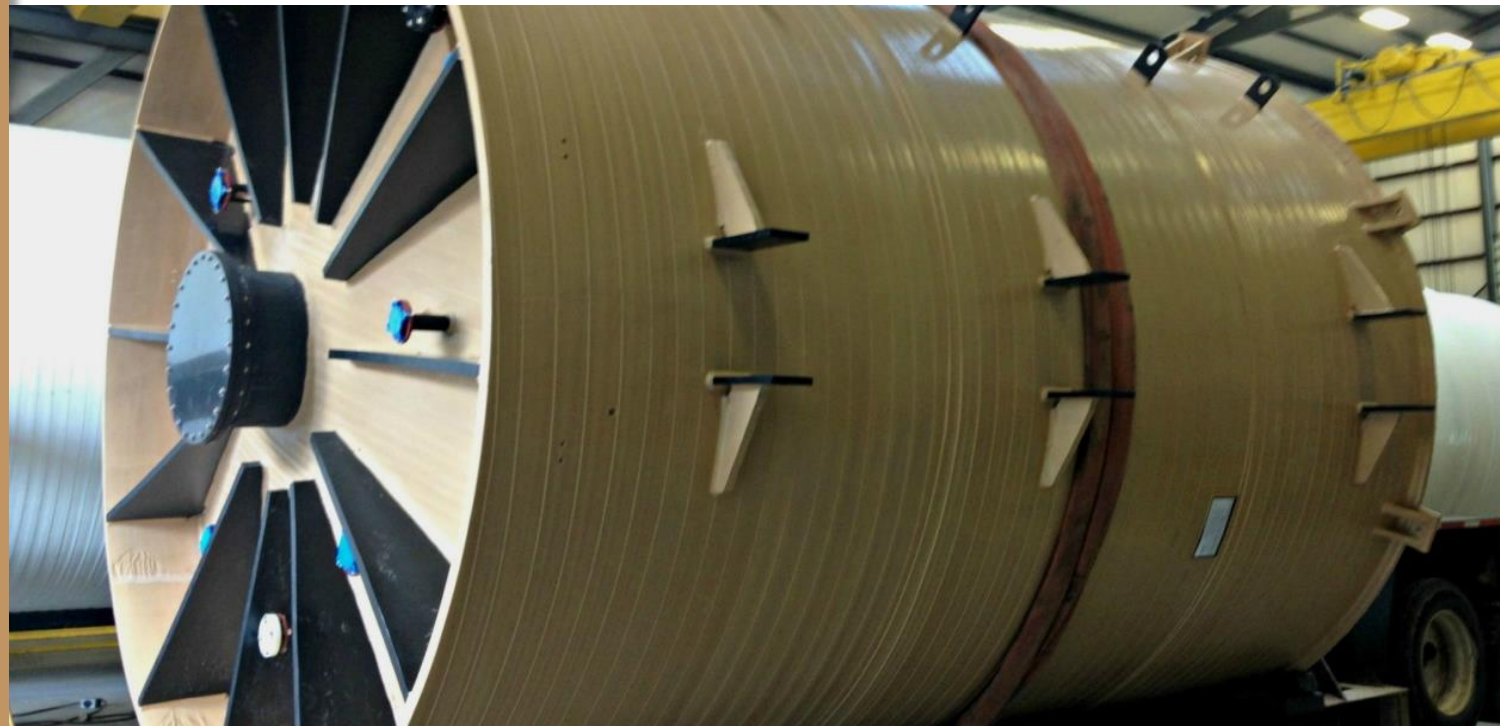




INNOVATIONS IN TANK TECHNOLOGY:

