

Owner – Tank Tank Tank Capacity Report

Location

NOVLUM INC. 

02/01/2022

OWNER – TANK TANK

LOCATION

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1 INTRODUCTION

The purpose of this examination was to assess the capacity of the tank according with the relevant sections of *API MPMS 2.2A: Manual of Petroleum Management Standard Chapter 2 – Tank Calibration*.

2 ANALYSIS

The elevation at the Bottom (bottom to shell weld nearest to the Manway) was set to zero.

Table 1: Tank specifics

Shell inner diameter	59 ft 11.03 in
Shell height	40 ft 1.46 in
Course heights	8 ft 0.0000 in; 8 ft 0.0000 in; 8 ft 0.0000 in; 8 ft 0.0000 in; 8 ft 0.0000 in
Course thicknesses	0.2500 in; 0.1850 in; 0.1500 in; 0.1250 in; 0.1250 in
Shell elasticity	29,000,000.00 psi
Strike height (wrt Bottom)	1.35 in
Overflow height (wrt Bottom)	39 ft 1.34 in
Overflow height (wrt Strike)	38 ft 11.99 in
Max fill height (wrt Bottom)	39 ft 1.34 in
Max fill height (wrt Strike)	38 ft 11.99 in
Gauge height (wrt Strike)	42 ft 4.50 in
Fill density	0.860
Floating Roof	Yes
Weight	28,000.00 lb
Position	Low Leg
Displaced depth	2.30 in
Low Leg bottom height (wrt Strike)	5 ft 10.65 in
Low Leg top height (wrt Strike)	6 ft 0.95 in
High Leg bottom height (wrt Strike)	7 ft 10.65 in
High Leg top height (wrt Strike)	8 ft 0.95 in
Measurement temperature	72.00 °F
Standard temperature	60.00 °F
Temperature correction factor to standard temperature	0.99992
Fill capacity at 60.00 °F	19,513.5070 bbl
Shell data precision (1σ)	0.06 in
Bottom data precision (1σ)	0.06 in
Data accuracy (1σ)	0.1 in (Manufacturer specification)

2.1 REFERENCE LOCATIONS

The following shows the shell and bottom profiles.

