cond A, F50)	D1693	400-1000 Hours
ESCR (10% lgepal,Cond A, F50)	D1693	200-500 Hours
Vicat Softening Degrees F	D1525	235 F
Flexural Modulus	D790	97000-103000 PSI

Accessories

- External Mixing Bridges or Mounts for Portable Mixers
- Level Transmitters and Switches
- Bulkhead and Welded Fittings
- Valves and Piping
- Sight Glasses with Level Switches
- Tank Stands
- Polyethylene Containment Basins

Montreal
Tel: (514) 697-6445
Fax: (514) 697-1164

Toronto (Head Office)
Tel: (905)693-8595
Fax (905)693-1452

Calgary
Tel: (403) 253 2737
Fax (403) 253-1353

Vancouver
Tel: (604) 986-8764
Fax (604)986-8794

Hayward Gordon Ltd.
Pumps • Mixers • Strainers • Engineered Systems and Controls

Tank Types and Sizes

- Vertical Cylindrical Open Top: 6-6900 USG
- Vertical Cylindrical Closed Top: 26-16560 USG
- Horizontal Industrial Tank: 30-3000 USG
- Open Top Rectangular Storage/Containment: 7-360 USG
- Closed Top Rectangular Storage: 30-325 USG
- Vertical Cylindrical Conical bottom: 14-11520 USG

Industrial Vertical Storage Tanks

- Seamless Roto-Molded Free Standing Tanks
- Lifting Lugs
- Tie Downs
- Welded Fittings
- Bulkhead Fittings
- Fill Lines
- Goose Neck Vents
- Outlet Valves
- Custom Fabrication

22 - 18,300 Imperial Gallons
(26 - 21,978 US Gallons)

Industrial Conical Tanks

- Complete Drainage
- Closed or Open Top
- Steel Stands
- Fill Lines
- Vent Fittings
- Outlet Valves
- FDA Poly
- Sight Glass

12 - 9,600 Imperial Gallons
(14 - 11,529 US Gallons)

Containment Systems

- Goose Neck Vents
- External Fill Lines
- Pump Out Lines
- Sight Glass Assembly
- Lifting Lugs
- Self-Contained
- Heat Tracing
- Insulation Package

500 - 8,000 Imperial Gallons
(600 - 9,608 US Gallons)

Montreal
Tel: (514) 697-6445
Fax: (514) 697-1164

Toronto (Head Office)
Tel: (905)693-8595
Fax (905)693-1452

Calgary
Tel: (403) 253 2737
Fax (403) 253-1353

Vancouver
Tel: (604) 986-8764
Fax (604)986-8794

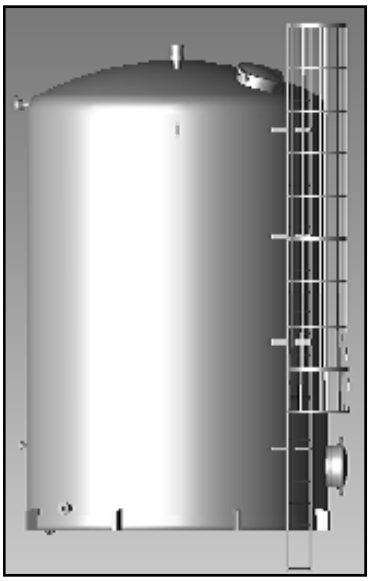
Fiberglass Tanks

Fiberglass tanks are manufactured to ASTM standards. There are 2 methods of fabricating Fiberglass tanks: Centrifugal casting (manufactured to ASTM D-4097-01) and Chop Hoop Filament (manufactured to ASTM D-3299-00).

When a tank is manufactured the following details must be taken into consideration:

1) Product to be stored (requires MSDS for proper resin chose).
2) Temperature of stored product.
3) Location of Tank (indoor, outdoor).
4) Seismic zone for which the tank is located.
5) Heating and Insulation required.