10 Reasons Why Your Chemical Storage Tank Is Failing (It's Not What You Think!)

*Innovations in
Tank Technology*



Top Ten Reasons

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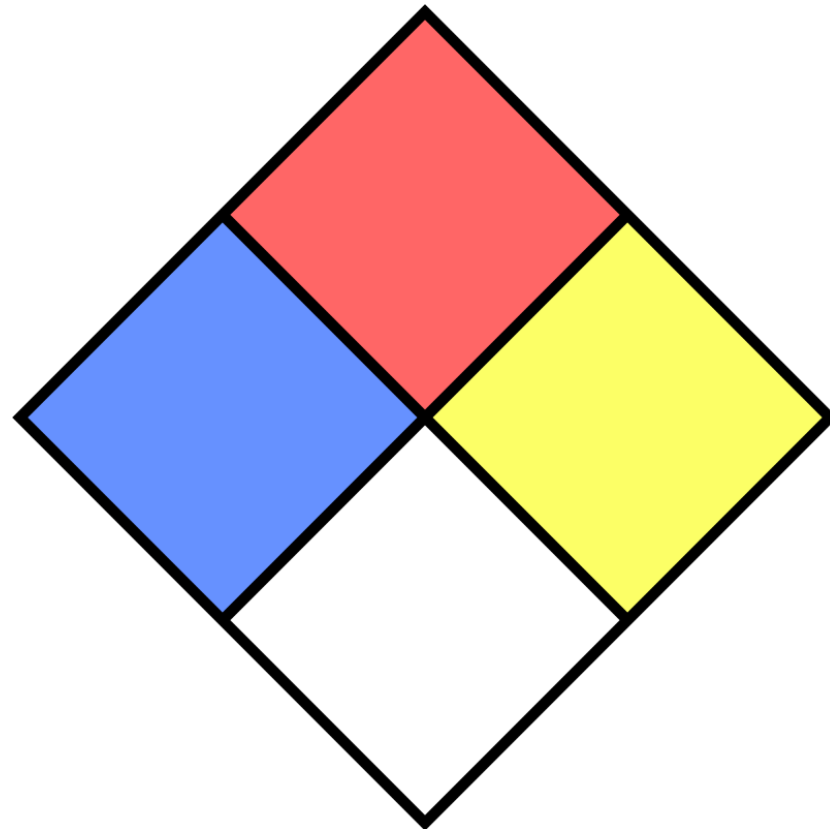
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INTRODUCTION

Storing harsh chemicals that are used as a part of a production process is not an easy task. There are safety considerations that must be adhered to and techniques that will enhance production processes. If you are not thinking about these issues, then your chemical storage tank is failing. Engineers want to make sure they maximize both workplace safety and plant efficiency, and by thinking through the reasons on the following pages, one can ensure the best possible tank solution for the need at hand.

In order to properly specify the right tank, you need to consider the following:

- Specific Application
- Chemical Compatibility
- Working Temperature
- Specific Gravity
- Size
- Physical location
- Weather
- Maintenance
- Safety concerns



Top Ten Reasons

1

IT'S THE WRONG TYPE OF STORAGE TANK

What kind of storage do you need? This is a fundamental question to answer, as it can play a major role in deciding what type of tank you specify for your project. You may consider steel, stainless steel, fiberglass, roto-molded plastic or the newest manufacturing method, extrusion-wound plastic. Each has its strengths and weaknesses, so be sure to choose the right material for the job.

	Carbon Steel	Stainless Steel	Fiberglass	Roto-Molded	Extrusion Wound
Rigidity/ Wall Thickness	Rigid	Rigid	Slightly Stiff	Minimal Rigidity – Will bulge when filled and emptied	Very Rigid – Will not bulge
Size	All sizes	All sizes	All sizes	Small /medium	All sizes up to 50,000 gallons
Maintenance Needs	Higher maintenance	Higher maintenance	Low/No Maintenance	Low/No Maintenance	Low/No Maintenance
Corrosive Resistance	Some Material	Better than Carbon Steel	Extremely Corrosive Resistant	Good Corrosive Resistant	Extremely Corrosive Resistant
Investment	\$	\$\$\$	\$\$\$	\$	\$\$\$
Ability to Accessorize	Flexible	Flexible	Flexible	Very limited	Extreme Flexibility
Long-lasting	Need to combat rust	Need to combat rust – better than carbon steel	Longer lasting	Replaced every few years with harsh chemical use	Longer lasting

For both storage and reactor tanks, extrusion-wound tanks are particularly well-suited for use with aggressive chemicals and are often specified in these types of projects. This document will review many of the important considerations for specifying extrusion-wound tanks for your next project.

