

Tank Talk®

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Storage Tank Engineering Updates for Owners and Operators of Industrial Tanks

Buying Tanks is Easy...

by Raymond E. Penny, Director of Industrial Sales & Marketing Penny@TankIndustry.com

Buying tanks may be fairly routine for many companies, however getting value isn't easy. There are many issues to consider and the buyer needs to know which ones are important to his tank as he prepares to buy the tank. Some issues are important to all tanks and some only to specific tanks. The important issues affect the value an owner receives from his tank. The average buyer focuses more on cost, and more specifically on *first cost* than on value. Not getting value leads to more pressure to reduce costs.

Tanks may look fairly simple, but with ever-changing environmental regulations, advancements in technology, and the relentless demand to *reduce* costs, tanks have become more complex than they once were. Current requirements to reduce emissions, leaks and spills are evolving toward *elimination* of them. Open pits are no longer tolerated for storing crude oil, much less gasoline and the myriad of hazardous and polluting compounds now produced.

Tank design and construction improvements have been for the most part developed by tank contractors and their engineers, not by tank owners and operators, although without demand, there would be no supply. Those tank contractors who have developed the designs and the improvements to meet their customers' needs have tended to stay in the business longer. Today, there is essentially only one big, worldwide tank contractor and a number of smaller regional ones.

While owners continue their efforts to reduce costs, issues affecting tanks have become more numerous and complex, driving costs higher. Many owners developed standard specifications to make it easier for the smaller contractors to partici-

pate, thereby reducing dependence on a relatively small number of experienced and knowledgeable contractors. As the number of contractors has grown, the need for maintaining quality and safety has increased leading to pre-qualification evaluations, again adding to cost.

Cost cutting has gone beyond eliminating waste and inefficiency. Owners have also cut staff. Reducing payroll generally starts with the older people who make the most money, but these folks are generally those who have the most knowledge and experience. Contractors have reduced cost by reducing services. Many have reduced in-house quality control. Some contractors have few or no experienced engineers. As the focus continues on low cost, contractors furnish less and less to stay competitive and meet the challenge. Owners believe that the big, experienced contractors offering more services are only needed for the large, complex, difficult or risky jobs.

There is still a market for used tanks. Re-constructing used tanks in a new location is not uncommon. Changing service is also used to extend the useful life of a tank. Owners have more options today than in the past. API-653 helps owners manage risk, reconstruct used tanks and extend service life thus facilitating alternatives to investment in new tanks.

In order to get value from tanks in today's world, owners need to know about the tanks they have and about the tanks they buy. They should understand their needs from not just an economical standpoint, but also from a technical standpoint. Having a clear and precise specification (and bid package), hiring a knowledgeable and capable contractor, and inspecting the contractor's work are keys to getting value.

Like I said, "Buying tanks is easy."

Creating standard in-house specifications and adding engineers to the owner's staff have their drawbacks. Perhaps the best solution is to hire an experienced and knowledgeable tank consultant to help. The consultant can help the owner identify the important issues and prepare a complete and thorough specification to communicate the owner's needs to the contractor. Then, the consultant can help the owner evaluate bids and inspect that *low bid* contractor's work to see that the contractor delivers what is contracted. When the work is done, the owner can send the consultant home without having a continuing payroll burden. A good consulting company who has people with extensive knowledge of tank technology and industry standards, and first hand experience designing and building tanks can bring real value to the owner.

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Spheroid Inspection & Evaluation

by John Lieb, P.E., Lieb@TankIndustry.com

You may have seen tanks on the ground that look like *pumpkins* or *squashed spheres*. Chances are these are spheroids. In the period roughly between 1930 and 1960, Chicago Bridge & Iron (CBI) built many of these vessels, after having invented the design. CBI built two varieties, known as Smooth Hortonspheroids® and Noded Hortonspheroids®.

The original purpose of the spheroid was a pressure container used for the storage of volatile liquids. It was particularly intended for the storage of hydrocarbons ranging in volatility from motor gasoline to natural gasoline.