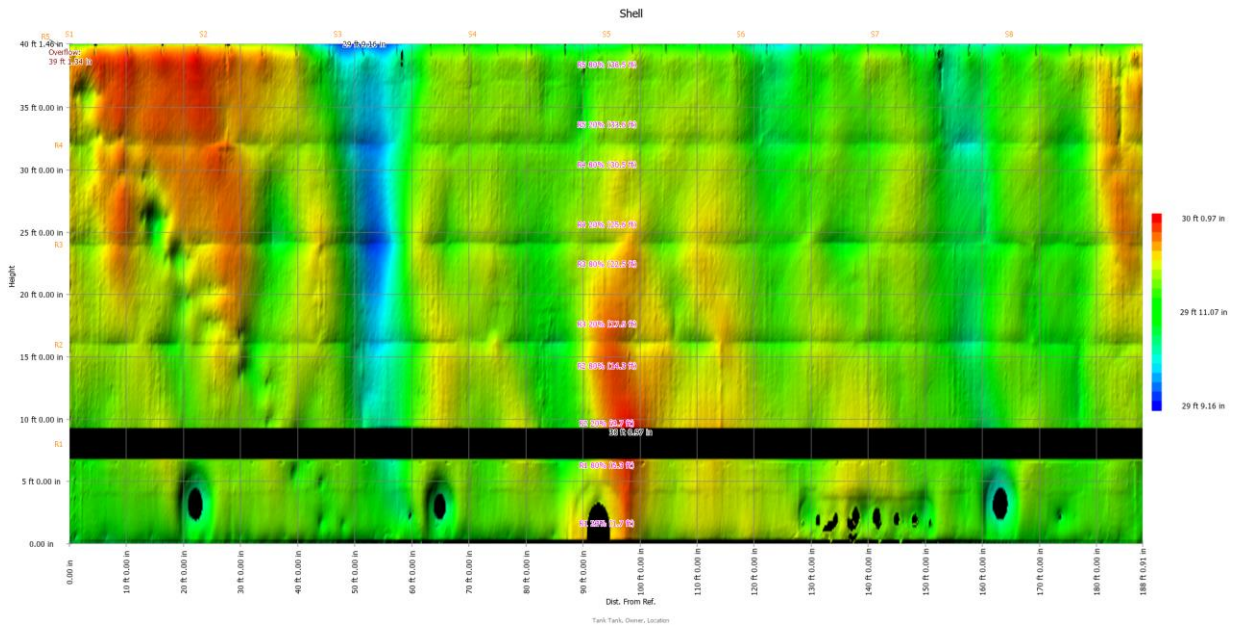


Figure 1: Shell profile

Bottom

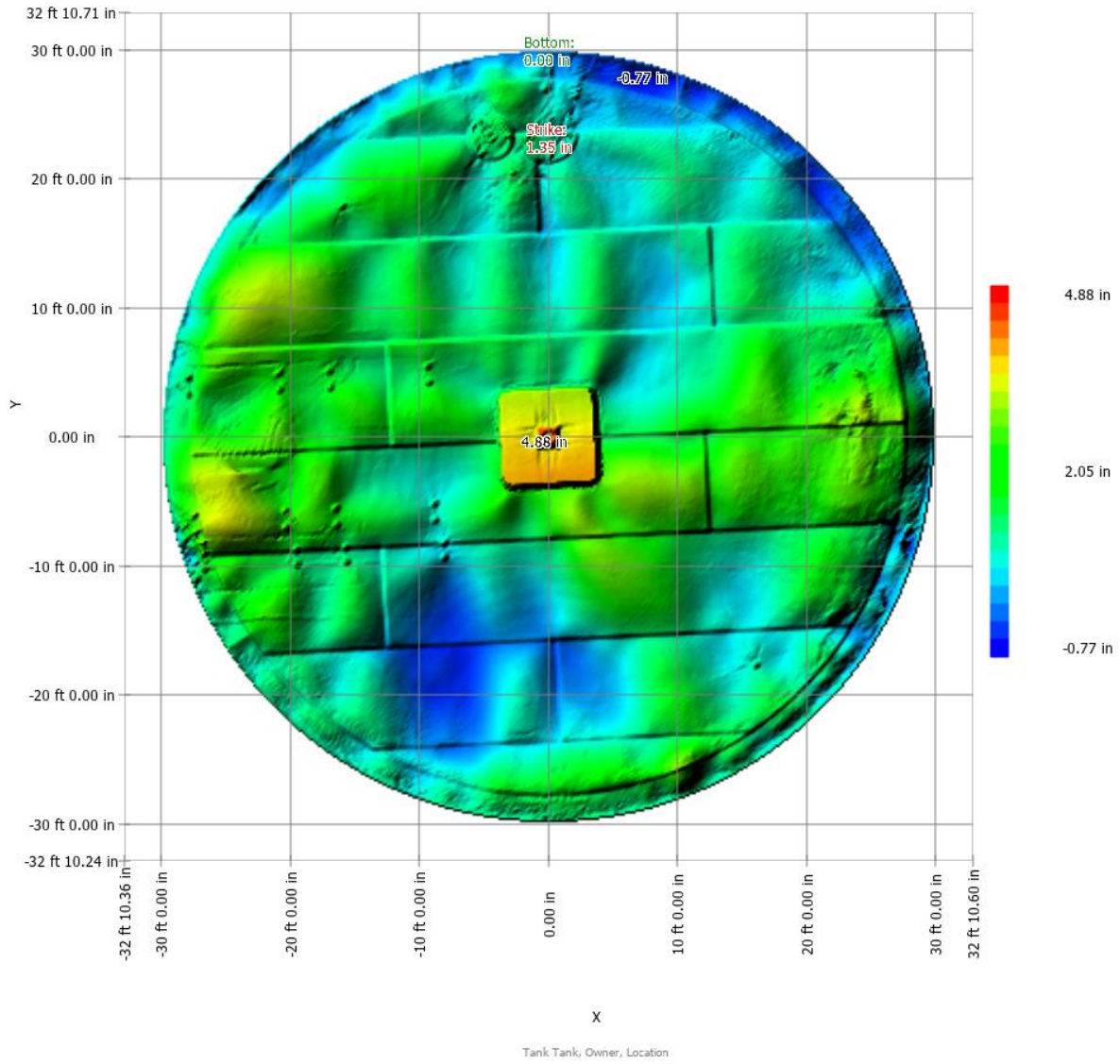


Figure 2: Bottom profile

The following shows the Bottom Reference, Strike Point, Overflow, and Gauge Point locations.

