

Owner – Tank 1

Tank Analysis Report

Location

NOVLUM INC. 

08/17/2022

OWNER – TANK 1

LOCATION

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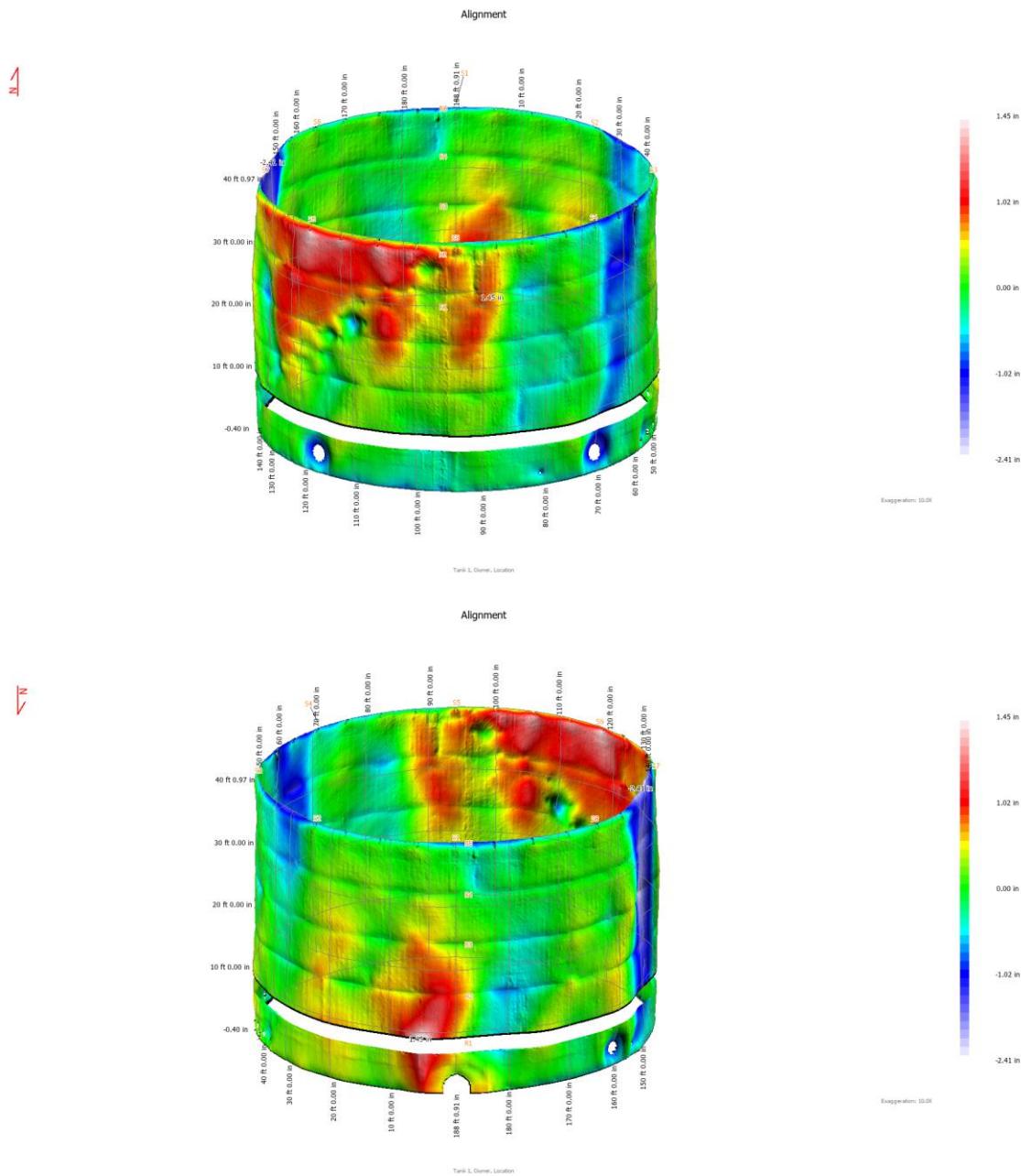
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