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Where are you going to put your storage tanks? It's a simple question but such information is a critical part of the proper design of storage tanks.

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Tanks can be mounted indoors or outdoors, near other equipment, or separated and far away from other equipment... The answers to these questions will help to drive decisions on the specific and safe design of your storage tanks.

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But one of the first considerations is to design the mounting surface for your tank. The size of the tank, the liquid being stored— even the geography of the site—are all elements to be considered.

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Geography

If the tank is to be kept outside, the engineers need to be concerned about wind loads and potential hurricane or earthquake compliance regulations that need to be followed. The area designated for storage tanks needs to be completely level, so the terrain of the area needs to be taken into consideration. If there is unlevel topography that could channel run-off from the rain, that needs to be engineered right from the beginning.

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Cement Footings

It's important to properly engineer the footings for any tank. Houston PolyTank's exclusive extrusion wound plastic tanks have very thick, rigid walls and a thick base, which can be sturdier and heavier than rotomolded tanks. To properly position a tank, it should rest on a very flat, very clean reinforced cement pad. There should be no pebbles or rocks underneath the tank, as this can lead (over time) to the development of a crack in the tank, which would affect the longevity of the tank.

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Mounting Surface

Make sure you have enough space for the storage tanks that you need. Footings need to be larger than the tank bottom in order to bolt the bottoms of the tanks to the mounting surface, and the bolts should not be too close to the edge of the cement footing. Typically, the surface would be at least 1.5 feet larger than the diameter of the tank to accommodate the mounting brackets and allow for the expansion and contraction of a plastic tank.

Specific Gravity and Stress

Whether indoors or out, it's important to account for the weight of the storage tank and the specific gravity of the liquid that you are going to be storing. If you are storing water, specific gravity would be "1" and the calculation is easy in terms of the stresses on that mounting surface... But if you are planning to house a chemical that has a higher specific gravity, your engineers need to make sure to calculate the *overall* stress on that cement pad and ensure that it can handle the entire load. Fortunately, our tank bottom acts as a membrane and disperses the weight of the liquid in the tank to the cement pad. The thickness of a cement pad may be 6-8 inches deep and could include metal rebar within, depending on the particulars of the project.



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What accessories will your tank need? Depending on the application, your tank may need to be “accessorized” or fitted with optional gauges, systems, or access panels. Take these into consideration in determining the type of tank you need as well as which accessories are required.

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For example, many applications require a liquid to be maintained at a certain temperature. An agitator paddle or mixer mounted right onto the tank can accomplish this. Rotomolded or other types of tanks would require a separate structure or elevated mounting platform to hold the weight of the mixer above the tank. However, the walls of an extrusion wound tank are thick enough and sturdy enough to hold the weight of the mixer right on top of the tank.

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Other accessories could include:

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- Ladder (with or without safety cage)
- Handrail
- Inspection ring
- Mixer mount
- Immersion heater or heating coil
- Baffles
- Tie downs
- Lightning protection
- Insulation systems
- Side or top manways
- Catwalks
- Level control gauges
- Vents

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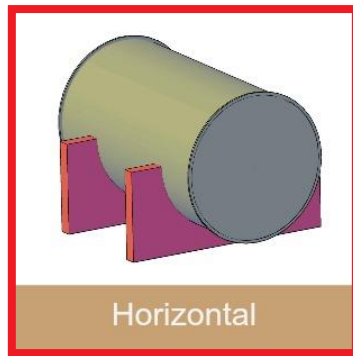