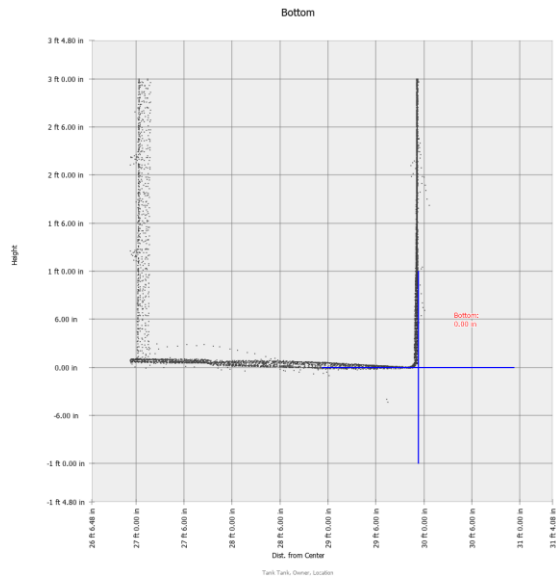


Figure 3: Bottom Reference

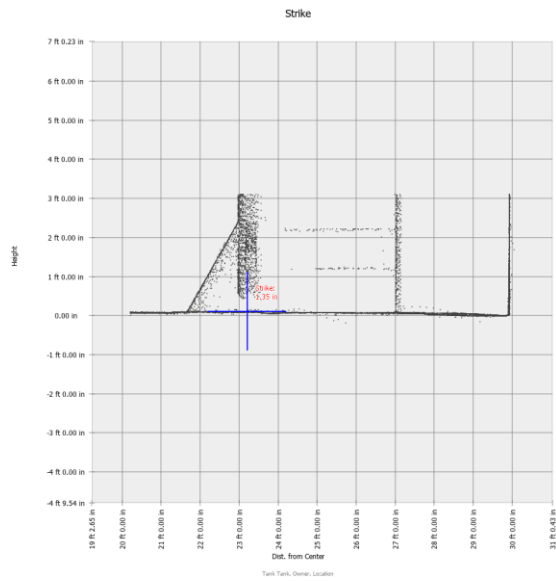


Figure 4: Strike Point

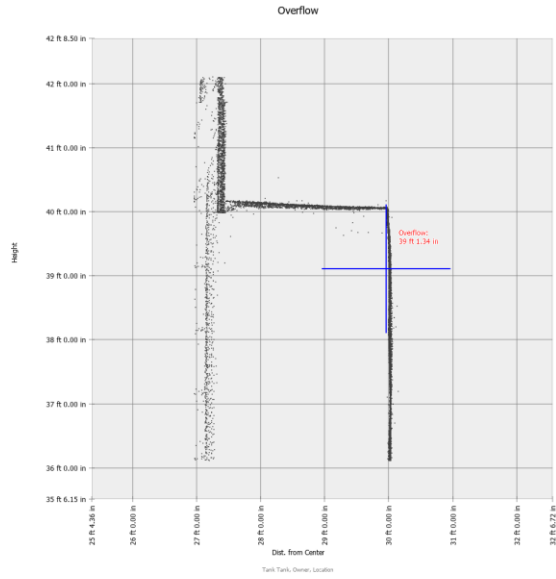


Figure 5: Overflow Reference

2.2 SHELL CIRCUMFERENCES

Table 2: Shell circumference and corrections

Ring	Perc. (%)	Elev. (ft-in)	Cir. Meas. (ft-in)	Cir. Std. (ft-in)	Cir. Stress (ft-in)
1	20	1' 7.98"	188' 2.16"	188' 1.98"	188' 2.25"
1	80	6' 3.91"	188' 2.91"	188' 2.74"	188' 2.80"
2	20	9' 7.87"	188' 3.27"	188' 3.10"	188' 3.46"
2	80	14' 3.81"	188' 3.24"	188' 3.06"	188' 3.16"
3	20	17' 7.76"	188' 3.17"	188' 3.00"	188' 3.44"
3	80	22' 5.70"	188' 3.20"	188' 3.03"	188' 3.13"
4	20	25' 7.66"	188' 3.25"	188' 3.08"	188' 3.61"
4	80	30' 5.59"	188' 3.26"	188' 3.08"	188' 3.21"
5	20	33' 7.55"	188' 3.17"	188' 2.99"	188' 3.45"
5	80	38' 5.48"	188' 3.24"	188' 3.07"	188' 3.12"

Table 3: Shell course incremental volumes

Ring	Cir. (ft-in)	Inc. Vol. (bbl)	Inc. Vol. LH (bbl)	Inc. Vol. Total (bbl)
1	188' 2.53"	41.8388	0.0000	41.8388
2	188' 3.31"	41.8677	0.0124	41.8801
3	188' 3.29"	41.8670	0.0291	41.8961
4	188' 3.41"	41.8715	0.0497	41.9212
5	188' 3.28"	41.8669	0.0744	41.9413

2.3 BOTTOM SURVEY

Table 4: Bottom survey

From Height (ft-in)	To Height (ft-in)	Pos. Vol. (bbl)	Neg. Vol. (bbl)	Total. Vol. (bbl)
-	0.00"	0.5896	-43.5939	-43.0043
0.00"	1.00"	0.0000	-11.1839	-11.1839
1.00"	2.00"	0.0000	-1.9096	-1.9096
2.00"	3.00"	0.0000	-0.1957	-0.1957
3.00"	4.00"	0.0000	-0.0038	-0.0038

2.4 DEADWOOD

Table 5: Deadwood measurements

Name	From Elev. (ft-in)	To Elev. (ft-in)	Vol. (bbl)
MANWAY-004	1.36"	3' 2.06"	0.9435
Gauge	2.53"	39' 9.90"	-0.4088
PIPE-006	3.01"	2' 3.07"	-0.0121
Ladder	3.15"	39' 10.74"	-0.4090
COLUMN-01	5.24"	39' 10.08"	-0.7013
NOZZLE-005	1' 4.06"	1' 9.64"	-0.0041
PIPE-004	1' 4.14"	2' 4.04"	-0.3051
PIPE-001	1' 4.37"	2' 4.27"	-0.3052
NOZZLE-003	1' 4.58"	2' 3.61"	0.0765
