



M/S. GIRISH CHANDRA GHOSH & G.G.S





M/s. GIRISH CHANDRA GHOSH & G.G.S.

Tank calibration,
tank roundness, tilt, settlement survey,
UST and P & I of pipe lines and tanks
in INDIA & ABROAD.



HORIZONTAL & BULLET TANK CALIBRATION



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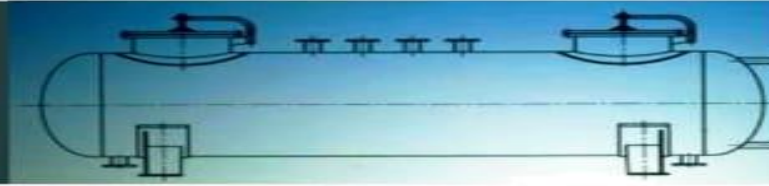


An ISO 9001:2008 certified Company

**NSIC-MSME registered Unit
NSIC-ONICRA credit rated Co.**

Approved by Office of Zonal Director General
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Exporter Code (IEC) No: 0216925703 and
the Registered member of EEP
(Engineering Export Promotion Council)
India, Reg. No-301/M28655

Procedures



Horizontal Tanks and Bullets

1. Measurement Standards: Indian IS 2009 and 2166, International API MPMS, 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 < 5 kg.
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.



Horizontal type tank calibration above/under ground

• Why Calibration is Essential :

To ascertain gain or loss in sales, purchases to provide only reliable means of maintaining adequate control over the storage & distribution & stock keeping & in industrial production process control , as oils, chemicals and it's allied products are very costly items business & service render from it.

- Profit & Loss depends on accuracy of storage tank calibration work &
- Settlement of disputes in management, Production Purchase/Sales Cycle

The leading Company in Calibration & Weighing & Measuring Solutions

We are committed to execute consumer requirement by offering consistent quality service at an competitive price.

Company's profit depends on the accuracy of Storage Tank Calibration Chart.

Horizontal Tank Calibration Rules

- ❑ **BIS 2009-2166 BIS STANDARD (INDIAN)**
- ❑ **ISO 121917 (Complete**
- ❑ **API MPMS 2.2 E International Method)**



Horizontal type tank calibration above/under ground



Horizontal type tank calibration above/under ground

- Procedure :

Volumetric Method (Liquid Calibration)

Volumetric or Liquid Calibration is a method of increment/decrement of volumes and capacities of Tanks by transfer of known quantities of a liquid to and from the tank under observation. This procedure is suitable for calibrating a tank at its different level, through a liquid, or using a calibrated positive displacement meter. This procedure is selected keeping in mind the accuracy requirement and available equipment at the site, so that a better accuracy is maintained.

The positive displacement meter having standard accuracy should be used during calibration. Other measuring equipment like Dip Tape, Can etc. should be accurately stamped / calibrated by recognized methods & should confirm to their respective standard specifications. At the beginning of the calibration process, water flow meter is fitted with water connection. Due attention should be paid for all house pipe connections properly tightened. If a pump is used to transfer the liquid, caution should be observed to ensure that the liquid level in the delivering tank is never lowered to allow the suction of air in the system. Then reading is being taken after inserting / extracting a certain volume of water. Generally reading is being taken at the time of opening / closing the meter each time liquid is inserted / extracted. It should be properly selected taking into consideration the capacity of the tank and specially that of the bottom. Generally lower quantity of water is inserted / extracted for upper / lower portion of the Tank & higher quantity of water is inserted / extracted for middle portion of the tank for maximum accuracy.



Horizontal type tank calibration above/under ground

- Procedure :

Volumetric Method (Liquid Calibration)

Capacity Table and Raw Field Data :

- ❖ All Raw Data Collected in the Field should be made available to the tank owner along with main capacity table.
- ❖ Capacity Table should generally contain following information at the very minimum :
 - Product Id, RH, Nominal Diameter
 - Product Gravity
 - FR Total and incremental corrections
 - RH and reference gauge point location
 - Method of Calibration and Date of Calibration

Volumetric analysis and corrections on data, consumption, layout of the calibration chart as per rules is carried out subsequently after field data consistency and quality checks. Volumetric data is also provided electronically for SAP or any other uploading.



Horizontal type tank calibration above/under ground

- **Procedure : Laser**

External measurements of circumference of each course at 2 points 20% from the end of welds. These points will be marked with crayon/chalk before measurements. Each Tank comprises of multiple courses and a mean circumference will be delivered from the measurements. Circumference will be taken with Steel Tapes at a tension of < 5 kg.

