



Exceeding Expectations

“You are now entering the CRITICAL ZONE” ...

In this issue of TECHTALK, we will describe “the critical zone,” a condition which exists when a floating-roof storage tank is in the process of “coming out of floatation” and why volumes in this area of a tank’s strapping chart are often suspect and recommended not to be used for custody transactions.

(TECHTALK Issue #6, attached for your review describes the types of product storage tanks used in the petroleum industry and can be a helpful reference when discussing the critical zone.)

This subject matter can be intense therefore the description will be more general than specific. If you require more details, please let us know.

In order to understand the critical zone condition, let’s briefly review a simplified structure design of a floating-roof storage tank. A floating roof storage tank is one where the roof floats directly on the product to reduce vapor loss and emissions to the ozone.

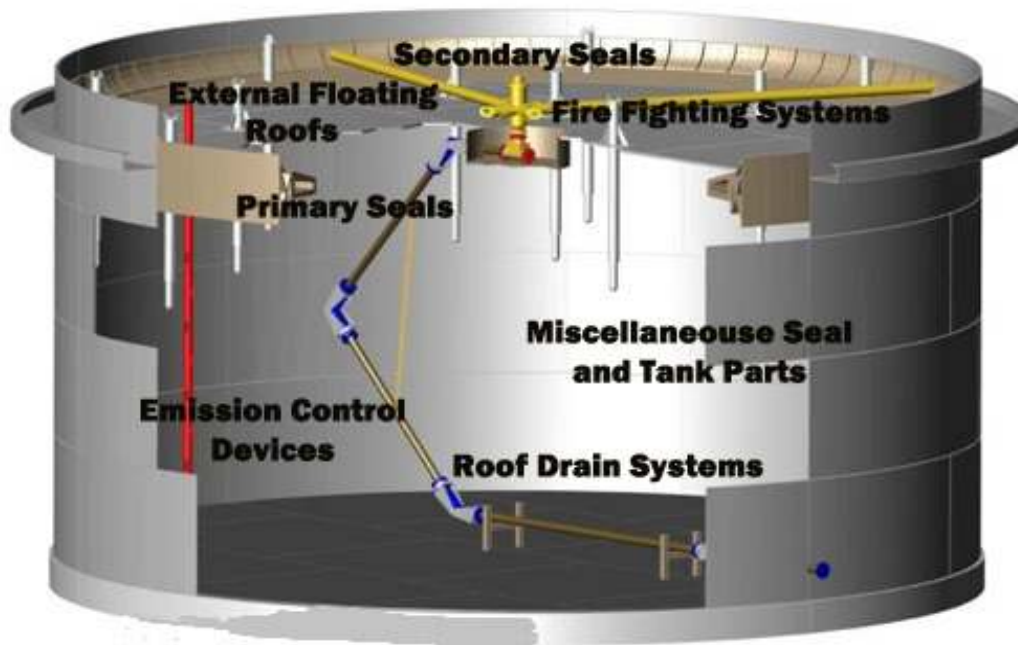
Visualize an empty tank shell.

Next, place a circular table with legs inside the tank shell. This table will represent the tank’s floating roof.

Examine the diagram on the following page and locate the white vertical lines extending above and below the floating roof. These are the roof’s (or table’s) legs. Note most floating roof tanks are equipped with adjustable legs which can be set in a high leg (commonly used for performing maintenance) or low leg position (commonly used when in service). See attached strapping chart examples.

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When filling this type of tank with product, there will be a time when one of three conditions exist:

1. One condition is when the **product level is not touching the roof** and the roof is therefore resting on its legs. When this occurs, the tank is termed **out of floatation**.
2. A second condition is when the **product level initially causes the roof to begin to float but is not entirely in the floatation mode**. This condition is where the product is entering the **critical zone**.
3. A third condition is where the **product level is no longer in the critical zone and is fully floating the roof** therefore terming the tank roof “**in floatation**”.

Before we discuss the critical zone in more detail, we need to discuss one more aspect of the tank that comes into play...the gauge pipe, also called the standpipe or stillwell. This is a vertical pipe which runs inside the tank which provides a fixed location where inspectors gauge, temperature and sample product.

When the weight of the roof is completely floating on the product, it pushes down on the product in the tank and displaces product **up the gauge pipe**. Conversely, when the roof is not floating on the product, the roof weight does not affect the gauging and does not displace product up the gauge pipe. When these conditions exist, the tanks strapping charts accurately reflect the listed volumes.

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But what about when the roof is in the critical zone and the product level is not completely floating the roof? How is an accurate measurement in the gauge pipe affected when the tank roof is *about to come out of floatation* and is neither resting totally on its supports nor freely floating? Under these conditions, what steps need to be taken for accurate measurement?

All tanks are “strapped” or calculated at different levels with an amount represented on a strapping chart. (ref: attachment strapping chart). The critical zone is designated and clearly marked on these charts. Accurate measurements of quantities within these designated areas are virtually impossible to determine unless the critical zone has been liquid calibrated. (Ref: notes at the bottom of the attached strapping chart)

In reference to the actual critical zone, API Chapter 2.2A.19.8.2.2.3 states:

Since the displaced volume of liquid is contingent upon an assumed specific gravity of liquid to be handled in the tank, and since the shape of the roof and tank bottom may change with time, it is advisable to allow 2 inches (or 50 millimeter) of depth below position A (which is the start of critical zone) and above position 2 (which is the end of the critical zone) in establishing the critical zone.

This allowance does not influence any calculations but only the upper and lower limits of the critical zone indicated on the gauge table.

Note: An accuracy problem often encountered when a roof position is measured is that the roof will be in the high position for maintenance. Often, when the tank is returned to service, the roof legs are adjusted to the low position. This action will create errors in the capacity table if it is computed and issued with the roof in the high position. The quantities from the start of the low position to the end of the high position of the roof critical zone will be in error. To ensure the accuracy of the floating roof capacity table, it is necessary to confirm the operational roof position with the tank operator or owner before development of the capacity table.

The bottom line is product volumes starting and / or ending in the area of a tank’s strapping chart designated to be a critical zone should be avoided at all costs during custody product transfers in order for accurate gauging to occur.

It is important an inspection report note to all in the custody chain when the roof is in the critical zone 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 affected can be hundreds if not thousands of barrels.

API Chapters are the usual governing rule when product is measured in the critical zone but is commonly superseded if a commercial contract addresses these conditions differently.

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