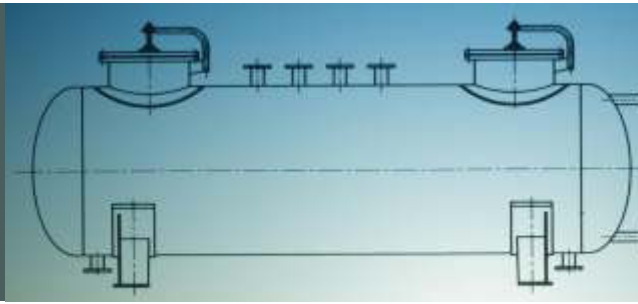


Procedures



Horizontal Tanks and Bullets

1. Measurement Standards: Indian IS 2009 and 2166, International APIMPMS, ISO 12917
2. External measurements of circumference of each course at 2 points 20% from the ends of welds. These points will be marked with crayon/chalk before measurements. Each tank comprises of multiple courses and a mean circumference will be derived from the measurements. Circumference will be taken with Steel tapes at a tension of <math>< 5 \text{ kg}</math>.
3. When accessed internally, laser beam measurements are used inside to determine vertical and horizontal diameters with laser distance meters or laser total stations.
4. Length of each course will be added translating into tank length. This length will also be measured externally with a laser distance meter by aligning the instrument at one end and holding a vertical plate aligned to the other end, which will give tank external length. Internal length will be derived after deducting plate thickness at both ends.
5. Ultrasonic plate thickness measurement with digital meters will be taken at positions around the marked circumference line and a mean thickness of each course will be obtained. Thickness of end plates will also be taken. This thickness will be used to arrive at internal diameter from external measurements. A general thickness report will be provided in addition to tank tables.
6. Tank outer mean vertical diameter and horizontal mean diameter measurements will be done with laser distance meter with maximum length reported from the meter. This will be done at both ends of the tanks. A vertical plumb line and a horizontal axis will be drawn as a reference line prior to measurements.
7. Dip reference height and distance of the point from the tank ends on top of tank will be measured.
8. Tank inclination / slope is an important factor in horizontal tanks. We use automatic laser levels with visible laser beams which clearly mark out the horizontal and vertical line inside the tank. For tanks which cannot be accessed inside, the instrument will be placed on top of the tank on one end on a tripod/ solid elevated base. The instrument will give out a laser beam which is crosshair type in both horizontal and vertical directions. Vertical depth measurement from this laser line to the top of the tank will be carried out from one end to another end. The vertical rise at another end will provide the inclination of the tank with respect to the horizontal. This value will be the maximum vertical rise of the tank at the end opposite to outlet. When the tank is accessible inside, the vertical rise at one end is similarly taken inside the tank. Also, the vertical distance from laser level to datum plate/ point is recorded.
9. Some horizontal tanks have ends which are not flat they can be bulged, dished, truncated cone, hemispherical or tori spherical. It is important measure the profile of both the ends. For external measurements, a vertical plumb will be dropped from the tank side at middle position of the tank and a horizontal measurement recorded near the base from the weld (tan line). This procedure is repeated at both ends. The knuckle radius is measured for tori spherical ends and end diameter measured for truncated cones. For internal measurements, a vertical plumb line is created at the tan line and the maximum offset is measured at the centre position with laser distance gauge.
10. Calculations are done as per BIS 2166 (Basic Indian method), API MOMS 2.2 E, ISO 12917 (Complete International method). Temperature correction, thickness correction, liquid head stress correction is applied on volumes analyzed and processed on custom made formulations. These volumes in our tables will have a uniform exponential curve as opposed to intermittent linear progression when calculations are done manually with water filling at fixed intervals/ volumes. Very complex mathematical formulations are used to arrive at volumes for inclined horizontal tanks. Softcopy are also provided in Excel or pdf file.

