Technical Notes
006

Exceeding Expectations

My Roof Is Out of Floatation!

There are several types of product storage tanks in the petroleum / chemical industry. This issue of AmSpec TechTalk will focus on the differences between **fixed roof** and **floating roof** tank storage, the advantages and disadvantages of each and the challenges they present to obtaining precise gauging.

A fixed roof tank is just that... its roof is fixed like the one on an ordinary home and usually peaked in the center allowing for roof rain water drainage. It has vents to allow vapors between the product level and roof to escape to the atmosphere since a fixed roof tank is incapable of withstanding any appreciable pressure or vacuum. This is considered a disadvantage of this type of roof design since it results in some product vapor loss and emits vapors to the ozone layer or to some vapor recovery system.

Fixed roof tanks are best adapted to storage of products which have relatively low vapor pressure such as distillates and fuel oil.

An external floating roof (Ref: Figure 1) is primarily a type of tank configuration where the roof actually floats on the product surface. Lighter products such as gasoline and jet fuel are usually stored for environmental or economical reasons to limit product vapor loss and reduce the emission of volatile organic compounds (VOC), an air pollutant.

Since floating roof tanks are designed to float on the liquid fuel, corrosion, which is caused by the presence of air, is almost entirely eliminated and fire hazard is materially reduced. Floating roof tanks are susceptible to some minor product loss primarily as a result of the action of the wind which tends to take vapors out of the narrow space between the seal and the tank shell.

Floating roof tanks have three main features which is unique to its design:

a) rubber seal
b) roof drains
c) legs

The **seal** is generally of a continuous strip of flexible, special rubber material which is attached to the roof and to the seal ring around the inside circumference of the tank shell and allows the roof to ride up and down as volumes increase and decrease. This seal needs to be constantly inspected for cracks and leaks to prevent rain water from entering the tank. It is located between the edge of the floating roof and the inside of the tank shell to minimize vapor leakage.

Unlike fixed roofs, floating roofs are slightly pitched towards the middle of the tank therefore allowing rain water accumulation to be disposed of thru the use of a roof drain.

A **roof drain,** which runs thru the product, is designed to collapse as product volumes fluctuate. Picture the letter Z in your mind and you will have good idea of how it works. It is connected to the roof's center and an outlet valve located at the bottom of the tank. It is recommended these drains be in the open position for gauging purposes when rain is in the forecast because the accumulation of rain water will affect precise gauging.

The weight of roof water accumulation, especially during heavy downpours over hours of extensive product transfers will cause inaccurate gauging. In this case, the gauging performed at the end of the product transfer should be suspended until roof water is drained to match opening gauging conditions.

(Roof drain valves are usually in the closed position because of the tendency of the roof drain pipes to crack which could allow water and product to interface.)

Much like an ordinary table, an external floating roof has **legs** attached to it which the tank roof rests on at low volume inventory.

When product levels no longer support the roof and the roof is resting completely on its legs, the tank is labeled "out of floatation". This is not to be confused with the "critical zone" which is the point where the tank is *about to come out of floatation* and is neither resting totally on its supports nor freely floating.