PIPE-005	1' 4.69"	2' 1.94"	-0.2106
NOZZLE-004	1' 4.78"	2' 8.74"	0.1101
NOZZLE-006	1' 6.15"	2' 7.91"	-0.0362
MANWAY-001	1' 9.16"	4' 3.16"	0.4524
MANWAY-002	1' 9.72"	4' 3.72"	0.4481
MANWAY-003	1' 10.04"	3' 10.04"	0.2984
NOZZLE-002	1' 10.06"	2' 2.07"	0.0097
NOZZLE-001	1' 10.96"	2' 0.62"	0.0007
Floating Roof	6' 0.00"	6' 2.30"	-92.8887

2.5 FLOATING ROOF

A total of **92.8887 bbl** has been deducted from this table in **Low Leg** position, between **5 ft 10.65 in** and **6 ft 0.95 in** above the strike point, for roof displacement based on a floating weight of **28,000.00 lb** and an observed liquid density of **0.860** as observed under conditions of the liquid in which the roof is floating. Gauged levels above this range reflect this deduction but should be corrected for actually observed gravity of the liquid at prevailing temperatures as follows:

- **For specific gravity of 0.860 observed, no correction**
- **For each 0.001 above specific gravity of 0.860 observed, add 0.1079 bbl.**
- **For each 0.001 below specific gravity of 0.860 observed, subtract 0.1079 bbl.**

Critical Zone - The displacement of the floating roof is distributed within the range specified above. This range cannot be accurately calibrated because the shape of the roof changes within this range, changes as the tank fills, and may change over time. Therefore, critical zones should be observed as follows and should be avoided for critical measurements:

- **Low Leg critical zone - between 5 ft 8.00 in and 6 ft 3.00 in above the strike point.**
- **High Leg critical zone - between 7 ft 8.00 in and 8 ft 3.00 in above the strike point.**

When not operating in Low Leg position, values between the start of the Low Leg position to the end of the High Leg position of the roof critical zones will be in error because the capacity table was computed with the roof in the Low Leg position.