Top Ten Reasons

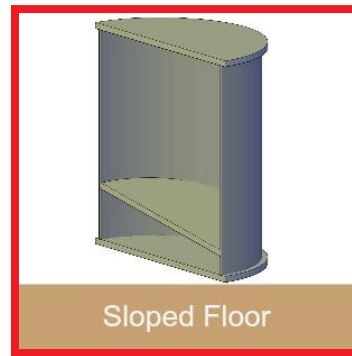
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YOUR STORAGE TANK DOESN'T HAVE A SKIRT

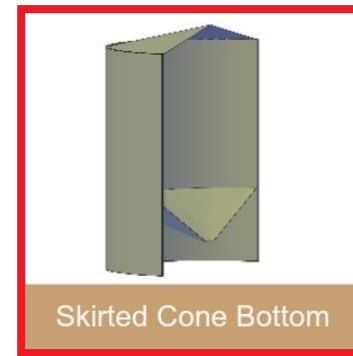
Do you need a skirt on the tank? Many storage tanks require a cone bottom. If the tank is an extrusion-wound plastic tank, it is possible for a non-flat storage tanks (such as cone-bottomed tanks) to be supported by a baseleg skirt made from the same material. This skirt is actually part of the cylinder of the tank. By having a skirt with the same material as the tank, it eliminates time-consuming maintenance, mitigates the potential for rot or corrosion, and is aesthetically pleasing. A skirt protects the integrity of the tank and provides something that is visually attractive, while maintaining access to the bottom of the tank through cutout access holes in the skirt. While it does often make the tank a bit taller than it otherwise would be, it can also be a great solution for providing support for necessary piping that runs to and from the tank. These skirts can include drainage holes (so that snow or rain doesn't accumulate and add weight to the tank structure) or manways for constant undercarriage access.



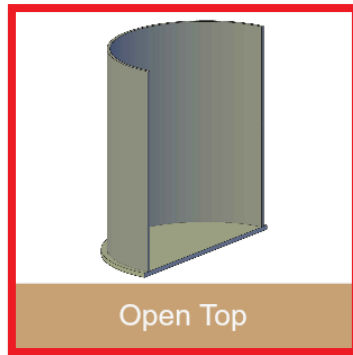
Horizontal



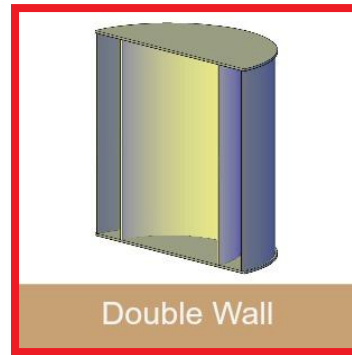
Sloped Floor



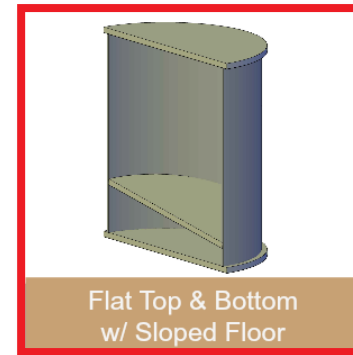
Skirted Cone Bottom



Open Top



Double Wall



Flat Top & Bottom
w/ Sloped Floor

Top Ten
Reasons

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What are the containment requirements of your chemical storage tank? Engineers need to think about the chemical itself and what other chemicals will be around it. To avoid potential hazardous situations, liquid chemical storage facilities need to be carefully constructed according to industry standards, safety regulations and common sense. For example, no engineer would house an acid next to a base liquid because it can create a potentially hazardous environment. There are laws in place to encourage companies to do everything possible to prevent aggressive chemicals from leaking into the soil, groundwater or surface water during the use of the tank system.