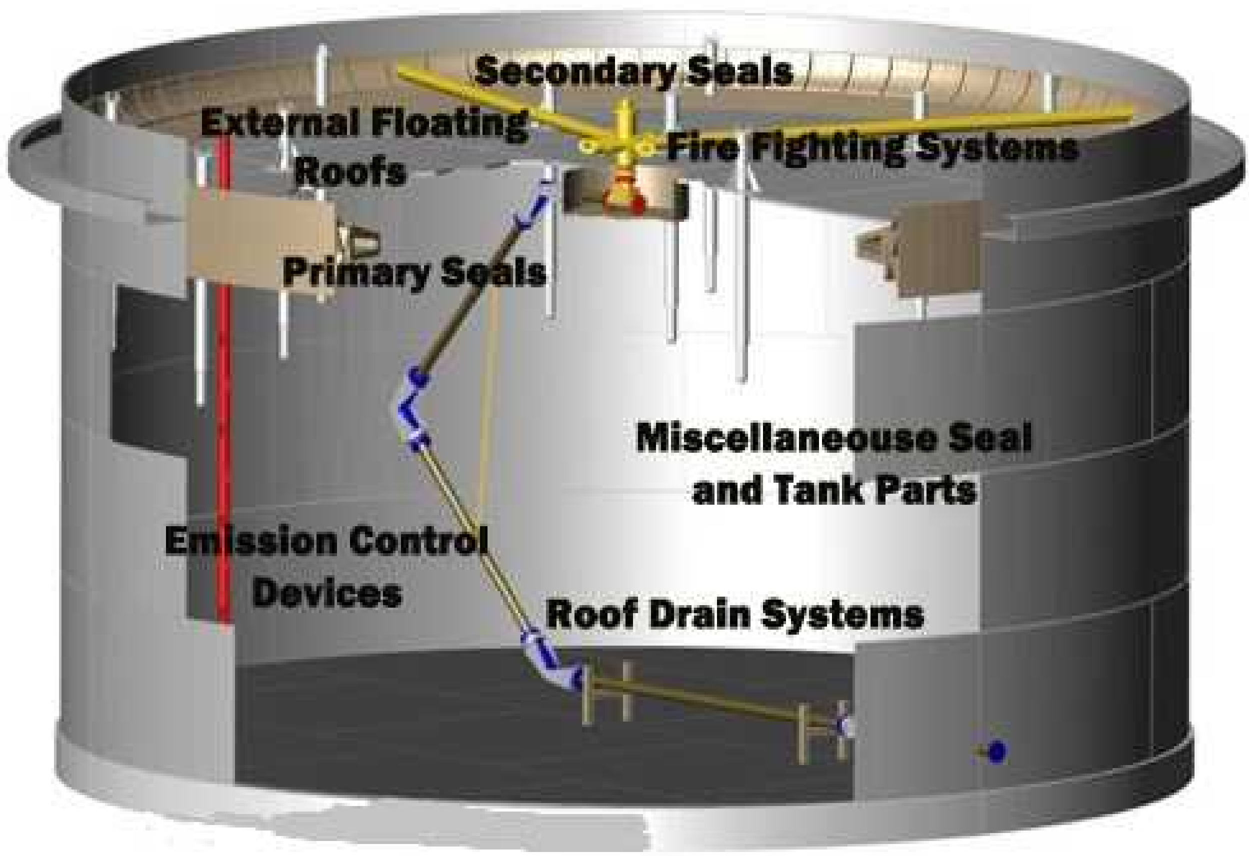
When the weight of the roof is no longer pressing down on the product, the product level in the gauging pipe automatically drives down in the gauging still; and vice versa… when the tank goes back into floatation, the weight of the roof drives the product level up the gauge pipe.

This loss / gain of product barrels needs to be adjusted for and corrected by the use of a roof correction factor which is a calculation at the bottom of each tank's strapping chart. (A strapping chart lists the tank's quantities at every inch level.) In this calculation, you will find that the barrels per inch are different below the critical zone than those above it. The calculated roof correction that we apply on our shore tank reports are to take into account variances in density or API gravity. This is caused by the product having a different density and a temperature from when the tank was originally strapped.

It is important an inspection report note to all in the custody chain when the roof is out of floatation because of the inaccuracies this condition can cause. It is therefore usual commercial practice to agree on the barge / vessel volumes in these instances. Depending on the size of the tank, the volume can be affected by hundreds if not thousands of barrels.