2.6 STRAPPING TABLE

Note that the following heights are computed to allow for the difference in elevation at the Strike point vs. the elevation at the Bottom (bottom to shell weld nearest to the Manway). Volumes are corrected to standard temperature of 60.00 °F.

Table 6: Tank strapping table at 60.00 °F

B – Denotes increments below top of bottom
 L – Denotes floating roof critical zone in Low Leg position
 H – Denotes floating roof critical zone in High Leg position
 X – Denotes increments above the max fill height

in	bbl	in	bbl	in	bbl	in	bbl
- 0 ft -	13.3775 B	- 6 ft -	2,959.2970 L	- 12 ft -	5,935.0328	- 18 ft -	8,950.5736
1	44.0578 B	1	2,962.6685 L	1	5,976.9097	1	8,992.4664
2	84.0116 B	2	3,004.5041 L	2	6,018.7866	2	9,034.3593
3	125.6782 B	3	3,046.3397 L	3	6,060.6635	3	9,076.2522
4	167.5365 B	4	3,088.1752	4	6,102.5403	4	9,118.1451
5	209.3973	5	3,130.0108	5	6,144.4172	5	9,160.0379
6	251.2581	6	3,171.8464	6	6,186.2941	6	9,201.9308
7	293.1189	7	3,213.6820	7	6,228.1710	7	9,243.8237
8	334.9797	8	3,255.5176	8	6,270.0479	8	9,285.7166
9	376.8405	9	3,297.3532	9	6,311.9247	9	9,327.6095
10	418.7013	10	3,339.1888	10	6,353.8016	10	9,369.5023
11	460.5621	11	3,381.0244	11	6,395.6785	11	9,411.3952
- 1 ft -	502.4229	- 7 ft -	3,422.8600	- 13 ft -	6,437.5554	- 19 ft -	9,453.2881
1	544.2837	1	3,464.6956	1	6,479.4322	1	9,495.1810
2	586.1445	2	3,506.5312	2	6,521.3091	2	9,537.0738
3	627.9996	3	3,548.3667	3	6,563.1860	3	9,578.9667
4	669.8032	4	3,590.2023	4	6,605.0629	4	9,620.8596
5	711.6025	5	3,632.0379	5	6,646.9398	5	9,662.7525
6	753.3997	6	3,673.8735	6	6,688.8166	6	9,704.6453
7	795.1969	7	3,715.7091	7	6,730.6935	7	9,746.5382
8	836.9970	8	3,757.5447	8	6,772.5704	8	9,788.4311
9	878.8238	9	3,799.3803 H	9	6,814.4473	9	9,830.3240
10	920.6668	10	3,841.2159 H	10	6,856.3241	10	9,872.2169
11	962.5101	11	3,883.0658 H	11	6,898.2010	11	9,914.1097
- 2 ft -	1,004.3531	- 8 ft -	3,924.9427 H	- 14 ft -	6,940.0779	- 20 ft -	9,956.0026
1	1,046.2045	1	3,966.8196 H	1	6,981.9548	1	9,997.8955
2	1,088.0679	2	4,008.6965 H	2	7,023.8317	2	10,039.7884
3	1,129.9363	3	4,050.5733 H	3	7,065.7085	3	10,081.6812
4	1,171.8444	4	4,092.4502	4	7,107.5854	4	10,123.5741
5	1,213.7524	5	4,134.3271	5	7,149.4623	5	10,165.4670
6	1,255.6604	6	4,176.2040	6	7,191.3392	6	10,207.3599