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Note: This ebook only addresses this issue in a very broad way and should not replace complete due diligence about particular industries, applications or chemical regulations.

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There are three secondary options to consider:

- Containment area with single wall tank
- Double Wall Tank (tank inside tank) without containment area
- Double Wall Tank (tank inside tank) with a containment area.

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Note: This option provides the strongest protection in case of leak from pumps, pipe, etc.

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The engineers need to think through, “where will the liquid go if the integrity of the tank or if the fitting connections would be compromised?”

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Top Ten Reasons

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Extrusion-wound tanks can be specified as double-wall tanks that are part of a larger chemical storage containment system where a plastic tank is created *inside* a plastic tank. These two tanks are welded together to create a double-wall containment system that is then set in a secondary containment area in the facility. It's important to account for the *entire* volume of the tank to ensure that if the tank breaks, the secondary tank can hold the entire volume of liquid. The connections of the primary tank will penetrate both walls, while the connections in the secondary tank will penetrate just the outside wall in order to drain the containment.

In building secondary containment tanks, one need is to vent the secondary tank as well as the primary tank. Also, it's important to be able to monitor the space between the two tanks to confirm that the first tank is not compromised. If there is a leak into the secondary tank, the operator can notify the tank manufacturer so that they can make plans to correct the situation. Extrusion-wound tanks can be repaired in the field to get it back into operation.

The best solution is to put a double wall tank within a containment area to have multiple levels of protection.

Need More Specific Chemical Storage Information?

You can find out more about containment system requirements at www.epa.gov

Your facility may also be required to meet other specific secondary containment requirements; to find out more, we suggest you consult with a local fire marshal for more localized information.

Top Ten
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THE TANK PLACEMENT DOESN'T ACCOUNT FOR TANK MAINTENANCE AND REPAIR

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How will the storage tank be maintained and repaired? What kind of access do you need to manage the tank itself? Some storage tanks are cleaned out regularly and include manways in the top or side. All plastic tanks, especially those that house particularly aggressive chemicals, should undergo a visual inspection at least once a month. In order to do this, personnel will need to be able to walk around the tank in order to perform a visual inspection.

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Signs that can be detected during the visual inspection include the following:

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- Bulges
- Discoloration
- Crazes
- Crack – like defects
- Leaning/loss of verticality
- Local wetting of external surfaces
- Erosion/corrosion of supporting structures and bases.

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In plastic rotationally molded tanks, most likely these stresses would be located around the fittings and the bottom of the tank where the tank wall meets the tank floor. When cracks occur in plastic tanks, the chemical barrier in that area is weakened. While crosslinked rotationally molded tanks cannot be fixed onsite, extrusion-wound tanks can.

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When you are determining the positioning of your tank, make sure to account for regularly-scheduled maintenance and inspections that may need to be done on your tank.

Top Ten
Reasons

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Have you built in the proper building access? Often customers need a storage tank that will be housed in the new facility, and many times, those tanks are of considerable size. Extrusion-wound tanks can be extremely large, and customers who like this type of tank make their plans accordingly. The engineers design the facility around their overall process needs, taking into consideration overall safety precautions and industry best practices. In the development and construction of a facility, it is not uncommon for the tank to be put into place by a crane before the entire structure is even completed. This makes logical sense, as the most efficient way to construct the manufacturing facility is to build it up around a chemical tank or series of storage tanks. Any company in this situation needs to make sure there is a way to replace the tank in the structure.

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One of the major advantages of extrusion-wound tanks over the rotationally molded tank is the unique rigid construction of the tanks. The sidewall will not bulge while being emptied and filled. This solves the issues of cracks because the sidewall will not bulge or move, especially, in plastic tanks that are filled and emptied frequently.