When accessed internally, laser beam measurements are used inside to determine vertical and horizontal diameters with laser distance meters or laser total stations.

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 the 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.

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 each plate will also be taken. The thickness will be used to arrive at internal diameter from external measurements. A general thickness report will be provided in addition to Tank Tables.

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 tank. A vertical plumb line and a horizontal axis will be drawn as a reference line prior to the measurements.



Horizontal type tank calibration above/under ground

- Procedure : **Laser**



Horizontal type tank calibration above/under ground

- **Procedure : Laser**

Dip reference height and distance of the points from the tank ends on the top of the tank will be measured.

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 can not be accessed inside, the instrument will be placed on the top of the tank and one end on a tripod / solid elevated base. The instrument will give out a laser beam which is a 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. The 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.

Some horizontal tanks have ends which are not flat they can be bulged, dished, truncated cone, hemi spherical or tori spherical. It is important measure the profile of both the ends. For external measurement 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 center position of the laser distance gauge.



Horizontal type tank calibration above/under ground

- Procedure : **Laser**

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 an uniform exponential curves as opposed to the intermittent linear progressions when calculations are done manually with water filling at fixed intervals / volumes. Very complex mathematical formulations are used to arrive a volumes for inclined horizontal tanks. Softcopy are also provided in Excel or Pdf file.



Horizontal type tank calibration above/under ground

- Report: Laser



TANK PARAMETERS PROCESSED ON TESTED CUSTOMIZED SOFTWARES

INT. DIA (CM) 300.2
INT.LENGTH(CM) 700
P1 (CM) 56.5
P2 (CM) 56.5
DEADWOOD (LT) 40

CALIBRATION CHART: 70 KL HOR. TANK

CALIBRATION C

NOTES:-

CHART AS PER IS: 2166-1963 (APPE. 'A')

DIP IN CMs, VOLUME IN LTs, DIFF. IN LTs/MM

TANK DIMENSIONS :

DIA.CM 300.2 LENGTH 700

P1 CMs 56.5 P2 CMs: 56.5

DEADWOOD FOR TANKS BASED
ON OUR STD. DRGS. ARE...

1) 15 KL – 16 LTs.

2) 20 KL – 18 LTs.

3) 70 KL – 81 LTs.

DIP	VOLUME	DIFF	DIP	VOLUME	DIFF.	DIP	VOLUME	DIFF.	DIP	VOLUME	DIFF.
1	16.04	1.60	41	4189.82	15.07	81	11368.86	20.18	121	20033.54	22.72
2	45.46	2.94	42	4342.18	15.24	82	11571.54	20.27	122	20261.09	22.75
3	83.59	3.81	43	4496.22	15.40	83	11775.12	20.36	123	20488.98	22.79
4	128.75	4.52	44	4651.91	15.57	84	11979.58	20.45	124	20717.22	22.82
5	179.99	5.12	45	4809.23	15.73	85	12184.91	20.53	125	20945.77	22.86
6	236.63	5.66	46	4968.15	15.89	86	12391.08	20.62	126	21174.64	22.89
7	298.21	6.16	47	5128.64	16.05	87	12598.09	20.70	127	21403.81	22.92
8	364.34	6.61	48	5290.68	16.20	88	12805.92	20.78	128	21633.26	22.95
9	434.74	7.04	49	5454.24	16.36	89	13014.56	20.86	129	21862.99	22.97
10	509.13	7.44	50	5619.30	16.51	90	13223.99	20.94	130	22092.98	23.00

Horizontal type tank calibration above/under ground



- Procedure : 3D

- Laser tool is a low cost solution for tank calibration that avoids cost of emptying tank, use of expensive meters and generation of waste water.
- It is HSSE compliant, easy to set up and use and cost effective
- No need to uplift whole product inside the tank (75% volume of tank should be empty)
- No need for tank cleaning nor degassing
- Reliable and cost effective compared to calibration with water

Horizontal type tank calibration above/under ground

• Procedure : 3D



1 INTRODUCTION

Most of ATG systems can calibrate tanks automatically. *Refer to GDS 08.009.*

However under following circumstances alternative solutions are required;

- Lack of ATG system
- Lack of tank calibration function of the ATG system
- Low sales volumes which does not allow automatic calibration via ATG system
- Legal authorities may not accept automatic ATG calibration charts

In such circumstances UST's need to be manually calibrated either by filling up the tank with fuel or water, or manual measuring with man entry which is strictly restricted with HSSE&SP Control Framework for Confined Space Work.