7	1,297.5696	7	4,218.0808	7	7,233.2160	7	10,249.2527
8	1,339.4760	8	4,259.9577	8	7,275.0929	8	10,291.1456
9	1,381.3798	9	4,301.8346	9	7,316.9698	9	10,333.0385
10	1,423.2835	10	4,343.7115	10	7,358.8467	10	10,374.9314
11	1,465.1873	11	4,385.5884	11	7,400.7236	11	10,416.8242
- 3 ft -	1,507.0910	- 9 ft -	4,427.4652	- 15 ft -	7,442.6004	- 21 ft -	10,458.7171
1	1,548.9874	1	4,469.3421	1	7,484.4773	1	10,500.6100
2	1,590.8655	2	4,511.2190	2	7,526.3542	2	10,542.5029
3	1,632.7435	3	4,553.0959	3	7,568.2311	3	10,584.3958
4	1,674.6216	4	4,594.9727	4	7,610.1079	4	10,626.2886
5	1,716.4996	5	4,636.8496	5	7,651.9848	5	10,668.1815
6	1,758.3777	6	4,678.7265	6	7,693.8617	6	10,710.0744
7	1,800.2557	7	4,720.6034	7	7,735.7386	7	10,751.9673
8	1,842.1337	8	4,762.4803	8	7,777.6155	8	10,793.8601
9	1,884.0079	9	4,804.3571	9	7,819.4923	9	10,835.7530
10	1,925.8735	10	4,846.2340	10	7,861.3692	10	10,877.6459
11	1,967.7391	11	4,888.1109	11	7,903.2461	11	10,919.5388
- 4 ft -	2,009.6047	- 10 ft -	4,929.9878	- 16 ft -	7,945.1445	- 22 ft -	10,961.4316
1	2,051.4703	1	4,971.8646	1	7,987.0374	1	11,003.3245
2	2,093.3331	2	5,013.7415	2	8,028.9303	2	11,045.2174
3	2,135.1742	3	5,055.6184	3	8,070.8232	3	11,087.1103
4	2,177.0098	4	5,097.4953	4	8,112.7160	4	11,129.0031
5	2,218.8454	5	5,139.3722	5	8,154.6089	5	11,170.8960
6	2,260.6810	6	5,181.2490	6	8,196.5018	6	11,212.7889
7	2,302.5165	7	5,223.1259	7	8,238.3947	7	11,254.6818
8	2,344.3521	8	5,265.0028	8	8,280.2875	8	11,296.5747
9	2,386.1877	9	5,306.8797	9	8,322.1804	9	11,338.4675
10	2,428.0233	10	5,348.7565	10	8,364.0733	10	11,380.3604
11	2,469.8589	11	5,390.6334	11	8,405.9662	11	11,422.2533
- 5 ft -	2,511.6945	- 11 ft -	5,432.5103	- 17 ft -	8,447.8590	- 23 ft -	11,464.1462
1	2,553.5301	1	5,474.3872	1	8,489.7519	1	11,506.0390
2	2,595.3657	2	5,516.2641	2	8,531.6448	2	11,547.9319
3	2,637.2013	3	5,558.1409	3	8,573.5377	3	11,589.8248
4	2,679.0369	4	5,600.0178	4	8,615.4306	4	11,631.7177
5	2,720.8724	5	5,641.8947	5	8,657.3234	5	11,673.6105
6	2,762.7080	6	5,683.7716	6	8,699.2163	6	11,715.5034
7	2,804.5436	7	5,725.6484	7	8,741.1092	7	11,757.3963
8	2,846.3792	8	5,767.5253	8	8,783.0021	8	11,799.2892
9	2,888.2148 L	9	5,809.4022	9	8,824.8949	9	11,841.1821
10	2,930.0504 L	10	5,851.2791	10	8,866.7878	10	11,883.0749
11	2,957.8478 L	11	5,893.1560	11	8,908.6807	11	11,924.9765