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Top Ten Reasons

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ACCESS TO THE TANK IS TOO BROAD

Who has access to the tank? Security is paramount, so personnel access to the tanks is an important consideration, particularly in today's global environment. Chemical tanks in particular can be explosive and harmful, and any loss of integrity in the tank can close a factory or an entire area. Terrorism is a consideration, so safety and security concerns need to be addressed at the start of such an engineering project.

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Overall accessibility of storage tank facilities is of critical importance—from physical access around the tank for ongoing maintenance and regular inspections, to having a pre-planned arrangement for repair and replacement of any tank and finally ensuring that overall safety and security measures are all attended to.

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Top Ten
Reasons

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What will the weather be like? If you are specifying chemical holding tanks that will be outside, exposed to the elements, you have some special circumstances that need to be taken into consideration.

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Heat

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This deals not only with heat created when using a tank as a chemical reactor or heat generated from immersion heaters meant to keep a liquid at a specific temperature but also heat from the sun.

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There are several issues to keep in mind when it comes to heat:

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**Chemical Holding Tanks –
Interior Temperature
(both the liquid and the air in the tank)**

In order to avoid potentially hazardous conditions in your outdoor chemical tank, you need to calculate how hot the liquid and the air will get in the tank as it sits in the sun on the hottest summer day.

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Expansion and Contraction

Both metal and plastic expand and contract.

Plastic tanks tend to expand more than metal, so it is critical to account for such fluctuations during the design phase. If the tank will perpetually be filled with a liquid, that liquid will probably absorb heat and keep the tank at a more constant temperature. However, if the tank will be left empty for an extended period of time, the best practice for tank installations today call for precautionary measures that will accommodate both expansion (in the heat) and contraction (in the cold). These measures include:

- Specific footing connections that adjust with the slight changes in positioning that come with those expansions and contractions
- Proper gaskets that adjust the openings required for tank accessories like inlet or outlet valves, manways, or measuring and mixing openings
- Tank & tank fittings that are isolated from vibrations (from pumps or other machinery)
- Tank fitting locations that can change slightly due to expansion and contraction. They need to be free to move slightly with such changes and should not be constrained

To solve the potential issues associated with vibration, expansion and contraction, pipes should not hard-wired to the tank, secured tightly to the ground, or otherwise unnecessarily constrained. They need to be free to move up or down. On the other hand, you should not put continuous unsupported weight on the tank flanges (such as heavy valves). To solve this issue, use extension joints designed to isolate the tank and its flanges from the surroundings. In addition, any heavy equipment that “hangs” on the tank should be supported separately (from the ground). If you don’t make accommodations for expansion and contraction, your tank is more susceptible to cracking, which can be disastrous to your plant and your team. Unlike rotomolded tanks, extrusion wound tanks can be fixed in the field.

If you are specifying chemical holding tanks that will be outside, exposed to the elements, you have some special circumstances that need to be taken into consideration.

Top Ten
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UV Attack From The Sun

In addition to heat caused by the sun, there is also ultraviolet light to contend with. There will always be some discoloration from the sun—it is a natural part of the wear and tear of the tank that needs to be expected and guarded against whenever possible. UV rays will constantly be attacking plastic tanks, and many plastic storage tanks come with UV inhibitors blended right into the plastic and welding at the time of construction.

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Rain

With plastic chemical storage tanks, rain is not particularly an issue. Even acid rain will have little to no effect on plastic extrusion wound tanks.

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Accessories, however, are a different story. If an engineer specifies a metal component, like a ladder or railing, those could potentially be impacted. To avoid corrosion, some components can be made from fiberglass or plastic.

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Lightning

No matter how short or tall your chemical holding tanks are, it's important to make sure there is some method of grounding to mitigate against potential lightning strikes. A lightning rod or metal cable needs to run to the ground in order to keep lightning from starting a fire. This is especially true for tanks that store oil.

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Top Ten
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Wind

When calculating the specifications for a chemical storage tank, engineers need to structure tank strength to withstand the stresses of wind shear. When the tank is full, this is typically less of an issue, so calculations need to be made based on an *empty* tank. This is not as important for a very small tank, but very large tanks can be very tall. The taller the tank, the more wind shear it will be susceptible to.