Laser tank calibration is an easy and reliable method which does not require man entry into tank. It also avoids cost of emptying tank, use of expensive meters, and generation of waste water.

2 WORKING PRINCIPLES

Currently 2 different type of 3D laser scanning tools are available.

1- Laser head moving vertically down inside the tank and rotating on its axis

2- Laser head fixed at the manhole and rotating at top of the tank

2.1 LASER HEAD ROTATING INSIDE THE TANK

A high accuracy laser measuring device enters the tank performing an helical scan to detect a series of axial and radial values. These polar coordinates when processed de-

termine the capacity of the tank inspected.

Components

- 1 Laser Meter
- 2 Optical Guide
- 3 Optical Mirror
- 4 Motor
- 5 Encoder
- 6 Control Unit
- 7 Structure System
- 8 Stabilizer System
- 9 Adjustable Trolley
- 10 Optical Guide Protection
- 11 Connection Flange
- 12 Extensible Supports

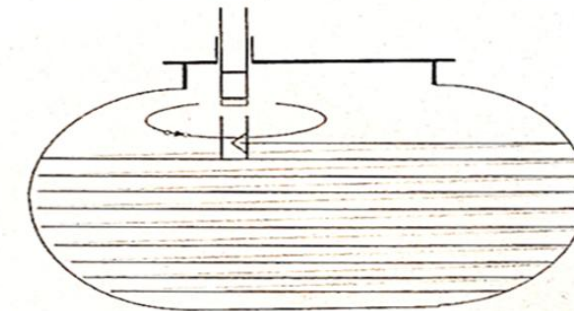
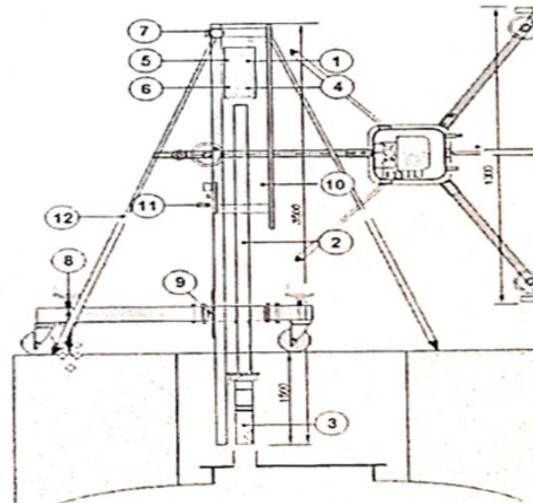


Figure 2 Rod rotating and moving downwards into the tank

Horizontal tank calibration above/under ground

- Procedure : 3D

The absence of electrical components inside the inspected tank allows the use of the equipment in the presence of flammable liquids or vapours, hazard area.

The optical guide is inserted in the tank through the manhole or other available 2" hole and is adjusted to be vertical with respect to the position of tank. In this way the effect of any inclination in the calculation of the volume of the tank is taken into account.

By advancing the rod and synchronizing the vertical movement of the same by means of threading or with cart lift on the linear guide support and recording all the detected values (angles, positions, distances) is possible to construct the volume of the tank..