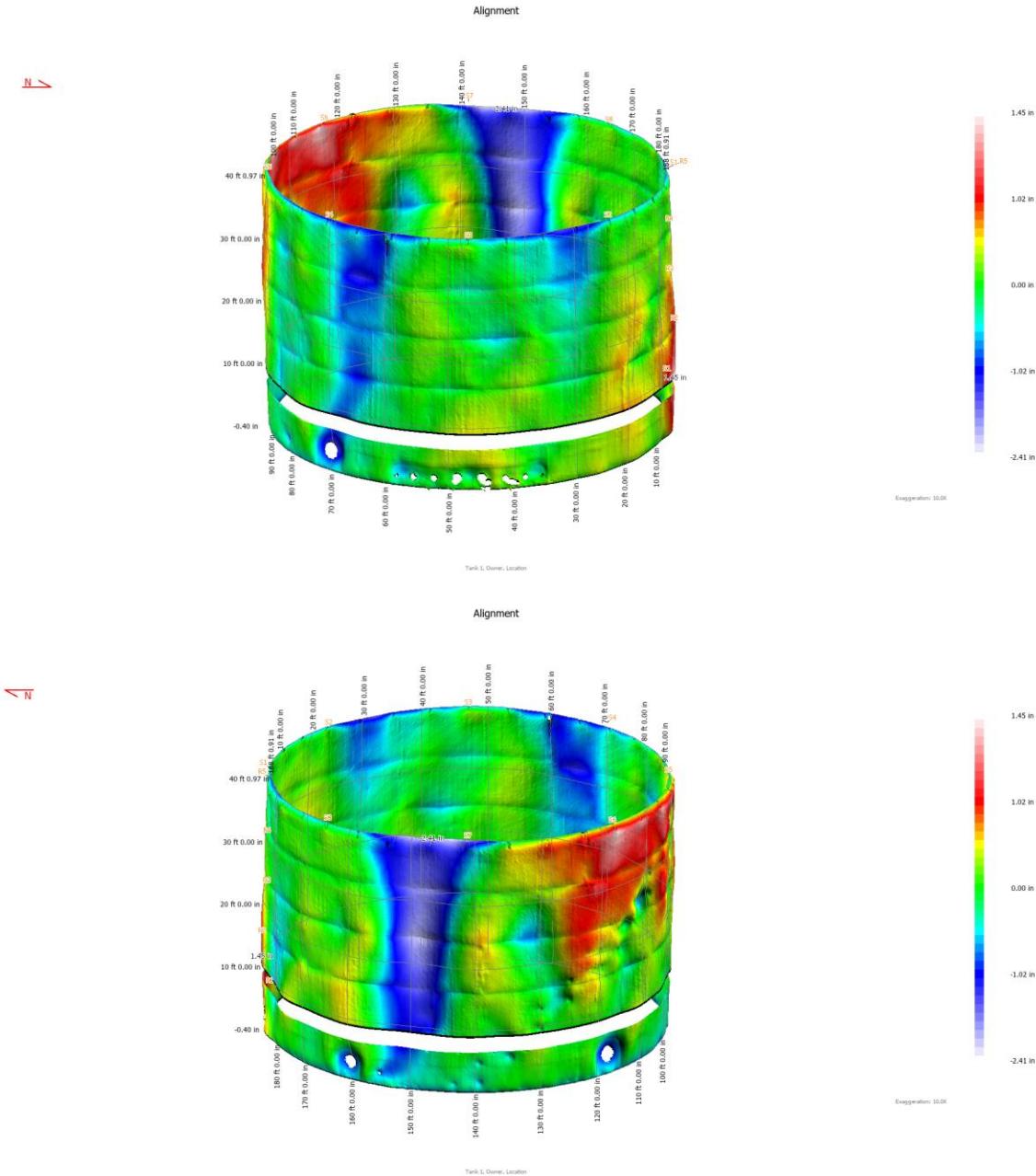
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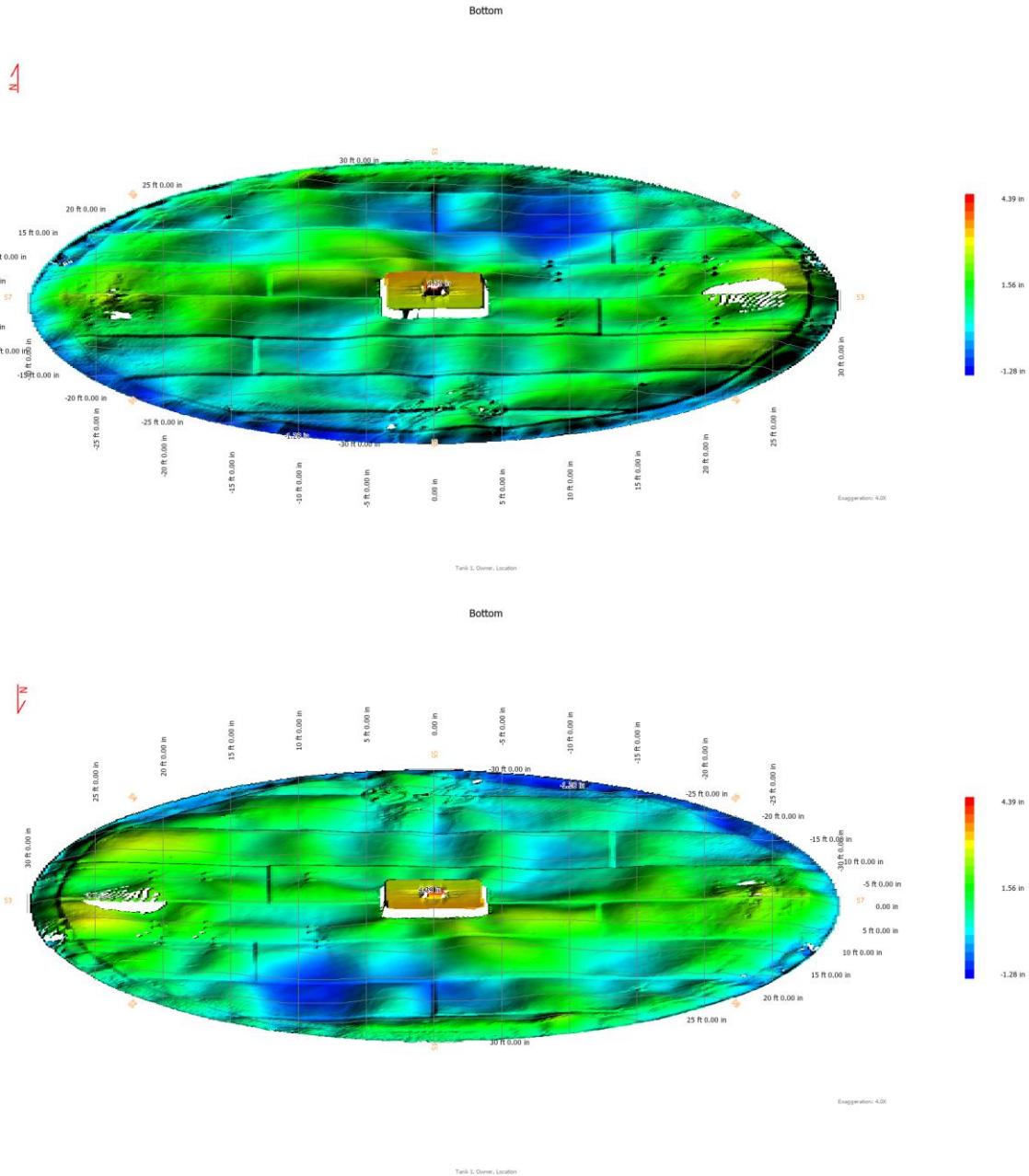