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Note: Every extrusion-wound tank is engineered to withstand up to 120 mile per hour winds when empty.

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Natural Disasters

Blizzards, tornadoes, earthquakes and hurricanes can all wreak havoc on outdoor chemical storage tanks. If the tank will be housed in an area that is prone to these types of weather occurrences, discuss your needs with your tank engineer.

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Examples

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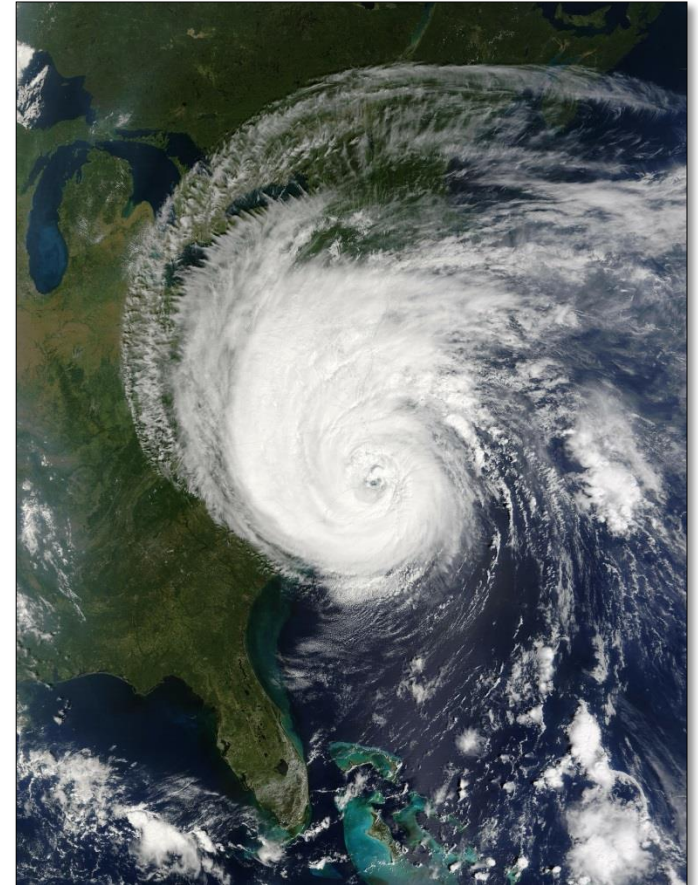
- In California, seismic supports are typically added to protect against earthquakes.
- In areas where large snowfall creates stress on top of the chemical holding tanks, drainage holes in cone-topped tank skirts or surface heaters can be engineered into the tank in order to mitigate against heavy snow loads.

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Heat, cold, wind, rain, snow, sleet—there are plenty of weather challenges to proper storage, so it's important to think through all of these issues right from the start and specify a tank that can stand up to the best of what Mother Nature dishes out!

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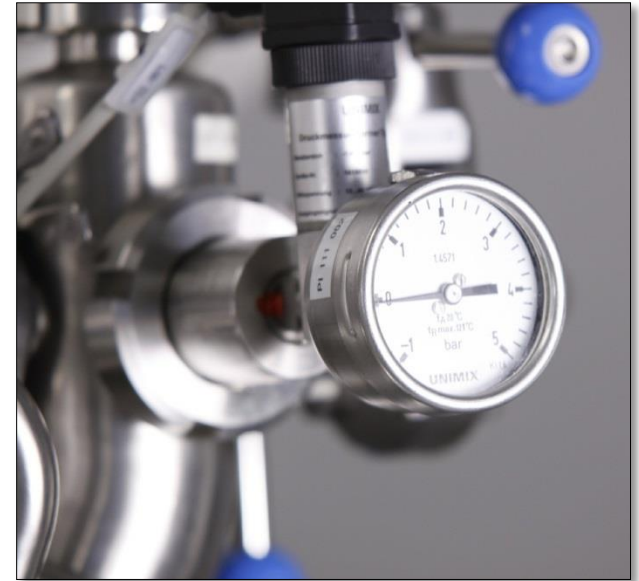
THERE ARE NO PRESSURE CONTINGENCIES