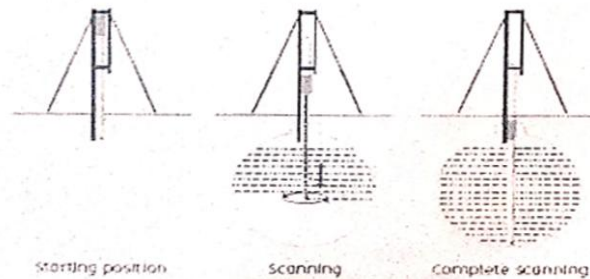


Figure 3. Scanning process



Figure 4. Set up of the tool

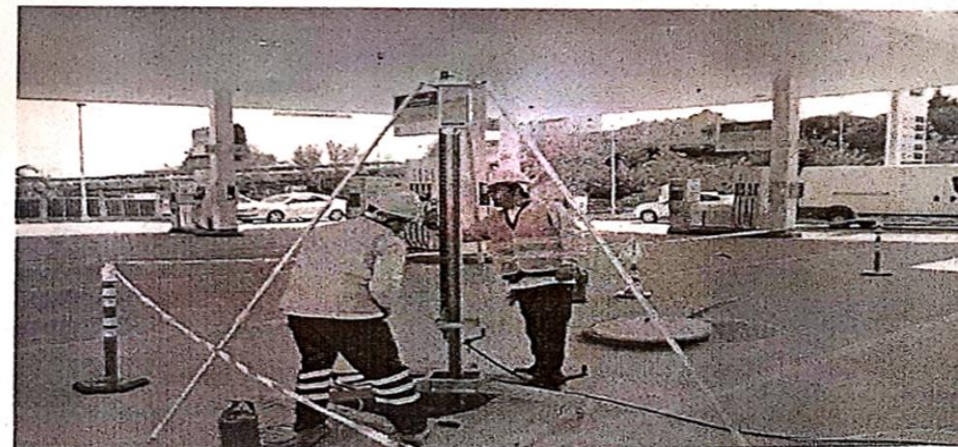


Figure 5. Scanning of empty tanks at NTI

Horizontal type tank calibration above/under ground

• Procedure : 3D



2.2 LASER TOOL MOUNTED ON MAN-HOLE

High accuracy laser head is mounted at appropriate 2" hole on the manhole cover. Laser head performs scan cycle in all axes.



Figure 6. Components

Components

1. Calibex Laser Scanner Unit
2. CalibeX Measurement Panel

Once the system is activated it;

- Finds all the dimensions of the tank's interior as 3D spatial points.
- Finds the slope of the tank, (Angle)
- Finds the direction and position of the tank,
- Finds the diameter of the tank, (R)

- Finds Interior dimensions of the tank (H, L)
- Finds the diameter of the tank dome, (Rd)
- Makes the mathematical model of the tank. (f (x))
- Generates calibration data through 3D modeling and sophisticated mathematical algorithms

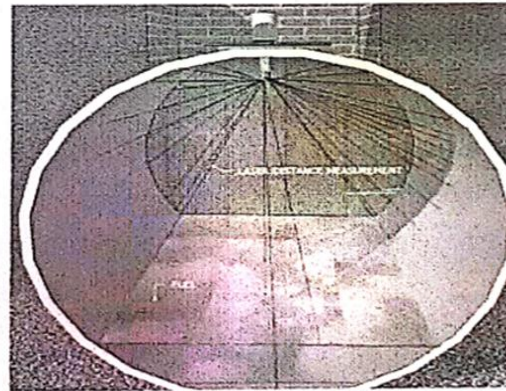


Figure 7. Scanning principle

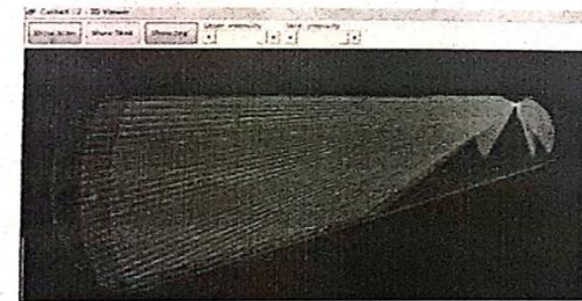


Figure 8. 3D modelling of a tank

3 TECHNICAL REQUIREMENTS

- Laser head should comply with EN 60079 standards
- Laser system shall be ATEX approved for Zone 0
- Shall be approved by internationally authorized metrology institute e.g OIML R71
- Shall comply with ISO 12917- 2
- Laser tool shall be able to scan up to 10 m long with up to 2.75 m diameter tank
- Working temperature shall be from -10°C to 40°C
- Accuracy shall be $\pm 1\text{mm}$ or $\pm 0.2\%$ of the tank volume
- Best volume accuracy can be get with

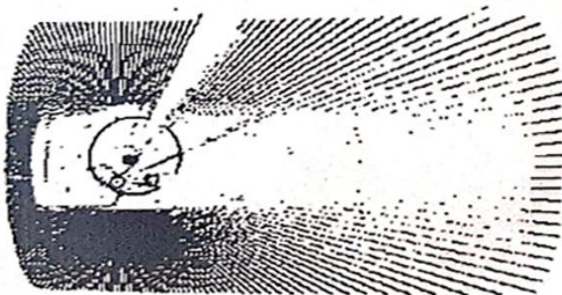
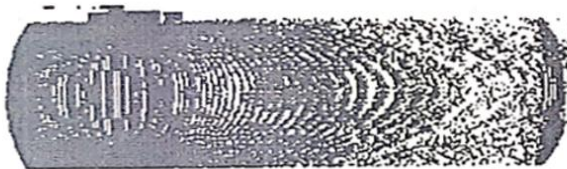
Horizontal type tank calibration above/under ground