Advantages of Fiberglass



- Corrosion resistant to a wide variety of chemicals and temperatures based on a large selection of resin types.
- FDA approved for potable water or food grade applications.
- Cost effective tank storage option.
- Longer Lasting - depending on application, 20 plus years is not uncommon.
- No need for sandblasting or painting - UV inhibitor and color are pigmented into resin.
- Great for any type of environment – indoors / outdoors / rain / snow.
- Light weight and easy to handle – 33% lighter than Aluminum and 75% lighter than steel.
- High strength to weight ratio.
- Fully customizable – design the tank to meet all of your needs.
- Specialty resins allow for fire resistant tanks.
- Insulation and heating are possible using heating panels and spray on polyurethane insulation.
- Non-conductive (prevents shorting of electrical equipment).

Applications

Fiberglass tanks are used by companies in a wide range of industries to store a variety of contents in a multitude of applications such as:

- Water
- Chemical
- Pharmaceutical
- Semiconductor
- Pulp/Paper
- Agriculture
- Food Processing
- Brining
- Biotech
- Textiles

Fiber Glass Mix Tanks

Mix tanks are available in several styles. This series of tanks is a heavy walled version of the standard line of fiberglass storage tanks.

FLAT BOTTOM (Flanged lip included)

Heavy duty flat-bottom mix tanks are ideal for applications where complete drainage is not critical. Hold-down lugs are recommended for mixing applications.

DISH BOTTOM WITH SKIRT (Flanged lip included)

Skirted mix tanks feature a 12” clearance to the floor and are designed to provide complete drainage.

DISH BOTTOM WITH LEG RING (Flanged lip included)

Dish-bottom leg-ring tanks are designed to achieve complete bottom access and maximum floor clearance.

Steel Pipe Legs

Legs may be ordered separately on all leg-ring tanks and can either be supplied by the tank manufacturer or the customer. All centrifugally cast tanks require four pipe legs. Legs available through the manufacturer are primed steel pipe with NPT threads on both ends and are designed to fit into steel couplings welded onto a fiberglass- encapsulated steel leg ring. The lower portion of the leg threads into a primed steel flange pad with ASA 150# bolting geometry. The pads can be bolted to the floor for stability. Other leg materials are available.

Ladders and Safety Cages

Ladders and safety cages that meet OSHA standards are available in carbon steel (primed, epoxy-painted, and powder-coated), fiberglass, or aluminum on any style fiberglass tank.

Ladders are secured to tank wall by bolting to an “L” shaped mounting lug bonded permanently to the tank. See drawing for detail.

Standard Fiberglass Storage Vessels - Centrifugally Cast Tanks

Utilizing centrifugal force to combine resin and glass, the centrifugally cast fiberglass tank has a dense uniform wall laminate capable of 70% resin content. The entire tank wall becomes a resin-rich, chemical-resistant barrier that can be custom engineered for specific requirements ranging from the storage of corrosive chemicals to food-grade applications.

Diameters available: 24”, 30”, 32”, 38”, 42”, 48”, 60”, 72”, and 90”
Heights (vertical) or lengths (horizontal) available: 18” - 233” for single-piece tanks.
Tanks greater than 233” are available with multiple sections.

The Process

The Centrifugal Casting Process was pioneered more than 40 years ago as a method to construct high-performance gondolas for atmospheric test balloons. It has developed into and remains one of the most versatile and economical methods of producing high quality fiberglass tanks. This fabrication technique employs a female mold, which provides a high-gloss, smooth, and aesthetically pleasing exterior to complement a customer’s facility.

The process provides all of the mechanical strength necessary for liquid storage plus the superior chemical resistance capability of a high resin-to-glass ratio wall construction.

In tanks 24” through 48”, the entire wall is constructed from a single resin system. Larger diameter tanks (60” through 90” diameter) feature the additional flexibility of manufacturing with a dual resin system to achieve a high-quality tank at an economical price.

Step 1 The spin cast tank is produced inside a smooth metal cylinder. The end section (head), which is manufactured in a separate mold, is inserted into the cylinder at a point determined by tank capacity.

Step 2 After the end section is positioned, sidewall construction begins by applying a 10-to-15 mil layer of resin coat or gel coat to the spinning mold, providing the desired color.