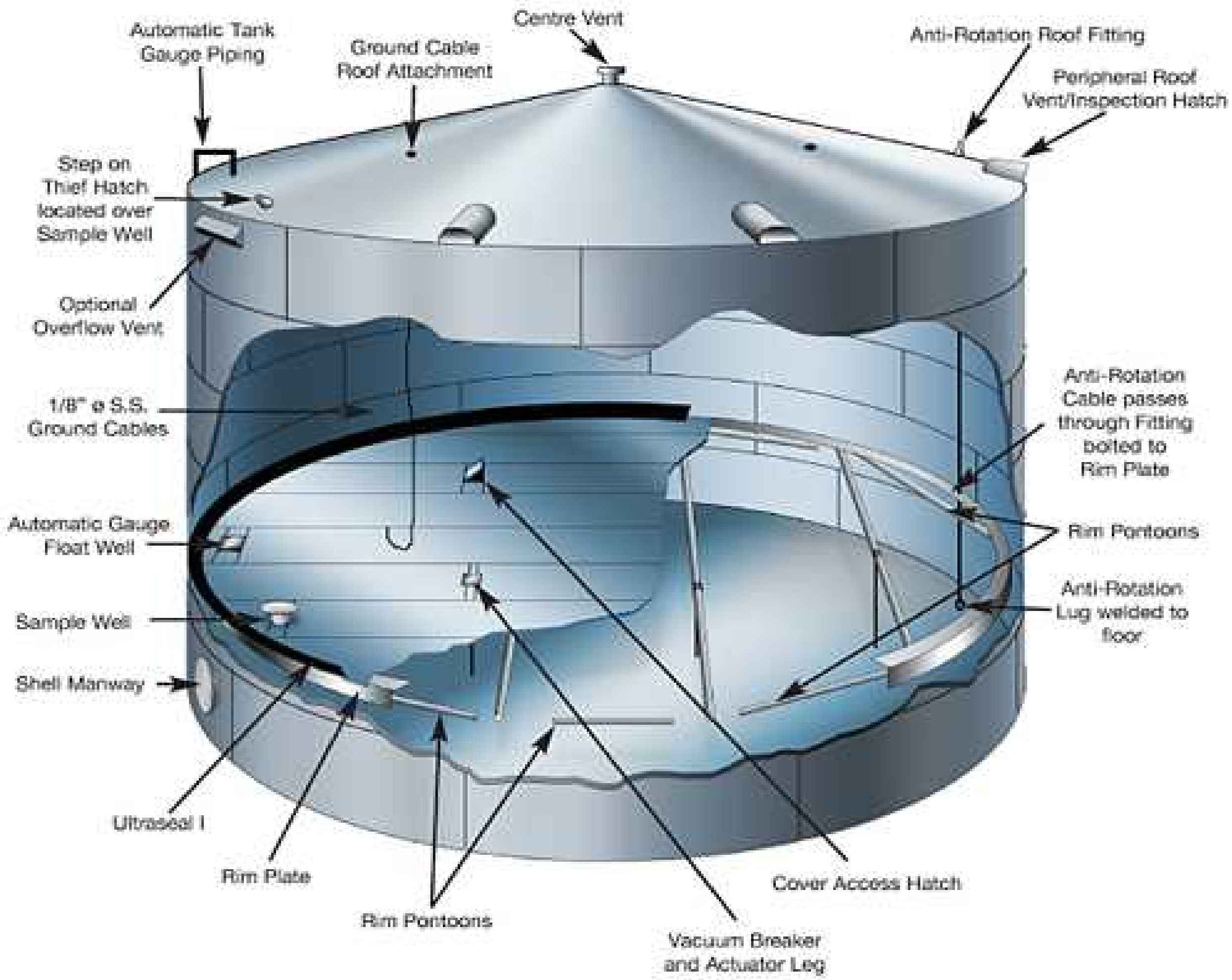
Realizing how rain (snow) accumulation affected gauging accuracy, engineers have redesigned tanks to **internal floating roof tanks** which offer the best of both worlds. This design offers the combination of floating roofs and a fixed roof which eliminates weather conditions and venting vapors to the atmosphere. (Ref: Figure 2)

Figure 1 Floating Roof Tank



Source Figure #1 http://www.hmttank.com/Products.htm

Figure2   Internal Floating Roof Tank



Source Figure #2 http://www.landandmarine.com/TankServProducts/InternalFloatingRoof.aspx

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