- Procedure : 3D

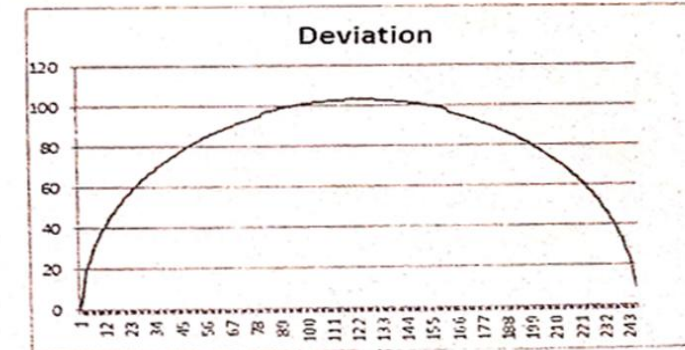
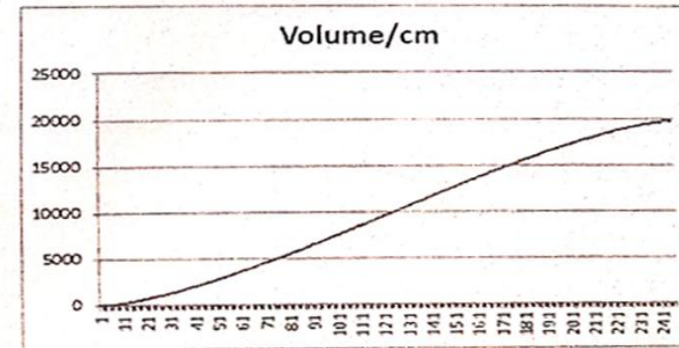
6 APPENDICES

Appendix 1

3D Modelling and calibration table



CM	LT	DEVIASYON
0	0	0
1	8.65	8.65
2	24.44	15.79
3	44.84	20.4
4	68.95	24.11
5	96.24	27.29
6	126.35	30.11
7	159.02	32.67
8	194.05	35.03
9	231.25	37.2
10	270.51	39.26
11	311.69	41.18
12	354.69	43
13	399.44	44.75
14	445.83	46.39
15	493.82	47.99
16	543.32	49.5
17	594.28	50.96
18	646.65	52.37
19	700.37	53.72
20	755.41	55.04
21	811.72	56.31
22	869.25	57.53
23	927.97	58.72
24	987.86	59.89
25	1048.86	61
26	1110.95	62.09
27	1174.11	63.16
28	1238.3	64.19
29	1303.5	65.2



Horizontal tank calibration above/under ground

• Report Generation :



Calibration Chart	
Tank No.	TK-1004
Owner's Name	Nayara Energy Limited Rail Fed Petroleum Storage Depot, Wardha
Location of Tank	Village - Neemgaon, Dist. - Wardha, Near Dhagaon Railway Station, Nagpur, Maharashtra - 442 001
Description of Tank	Cylindrical MS make UG Horizontal Storage Tank
Average Internal Diameter	300.0 cm
Internal Length of Cyl. Part	627.0 cm
Safe Filling Height	270 cm from bottom
Datum Height	Nil
Dip Reference Height	326.0 cm
Rim Level Difference (tilt)	Nil
Reference Gauge Point	On top of Tank
Dish End Type	Flat
Method of Calibration	IS 2009, IS 2166
Capacity of Tank	44,319 litres
Tank Contents	M.S.
Date of Calibration	19-05-2023
Next Date of Calibration	18-05-2028
Calibrated by	Girish Chandra Ghosh & G.G.S. ISO 9001:2015 certified company Mob.+91 9830081365 Email: ggc.ggs.kol@gmail.com website: www.storage-tankcalibration.in 40/2 B.T Road, Kolkata-700002, West Bengal