Step 3 The structural wall and corrosion barrier—the backbone of the tank—is constructed by simultaneously chopping “E” glass and delivering resin to the cylinder for strength. Computerized equipment provides a consistent laminate with uniform thickness.

Step 4 Upon completion of the wall, the inside surface is coated with 7 to 10 mils of pure resin to give the interior of the tank a smooth corrosion-resistant barrier. In highly corrosive applications, such as the storage of caustic materials, a layer of synthetic veil is added before the final resin coat to provide further resistance to chemical attack.

Step 5 After curing in the mold, the tank is removed and checked for quality before being sent to the final assembly area for installation of accessories.

Specifications

Centrifugally cast tanks are designed to meet or exceed the strength requirements of ASTM D4097-01. Standard catalog tanks are built to hold contents with a specific gravity of 1.3 at a safety factor of not less than 10:1. Custom-engineered tanks designed to hold heavier materials are available.

Typical Properties (Minimum)

Tensile Strength (PSI)	14,000 ASTM D638-01
Tensile Modulus (PSI)	800,000 ASTM D638-01
Compressive Strength (PSI)	18,000 ASTM D695-96
Flexural Modulus (PSI)	600,000 ASTM D790-98
Flexural Strength (PSI)	19,000 ASTM D790-98

Tensile Strength (PSI)	14,000 ASTM D638-01
Tensile Modulus (PSI)	800,000 ASTM D638-01
Compressive Strength (PSI)	18,000 ASTM D695-96
Flexural Modulus (PSI)	600,000 ASTM D790-98
Flexural Strength (PSI)	19,000 ASTM D790-98

Standard Fiberglass Storage Vessels - Chop-Hoop Filament-Wound Tanks

Chop-hoop filament winding is a unique blend of two proven fabrication techniques: chopped glass "spray up" and continuous filament winding. This combination provides the benefits of maximum corrosion resistance plus the strength required for vertical storage. The structural wall is constructed through a process of simultaneously glass chopping, resin application, and hoop filament winding.

Diameters available: 8', 9', 10', 11'9", 12', and 14'
Heights available: 3' – 50'

The Process

The Chop-Hoop Filament-wound Tank is produced over a smooth male mandrel in four automated steps:

Step 1 The bottom head is produced in a separate mold and affixed to the mandrel. A resin-rich inner surface is applied to the mandrel and reinforced either with a glass veil or a synthetic veil in those applications requiring maximum chemical resistance. This layer is a minimum of 10 mils thick with a 20/80 glass/resin ratio.

Step 2 The interior corrosion barrier is constructed by combining resin with chopped "E" minimum of 90 mils with a 30/70 glass/resin ratio.

Step 3 The structural wall is produced using a process of simultaneous glass chopping, resin application, and hoop filament winding. The glass/resin ratio is 50/50 with the glass roving (filament) providing the required hoop strength. The thickness of the structural wall is varied according to tank height, application, and specific gravity of the contents.

Step 4 Finally, a 5-mil resin coat or a 45-mil exterior corrosion barrier is added depending upon intended application. The exterior corrosion barrier consists of a layer of resin and chopped "E" glass strand applied in a 70/30 resin/glass ratio. An exterior pigmented resin of choice can be added if customer desires a color other than natural.

Specifications

Using chop-hoop filament-wound fabrication, fiberglass-reinforced plastic tank walls are manufactured to meet the criteria of ASTM D 3299-00.

Standard storage vessels are designed for contents with a specific gravity of up to 1.3. Tanks designed to hold heavier materials are available upon request. Chop-hoop filament-wound tanks can be manufactured for food-grade applications depending on customer requirements.

Typical Properties (Minimum)

Hoop Direction	
Tensile Strength (PSI)	42,000 ASTM D638-01
Tensile Modulus (PSI)	2,400,000 ASTM D638-01
Flexural Strength (PSI)	58,000 ASTM D790-98
Flexural Modulus (PSI)	1,800,000 ASTM D790-98

Axial Direction	
Tensile Strength (PSI)	13,500 ASTM D638-01
Tensile Modulus (PSI)	1,450,000 ASTM D638-01
Flexural Strength (PSI)	33,600 ASTM D790-98