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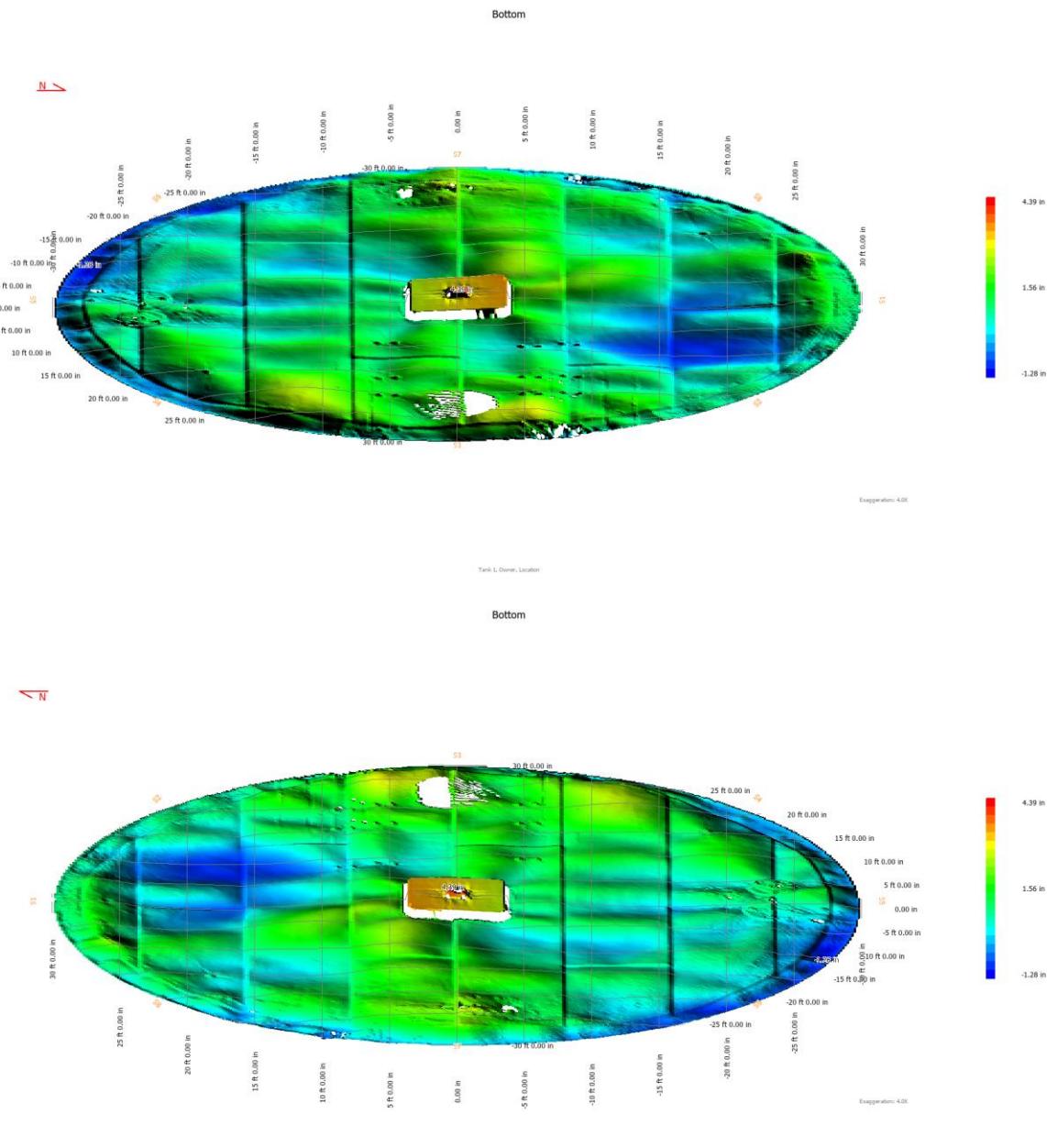
1 INTRODUCTION