Nayara Energy Limited - Wardha

Tank No. TK-1004

cm	litre	cm	litre	cm	litre	cm	litre	cm	litre
0.0	0.00	4.5	138.00	9.0	387.00	13.5	708.00	18.0	1086.00
0.1	1.00	4.6	142.00	9.1	394.00	13.6	716.00	18.1	1095.00
0.2	1.00	4.7	147.00	9.2	400.00	13.7	724.00	18.2	1104.00
0.3	2.00	4.8	152.00	9.3	407.00	13.8	732.00	18.3	1113.00
0.4	4.00	4.9	156.00	9.4	413.00	13.9	740.00	18.4	1122.00
0.5	5.00	5.0	161.00	9.5	420.00	14.0	748.00	18.5	1131.00
0.6	7.00	5.1	166.00	9.6	427.00	14.1	756.00	18.6	1140.00
0.7	8.00	5.2	171.00	9.7	433.00	14.2	764.00	18.7	1149.00
0.8	10.00	5.3	176.00	9.8	440.00	14.3	772.00	18.8	1158.00
0.9	12.00	5.4	181.00	9.9	447.00	14.4	780.00	18.9	1167.00
1.0	14.00	5.5	186.00	10.0	453.00	14.5	788.00	19.0	1176.00
1.1	17.00	5.6	191.00	10.1	460.00	14.6	796.00	19.1	1185.00
1.2	19.00	5.7	196.00	10.2	467.00	14.7	804.00	19.2	1194.00
1.3	21.00	5.8	201.00	10.3	474.00	14.8	812.00	19.3	1204.00
1.4	24.00	5.9	206.00	10.4	481.00	14.9	820.00	19.4	1213.00
1.5	27.00	6.0	212.00	10.5	487.00	15.0	828.00	19.5	1222.00
1.6	29.00	6.1	217.00	10.6	494.00	15.1	837.00	19.6	1231.00
1.7	32.00	6.2	222.00	10.7	501.00	15.2	845.00	19.7	1241.00
1.8	35.00	6.3	228.00	10.8	508.00	15.3	853.00	19.8	1250.00
1.9	38.00	6.4	233.00	10.9	515.00	15.4	861.00	19.9	1259.00
2.0	41.00	6.5	238.00	11.0	522.00	15.5	870.00	20.0	1269.00
2.1	44.00	6.6	244.00	11.1	529.00	15.6	878.00	20.1	1278.00
2.2	47.00	6.7	249.00	11.2	537.00	15.7	886.00	20.2	1288.00
2.3	50.00	6.8	255.00	11.3	544.00	15.8	895.00	20.3	1297.00
2.4	54.00	6.9	261.00	11.4	551.00	15.9	903.00	20.4	1307.00
2.5	57.00	7.0	266.00	11.5	558.00	16.0	912.00	20.5	1316.00
2.6	61.00	7.1	272.00	11.6	565.00	16.1	920.00	20.6	1326.00
2.7	64.00	7.2	278.00	11.7	573.00	16.2	929.00	20.7	1335.00
2.8	68.00	7.3	283.00	11.8	580.00	16.3	937.00	20.8	1345.00
2.9	71.00	7.4	289.00	11.9	587.00	16.4	946.00	20.9	1354.00
3.0	75.00	7.5	295.00	12.0	595.00	16.5	954.00	21.0	1364.00
3.1	79.00	7.6	301.00	12.1	602.00	16.6	963.00	21.1	1373.00
3.2	83.00	7.7	307.00	12.2	609.00	16.7	971.00	21.2	1383.00
3.3	87.00	7.8	313.00	12.3	617.00	16.8	980.00	21.3	1393.00
3.4	90.00	7.9	319.00	12.4	624.00	16.9	989.00	21.4	1402.00
3.5	94.00	8.0	325.00	12.5	632.00	17.0	997.00	21.5	1412.00
3.6	99.00	8.1	331.00	12.6	639.00	17.1	1006.00	21.6	1422.00
3.7	103.00	8.2	337.00	12.7	647.00	17.2	1015.00	21.7	1431.00
3.8	107.00	8.3	343.00	12.8	655.00	17.3	1024.00	21.8	1441.00
3.9	111.00	8.4	350.00	12.9	662.00	17.4	1032.00	21.9	1451.00
4.0	115.00	8.5	356.00	13.0	670.00	17.5	1041.00	22.0	1461.00
4.1	120.00	8.6	362.00	13.1	677.00	17.6	1050.00	22.1	1471.00
4.2	124.00	8.7	368.00	13.2	685.00	17.7	1059.00	22.2	1480.00
4.3	129.00	8.8	375.00	13.3	693.00	17.8	1068.00	22.3	1490.00
4.4	133.00	8.9	381.00	13.4	701.00	17.9	1077.00	22.4	1500.00