How will you maintain proper pressure? Pressure and vacuum are two big factors that can stress an industrial bulk container. Unless a tank is designed for specific operating pressure or vacuum, storage tanks including plastic and fiberglass are generally designed to be used at atmospheric pressure. Steel tanks can be introduced to a pressure of usually 2 PSI. In this article, we will concentrate on the influence of pressure and vacuum in plastic storage tanks. Introducing pressure or vacuum in plastic storage tanks can shorten the expected service life. In some cases, exceeding the vacuum and pressure design can result in a catastrophic failure of the tank.

What can cause pressure or vacuum in daily operation:

To avoid creation of pressure or vacuum in a tank, the plant engineer should develop an operation guideline and take into consideration the following:

- **FILLING AND EMPTYING THE TANK TOO QUICKLY** – It is strongly recommended that the tank will be filled and emptied in a slow rate to allow the venting system to displace the liquid volume with air. One needs to make sure that the venting system is allowing enough air movement to and from the tank.
- **OVERFILLING THE TANK** – This situation needs to be avoided since it can create pressure in the tank.
- **PRESENCE OF HARSH CHEMICALS** – Some chemicals release fumes by their nature. In many cases, these chemicals should not be openly vented to the atmosphere and are restricted by local ordinances. A scrubber system or other fume extracting devices are used to capture the fumes or odor. In the design of those scrubbers, we need to take into consideration and make sure that we are not restricting adequate air flow to and from the tank. A clogged scrubber and long piping to the scrubber are causes for restricting the air flow.
- **TEMPERATURE** – Elevated temperatures will increase the vulnerability of the tank. If a tank sits outdoors, pressure can build up and stress the container further.



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The Human Factor

Poorly trained or inattentive operators may not know how much liquid is already in a chemical storage unit, or they may not know how to read the gauges that indicate this information. It could also be that they are at the end of their shift and make a mistake in their rush to finish up and get home for the day. The venting design of the tank should have a high margin of safety to avoid these situations that can cause pressure or vacuum.

2

Allowable Pressure/Vacuum Restrictions

Generally, rotationally molded tanks will have a more stringent restriction than thick wall extruded plastic tanks. Some rotationally molded companies will allow a maximum pressure of .36 PSI. Extrusion wound tanks can allow a maximum additional induced pressure of 1 PSI. This can be increased to 2 PSI with additional structural supports. Always consult with the manufacturer regarding the maximum allowable pressure and vacuum in their tank.

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Consider the Following Instrumentation

- Emergency pressure/vacuum relief valve
- Electronic monitoring of the liquid volume in the tank
- Visual monitoring of the liquid volume in the tank such as reverse float level indicators

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Accumulating Damage Over Time

Unfortunately, stress cracks can form in plastic storage tanks yet still go unnoticed for long periods of time. Tanks need to be visually inspected periodically to look for any discoloration or cracks, which indicate a development of stress. The manufacturer should be contacted and consulted in this situation.

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Top Ten
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Storage of certain concentrated chemicals can be extremely challenging, because of concerns such as chemical attack, high specific gravity, UV attack and oxidation. By thinking through the issues before the tank is built, you can eliminate costly and time-consuming mistakes down the road.

2

Extrusion-wound tanks are particularly well-suited to house a wide range of harsh chemicals and may be just the right answer for your next application. You can find out more about these types of tanks and view both custom and premade tanks offered at www.HoustonPolyTank.com.

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If you'd like to discuss your next project, feel free to give our staff a call right away!

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