The purpose of this examination is to assess the dimensional compliance of the tank in accordance with the relevant sections of *API 650: Welded Steel Tanks for Oil Storage* and *API 653: Tank Inspection, Repair, Alteration, and Reconstruction*.









2 LAYOUT

2.1 SHELL LAYOUT

The following shows the layout of shell plates and appurtenances.

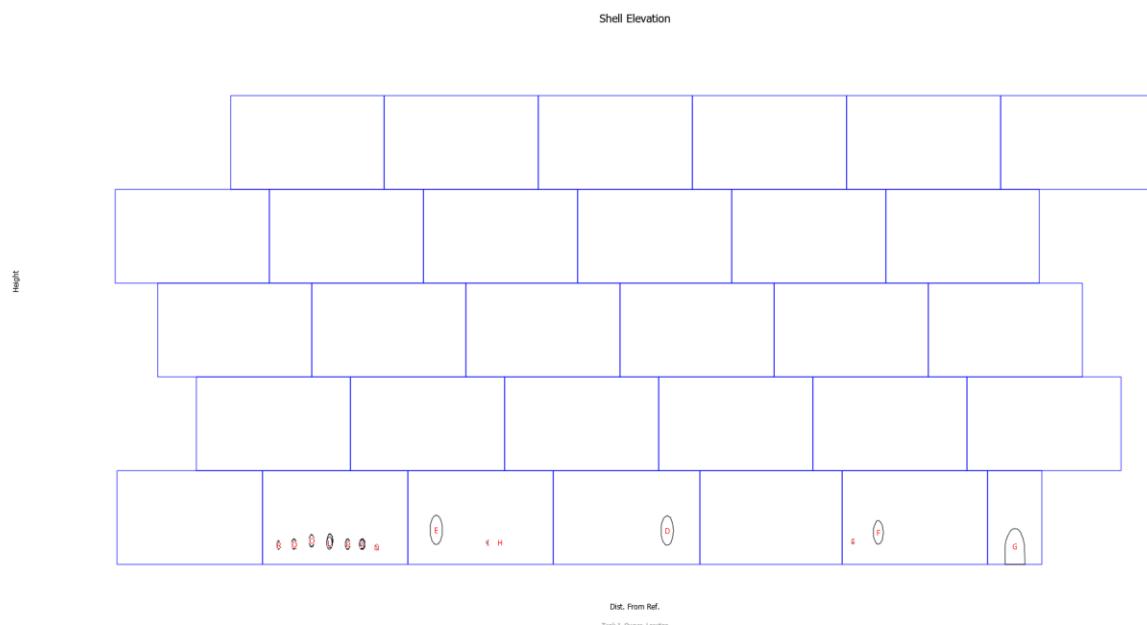
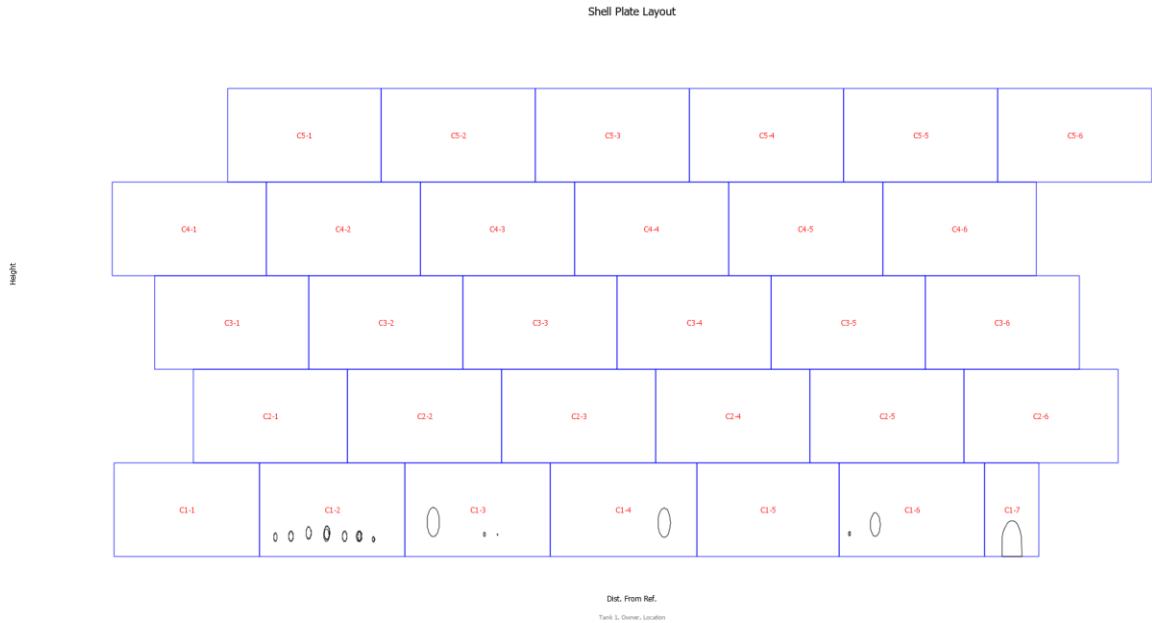