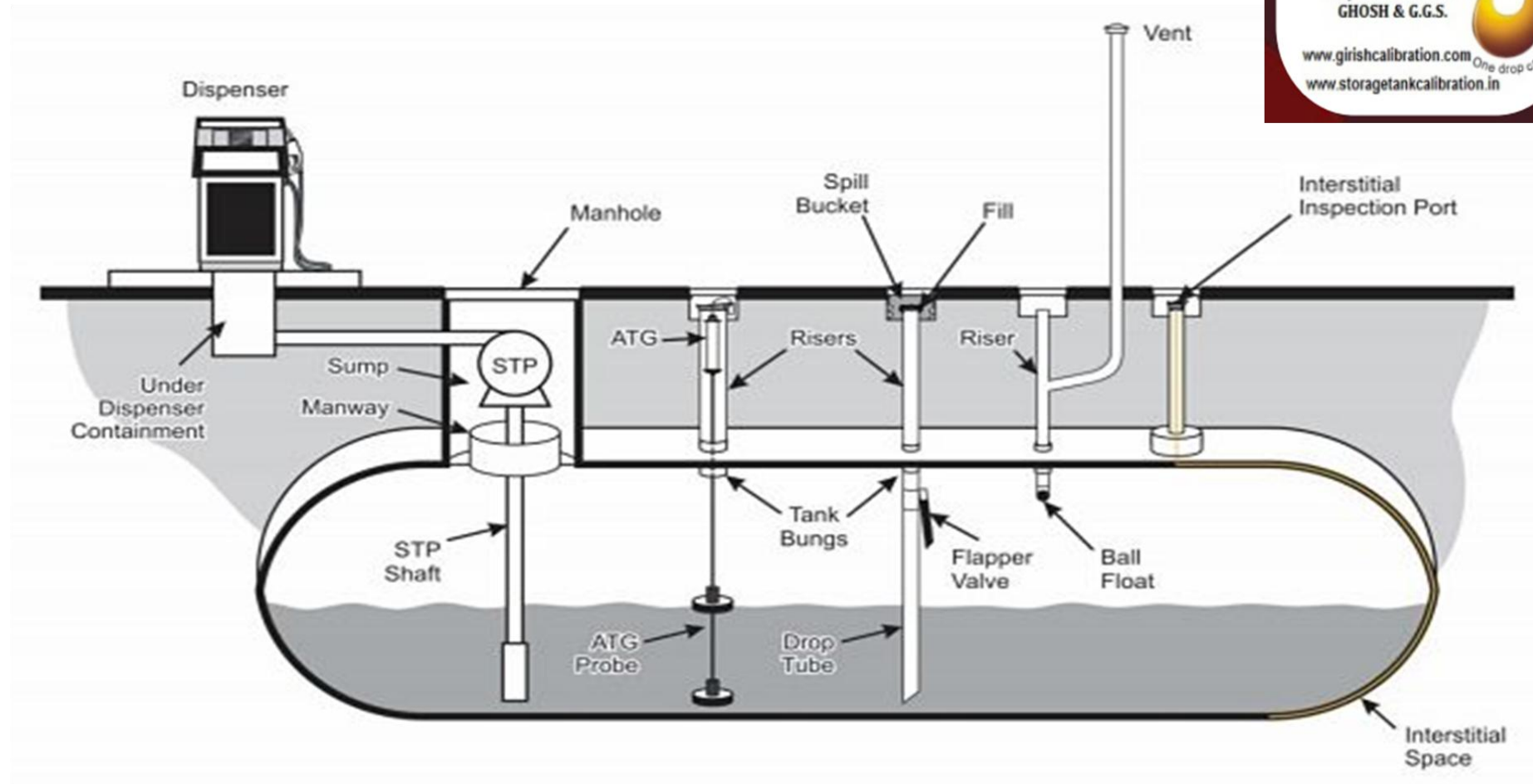
Page 1

Nayara Energy Limited - Wardha

cm	litre	cm	litre	cm	litre	cm	litre	cm	litre
22.5	1510.00	27.0	1976.00	31.5	2478.00	36.0	3012.00	40.5	3577.00
22.6	1520.00	27.1	1986.00	31.6	2489.00	36.1	3025.00	40.6	3590.00
22.7	1530.00	27.2	1997.00	31.7	2501.00	36.2	3037.00	40.7	3603.00
22.8	1540.00	27.3	2008.00	31.8	2512.00	36.3	3049.00	40.8	3616.00
22.9	1550.00	27.4	2019.00	31.9	2524.00	36.4	3061.00	40.9	3628.00
23.0	1560.00	27.5	2030.00	32.0	2536.00	36.5	3074.00	41.0	3641.00
23.1	1570.00	27.6	2041.00	32.1	2547.00	36.6	3086.00	41.1	3654.00
23.2	1580.00	27.7	2051.00	32.2	2559.00	36.7	3098.00	41.2	3667.00
23.3	1590.00	27.8	2062.00	32.3	2570.00	36.8	3111.00	41.3	3680.00