in	bbl	in	bbl	in	bbl	in	bbl
- 24 ft -	11,966.8945	- 30 ft -	14,984.9885	- 36 ft -	18,004.0743		
1	12,008.8125	1	15,026.9065	1	18,046.0124		
2	12,050.7304	2	15,068.8245	2	18,087.9504		
3	12,092.6484	3	15,110.7425	3	18,129.8885		
4	12,134.5664	4	15,152.6604	4	18,171.8266		
5	12,176.4844	5	15,194.5784	5	18,213.7646		
6	12,218.4023	6	15,236.4964	6	18,255.7027		
7	12,260.3203	7	15,278.4143	7	18,297.6408		
8	12,302.2383	8	15,320.3323	8	18,339.5788		
9	12,344.1563	9	15,362.2503	9	18,381.5169		
10	12,386.0742	10	15,404.1683	10	18,423.4550		
11	12,427.9922	11	15,446.0862	11	18,465.3931		
- 25 ft -	12,469.9102	- 31 ft -	15,488.0042	- 37 ft -	18,507.3311		
1	12,511.8281	1	15,529.9222	1	18,549.2692		
2	12,553.7461	2	15,571.8402	2	18,591.2073		
3	12,595.6641	3	15,613.7581	3	18,633.1453		
4	12,637.5821	4	15,655.6761	4	18,675.0834		
5	12,679.5000	5	15,697.5941	5	18,717.0215		
6	12,721.4180	6	15,739.5121	6	18,758.9595		
7	12,763.3360	7	15,781.4300	7	18,800.8976		
8	12,805.2540	8	15,823.3480	8	18,842.8357		
9	12,847.1719	9	15,865.2660	9	18,884.7737		
10	12,889.0899	10	15,907.1839	10	18,926.7118		
11	12,931.0079	11	15,949.1019	11	18,968.6499		
- 26 ft -	12,972.9258	- 32 ft -	15,991.0197	- 38 ft -	19,010.5880		
1	13,014.8438	1	16,032.9377	1	19,052.5260		
2	13,056.7618	2	16,074.8557	2	19,094.4641		
3	13,098.6798	3	16,116.7737	3	19,136.4022		
4	13,140.5977	4	16,158.6917	4	19,178.3402		
5	13,182.5157	5	16,200.6097	5	19,220.2783		
6	13,224.4337	6	16,242.5277	6	19,262.2164		
7	13,266.3517	7	16,284.4457	7	19,304.1544		
8	13,308.2696	8	16,326.3637	8	19,346.0925		
9	13,350.1876	9	16,368.2817	9	19,388.0306		
10	13,392.1056	10	16,410.1997	10	19,429.9686		
11	13,434.0235	11	16,452.1177	11	19,471.9067		
- 27 ft -	13,475.9415	- 33 ft -	16,494.0357	- 39 ft -	19,513.8447		
1	13,517.8595	1	16,535.9537				
2	13,559.7775	2	16,577.8717				
3	13,601.6954	3	16,619.7897				
4	13,643.6134	4	16,661.7077				
5	13,685.5314	5	16,703.6257				
6	13,727.4494	6	16,745.5437				
7	13,769.3673	7	16,787.4617				
8	13,811.2853	8	16,829.3797				
9	13,853.2033	9	16,871.2977				
10	13,895.1212	10	16,913.2157				
11	13,937.0392	11	16,955.1337				
- 28 ft -	13,978.9572	- 34 ft -	16,997.0517				
1	14,020.8752	1	17,038.9697				
2	14,062.7931	2	17,080.8877				
3	14,104.7111	3	17,122.8057				
4	14,146.6291	4	17,164.7237				
5	14,188.5471	5	17,206.6417				
6	14,230.4650	6	17,248.5597				
7	14,272.3830	7	17,290.4777				
8	14,314.3010	8	17,332.3957				
9	14,356.2189	9	17,374.3137				
10	14,398.1369	10	17,416.2317				
11	14,440.0549	11	17,458.1497				
- 29 ft -	14,481.9729	- 35 ft -	17,500.0677				
1	14,523.8908	1	17,541.9857				
2	14,565.8088	2	17,583.9037				
3	14,607.7268	3	17,625.8217				
4	14,649.6448	4	17,667.7397				
5	14,691.5627	5	17,709.6577				
6	14,733.4807	6	17,751.5757				
7	14,775.3987	7	17,793.4937				
8	14,817.3166	8	17,835.4117				
9	14,859.2346	9	17,877.3297				
10	14,901.1526	10	17,919.2477				
11	14,943.0706	11	17,961.1657				