Figure 1: Shell elevation

Table 1: Appurtenances list

| Mark | Name | Loc. | Bearing (CW) (°) | Height From Bottom (ft-in) | Diameter (OD) (in) | Length (ft-in) |
|------|------------|------|---------------------|-------------------------------|-----------------------|----------------|
| A | COLUMN-01 | In | 112.16 | - | 12.75 | 39' 4.84" |
| B | Gauge | In | 171.35 | - | 8.62 | 39' 7.37" |
| C | Ladder | In | 182.23 | - | 8.62 | 39' 7.59" |
| D | MANWAY-001 | Out | 224.50 | 3' 0.26" | 30.00 | 6.21" |
| E | MANWAY-002 | Out | 134.54 | 3' 0.45" | 30.00 | 6.15" |
| F | MANWAY-003 | Out | 306.62 | 2' 9.59" | 24.00 | 6.40" |
| G | MANWAY-004 | Out | 359.77 | 2' 0.09" | - | 6.00" |
| H | NOZZLE-001 | Out | 159.48 | 1' 11.45" | 1.66 | 3.30" |
| I | NOZZLE-002 | Out | 154.51 | 1' 11.80" | 4.00 | 7.52" |
| J | NOZZLE-003 | Out | 105.51 | 1' 9.21" | 10.75 | 9.57" |
| K | NOZZLE-003 | In | 105.92 | 1' 9.21" | 10.75 | 10.75" |
| L | NOZZLE-004 | Out | 92.97 | 1' 10.00" | 12.75 | 11.58" |
| M | NOZZLE-004 | In | 93.14 | 2' 0.50" | 14.00 | 2' 1.87" |
| N | NOZZLE-005 | In | 111.30 | 1' 6.13" | 5.56 | 9.27" |
| O | NOZZLE-006 | In | 86.02 | 1' 11.91" | 12.75 | 2' 0.43" |
| P | PIPE-001 | In | 100.06 | 1' 9.11" | 10.75 | 20' 11.95" |
| Q | PIPE-004 | In | 79.16 | 1' 8.87" | 10.75 | 20' 11.87" |
| R | PIPE-005 | In | 73.12 | 1' 8.53" | 8.62 | 20' 4.91" |
| S | PIPE-006 | In | 296.64 | 2' 0.40" | 4.50 | 3' 0.63" |

**Figure 2: Shell plates****Table 2: Shell plates list**

| Name | Type | Bearing (CW) (°) | Shell Dist. From Ref. (CW) (in) | Elevation (in) | Width (in) | Height (in) |
|------|-------|---------------------|------------------------------------|----------------|------------|-------------|
| C1-1 | PLATE | 10 | 65 | 1 | 355 | 96 |
| C1-2 | PLATE | 67 | 420 | 1 | 354 | 96 |
| C1-3 | PLATE | 124 | 774 | 1 | 355 | 96 |
| C1-4 | PLATE | 180 | 1,129 | 1 | 357 | 96 |
| C1-5 | PLATE | 237 | 1,486 | 1 | 348 | 96 |
| C1-6 | PLATE | 293 | 1,835 | 1 | 354 | 96 |
| C1-7 | PLATE | 349 | 2,189 | 1 | 133 | 96 |
| C2-1 | PLATE | 41 | 258 | 97 | 376 | 96 |
| C2-2 | PLATE | 101 | 634 | 97 | 376 | 96 |
| C2-3 | PLATE | 161 | 1,010 | 97 | 376 | 96 |
| C2-4 | PLATE | 221 | 1,387 | 97 | 376 | 96 |
| C2-5 | PLATE | 281 | 1,763 | 97 | 376 | 96 |
| C2-6 | PLATE | 341 | 2,139 | 97 | 376 | 96 |
| C3-1 | PLATE | 26 | 164 | 193 | 376 | 96 |
| C3-2 | PLATE | 86 | 540 | 193 | 376 | 96 |
| C3-3 | PLATE | 146 | 916 | 193 | 376 | 96 |
| C3-4 | PLATE | 206 | 1,292 | 193 | 376 | 96 |
| C3-5 | PLATE | 266 | 1,668 | 193 | 376 | 96 |
| C3-6 | PLATE | 326 | 2,044 | 193 | 376 | 96 |
| C4-1 | PLATE | 9 | 59 | 289 | 376 | 96 |
| C4-2 | PLATE | 69 | 436 | 289 | 376 | 96 |
| C4-3 | PLATE | 129 | 812 | 289 | 376 | 96 |
| C4-4 | PLATE | 189 | 1,188 | 289 | 376 | 96 |
| C4-5 | PLATE | 249 | 1,564 | 289 | 376 | 96 |
| C4-6 | PLATE | 309 | 1,940 | 289 | 376 | 96 |
| C5-1 | PLATE | 54 | 341 | 385 | 376 | 96 |
| C5-2 | PLATE | 114 | 717 | 385 | 376 | 96 |
| C5-3 | PLATE | 174 | 1,093 | 385 | 376 | 96 |
| C5-4 | PLATE | 234 | 1,469 | 385 | 376 | 96 |
| C5-5 | PLATE | 294 | 1,846 | 385 | 376 | 96 |
| C5-6 | PLATE | 354 | 2,222 | 385 | 376 | 96 |

2.2 BOTTOM LAYOUT

The following shows the layout of bottom plates and appurtenances.