Tank No. TK-1004

Horizontal type tank calibration above/under ground



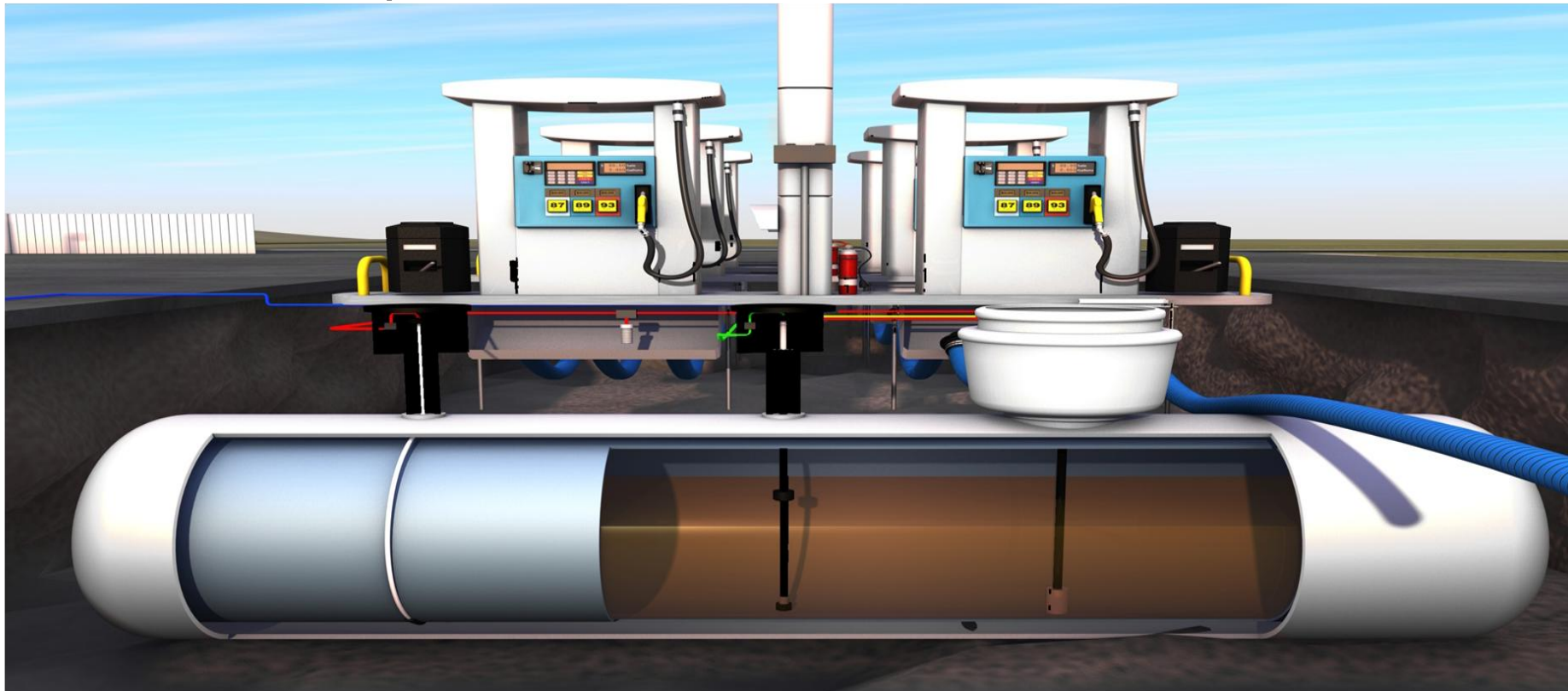
Horizontal type tank calibration above/under ground

- Technology / Process (Measurement Standards) :
Indian - IS 2009 and 2166, International – API
MPMS, ISO 12917



Horizontal type tank calibration above/under ground

- Accuracy Level :
 $\pm 0.3\%$ as per International Standard



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