Table 7: Tank average fractional increments table at 60.00 °F

Average fractional increments table should not be applied below 4.00 in and in Low Leg critical zone

Fraction (in)	Vol. (bbl)
1/16	2.6184
1/8	5.2369
3/16	7.8553
1/4	10.4738
5/16	13.0922
3/8	15.7107
7/16	18.3291
1/2	20.9476
9/16	23.5660
5/8	26.1844
11/16	28.8029
3/4	31.4213
13/16	34.0398
7/8	36.6582
15/16	39.2767
1	41.8951

Table 8: Incremental factor sheet at 60.00 °F

B – Denotes bottom displacement zone
 R – Denotes floating roof displacement zone in Low Leg position

Line No.	From Height (ft-in)	To Height (ft-in)	No. of Inc.	Inc. Vol. (bbl)	Tot. Vol. (bbl)	Zone
0	0.00"	0.00"	1	13.3775	13.3775	B
1	1.00"	1.00"	1	30.6803	44.0578	B
2	2.00"	2.00"	1	39.9538	84.0116	B
3	3.00"	3.00"	1	41.6666	125.6782	B
4	4.00"	4.00"	1	41.8583	167.5365	B
5	5.00"	1' 2.00"	10	41.8608	586.1445	
6	1' 3.00"	1' 3.00"	1	41.8552	627.9996	
7	1' 4.00"	1' 4.00"	1	41.8036	669.8032	
8	1' 5.00"	1' 5.00"	1	41.7993	711.6025	
9	1' 6.00"	1' 7.00"	2	41.7972	795.1969	
10	1' 8.00"	1' 8.00"	1	41.8001	836.9970	
11	1' 9.00"	1' 9.00"	1	41.8268	878.8238	
12	1' 10.00"	1' 10.00"	1	41.8430	920.6668	
13	1' 11.00"	1' 11.00"	1	41.8433	962.5101	
14	2' 0.00"	2' 0.00"	1	41.8430	1,004.3531	
15	2' 1.00"	2' 1.00"	1	41.8515	1,046.2045	
16	2' 2.00"	2' 2.00"	1	41.8633	1,088.0679	
17	2' 3.00"	2' 3.00"	1	41.8685	1,129.9363	
18	2' 4.00"	2' 6.00"	3	41.9080	1,255.6604	
19	2' 7.00"	2' 7.00"	1	41.9092	1,297.5696	
20	2' 8.00"	2' 8.00"	1	41.9064	1,339.4760	
21	2' 9.00"	3' 0.00"	4	41.9037	1,507.0910	
22	3' 1.00"	3' 1.00"	1	41.8964	1,548.9874	
23	3' 2.00"	3' 8.00"	7	41.8780	1,842.1337	
24	3' 9.00"	3' 9.00"	1	41.8742	1,884.0079	
25	3' 10.00"	4' 1.00"	4	41.8656	2,051.4703	
26	4' 2.00"	4' 2.00"	1	41.8627	2,093.3331	
27	4' 3.00"	4' 3.00"	1	41.8411	2,135.1742	
28	4' 4.00"	5' 10.00"	19	41.8356	2,930.0504	
29	5' 11.00"	5' 11.00"	1	27.7974	2,957.8478	R
30	6' 0.00"	6' 0.00"	1	1.4492	2,959.2970	R
31	6' 1.00"	6' 1.00"	1	3.3715	2,962.6685	R
32	6' 2.00"	7' 10.00"	21	41.8356	3,841.2159	
33	7' 11.00"	7' 11.00"	1	41.8499	3,883.0658	
34	8' 0.00"	15' 10.00"	95	41.8769	7,861.3692	
35	15' 11.00"	15' 11.00"	1	41.8824	7,903.2516	
36	16' 0.00"	23' 10.00"	95	41.8929	11,883.0749	
37	23' 11.00"	23' 11.00"	1	41.9016	11,924.9765	
38	24' 0.00"	31' 10.00"	95	41.9180	15,907.1839	
39	31' 11.00"	31' 11.00"	1	41.9250	15,949.1089	
40	32' 0.00"	38' 11.00"	84	41.9381	19,471.9067	
41	38' 11.99"	38' 11.99"	1	41.6003	19,513.5070	