How Much Is Left In The Fuel Tank?

In our experience, cell sites in the Philippines often rely on the fuel tank sight glass to determine how many liters of fuel is left in the tank. A horizontal cylindrical aboveground tank with flat heads for example is mathematically calculated to contain a certain volume by the formula:

$$V = \pi r^2 \times (L)$$

Where:
V is the volume of the tank
π is 3.1416
r is the radius of the tank
L is the length of the tank

Hence, the formula can be used to obtain the required volume in constructing a tank with flat heads. For horizontal cylindrical tank with dish heads, it has other features that need to be considered in calculating its volume.

Sight Glass

A sight glass is a transparent tube through which the user of the tank can observe the level of liquid contained within. Simple sight glasses may be just a plastic or glass tube connected to the bottom of the tank at one end and the top of the tank at the other. The level of liquid in the sight glass will be the same as the level of liquid in the tank, if the tank is perfectly levelled.

In most cases, a sight glass would not indicate the exact volumetric quantity of fuel in the tank. When calibrated with volumetric units, the quantity is affected by the diameter of the sight glass, tank geometry including the length of shell, flat heads or dish heads, tank angle and the density of fuel.

A sight glass installed beside the tank head is merely an observational instrument:

(a) To check if there is fuel in the tank,
(b) To inspect the quality of fuel in the tank, and
(c) To inspect if there is water or other contaminants in the fuel.

Calibrating the Sight Glass with Liters – Does it Matter?

No, it doesn't. If it does, then process engineers would not need to race for developing an accurate fuel level measuring device. There are advance technologies nowadays in fluid level measurement like ultrasonic method, laser and radar with computer intelligence. Besides, a sight glass on tank head may be exposed to any damaging impact which could leak the fuel. Actually, the International Mechanical Code does not allow this method specified under Section 1306, which says:

"1306.5 Gauge glass. A tank used in connection with any oil burner shall not be equipped with a glass gauge or any gauge which, when broken, will permit the escape of oil from the tank." – 2012 International Mechanical Code

If accurate quantity is critical in fuel stock then the user has to invest in advance technology in fluid level measurement.

Advance Technologies in Fluid Level Measurement

Ultrasonic

Radar

Laser

Telecom Site Generator Sets and Aboveground Fuel Tank

Nowadays, typical cell site generator sets range from 10 kVA to 25 kVA. Some sites may have aboveground fuel tank of 1,000 liters. Usually, field operations personnel are keen in knowing the amount of fuel in the tank by the liters. For example, if the sight glass is calibrated and the fuel level drops to 400 liters, it would be noted or a fuel delivery would be initiated. But what is 400 liters?

Facility managers in telecommunication industry, data centers and data center experts in the U.S. such as the Uptime Institute does not rely on knowing the number of liters in the tank. For these experts it is worth knowing the **hours of fuel** rather than the **liters of fuel**.

The hours of fuel is the estimated back up time of the generator set, which is vital in telecommunications facility. While the liters of fuel is only a matter of fuel stock inventory.

To cite an example, a cell site draws 75% of the generator set's rating. Its diesel generator set consumes 4.5 liters per hour at 75% load. The cell site has 1,000 liters tank full of diesel. The hours of fuel can be simply estimated by:

1000/4.5 = 222 (hours of fuel)
222/24 = 9 (days of autonomy)

Knowing that having a 222 hours of fuel, the cell site supervisor may already have peace of mind. Whether it takes 1 or 2 days of brown out, the generator set could run continuously even beyond since the designed autonomy is 9 days.

Today, Data Centers demand stringent requirement on availability of back-up power (generator sets). The ***Uptime Institute***, require data centers to maintain a **minimum of 12 hours of fuel** for Tier 1,2,3 and 4 classification data centers. Notice that the requirement is hours of fuel and not liters of fuel. Today, the ***Telecommunications Industry Association (TIA)*** and the Uptime Institute are working together for establishing data center designs as they are planned, constructed and operated.

Fuel Tank Contents

As described, calibrating the sight glass with liters does not matter, since it would not always show an accurate quantity. An indication of "FULL", "3/4", "1/2", "1/4" and "0 or EMPTY" is usually enough to show the fuel level in the tank. Notice that most cars do not even show fuel quantity in liters in their fuel gauge. Besides, if the designed autonomy of the cell site is 9 days (as an example earlier), then the site supervisor must ALWAYS ensure that the 1,000 liter tank is full. Hence, a sight glass with liters does not really matter at all.

A U.S. patented float type fuel level indicator on top of a cylindrical horizontal tank showing "FULL", "3/4", "1/2", "1/4" and "0 or EMPTY".

Most cars do not even show fuel quantity in liters on their fuel gauge.

Besides, the **NFPA 110 – Standards for Emergency and Standby Power Systems** states that:

*"To optimize the long-term storage of fuels for prime movers, the fuel tanks should be kept cool and dry, and **the tank as full as possible**. Tanks that are subject to temperature variations can experience accelerated fuel degradation, especially of the tanks are outside and aboveground or close to an extreme heat source if stored inside a structure…**Tank ullage (air space) should be kept to a minimum**."*

Less air space in the tank would lessen the space for the formation of moisture that would contaminate the fuel. Preventing the formation of moisture by keeping the tank full would also prevent the formation of rust from the inner wall of the tank, since diesel contains rust inhibitor.

So keeping the tank full has three benefits:

(1) Maintaining the cell site's designed autonomy,
(2) Optimizing the long-term storage of fuel, and
(3) Preventing rust from the inner wall of the tank

If tank in a cell site is not kept full, then the above benefits will not be achieved.