The principle of operation for the spheroid was originally to prevent evaporation losses from volatile liquid by making use of the simple fact that no loss can occur unless vapor escapes. The spheroid was designed to eliminate losses due to:

- Breathing, which results from daily temperature change: The spheroid was equipped with a relief vent set to open at a pre-determined pressure. The air-vapor mixture could not expand when the temperature rose and pressure was built up instead.
- Boiling: The spheroid was designed to minimize surface boiling of higher vapor pressure liquids at ambient storage temperatures by allowing the pressure to build to a level sufficient to stop the boiling.
- Filling: Spheroids were designed to either reduce filling losses or eliminate them completely, depending on the vapor pressure of the stored liquid and the pressure and vacuum settings of the relief valves.

An economical vessel capable of being built in large capacities was made available with the invention and introduction of the spheroid. Plain or smooth spheroids were built in standard capacities ranging from 2,500 to 30,000 US barrels and for gage pressures as high as 25 psig. Noded spheroids were built in standard capacities ranging from 2,500 to 30,000 US barrels and for gage pressures as high as 15 psig. Noded spheroids are distinguished by one or more discontinuities in the curved surface of the shell.

Today, most of these vessels have been retired from pressure service or dismantled. Of those that remain, many have been de-rated to lower pressure or to atmospheric pressure service.

The unique geometry of the vessels was intended to make the most efficient use of the steel shell plates by *balancing* the latitudinal and longitudinal membrane stresses. Today this unique geometry presents a challenge to those responsible for inspecting and evaluating the structural integrity of these vessels.

Help is available!

Tank Industry Consultants (TIC) has developed the analysis tools necessary to evaluate these unusual vessels.

We can inspect and evaluate them in accordance with API Standard 653 criteria, API Standard 510 criteria, or ASME B&PV Code criteria, to determine remaining life, inspection intervals and other necessary information for the owner/operator.

If you own or operate any spheroids and need help inspecting or evaluating them, please contact us at Lieb@TankIndustry.com or (630) 226-0745.

Venting of Tanks for Rapid Cooling

by John Lieb, P.E., Lieb@TankIndustry.com

Tanks that operate at moderate to high temperatures can suffer expensive damage, and sometimes even fail completely, when subjected to rapid cooling, as when a sudden rainstorm occurs. Such tanks are at risk and should be adequately vented for this condition. Properly designed roof and shell insulation can usually protect a tank from such rapid cooling and thus the accompanying damage. However, many times the tank roof, and sometimes the tank shell, is not insulated. Normally, venting for this condition can be accomplished at minimal cost with a simple, easy-to-maintain venting device.

API Standard 2000, "Venting Atmospheric and Low Pressure Storage Tanks," provides the information necessary to design venting for a tank for normal operating conditions, as well as that for fire exposure. API 2000 addresses both positive and negative pressure venting conditions. But API 2000 does not address the case of rapid cooling that has led to the damage or collapse of several tanks. The venting provided for the inbreathing that occurs during emptying of the tank is usually not adequate for the rapid cooling condition.

In cases where a tank is vulnerable to damage from rapid cooling, TIC performs venting calculations to evaluate this case. While it is difficult to accurately predict all of the factors that should be considered in venting design for this case, a rational and sufficiently conservative design can be made by making some assumptions, such as:

- The temperature of the vapor over the product at the start of the rainstorm is essentially the same as that of the product.
- The vapor above the product is essentially hot air. Since, in reality, the actual vapor is a mixture of air and petroleum vapor which will cool more slowly due to a higher density, the assumption of air is slightly conservative.
- The evaluation neglects the input of heat to the vapor space from the product.
- The evaluation assumes the cooling of the un-insulated steel to an equilibrium temperature is essentially instantaneous.

Cost-effective venting can usually be provided by using a properly sized *gooseneck* vent. The vent should be screened with corrosion-resistant material to prevent the ingress of birds.

The design and provision of rapid-cooling venting will provide cost-effective *insurance* against the type of damage shown in this photo.