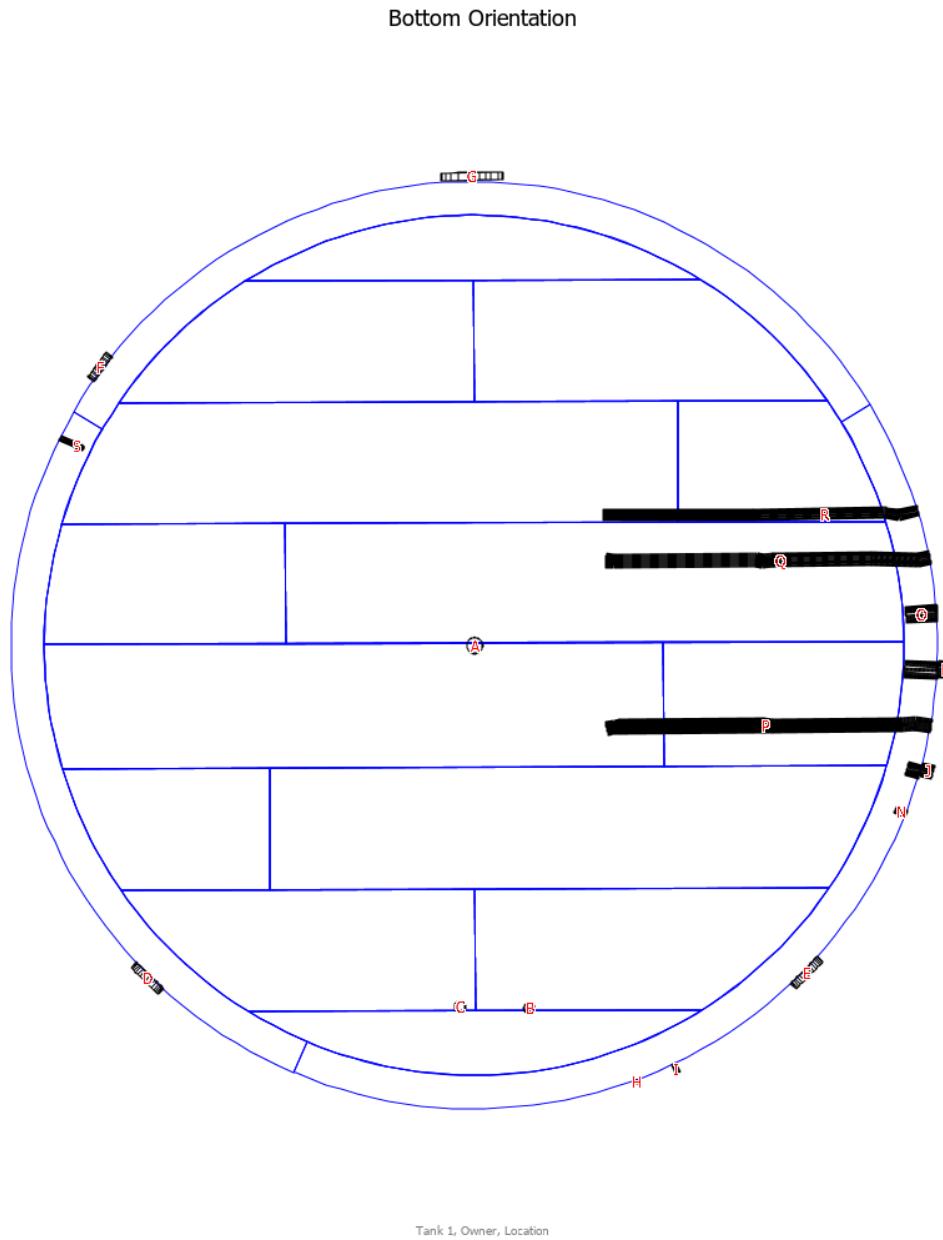
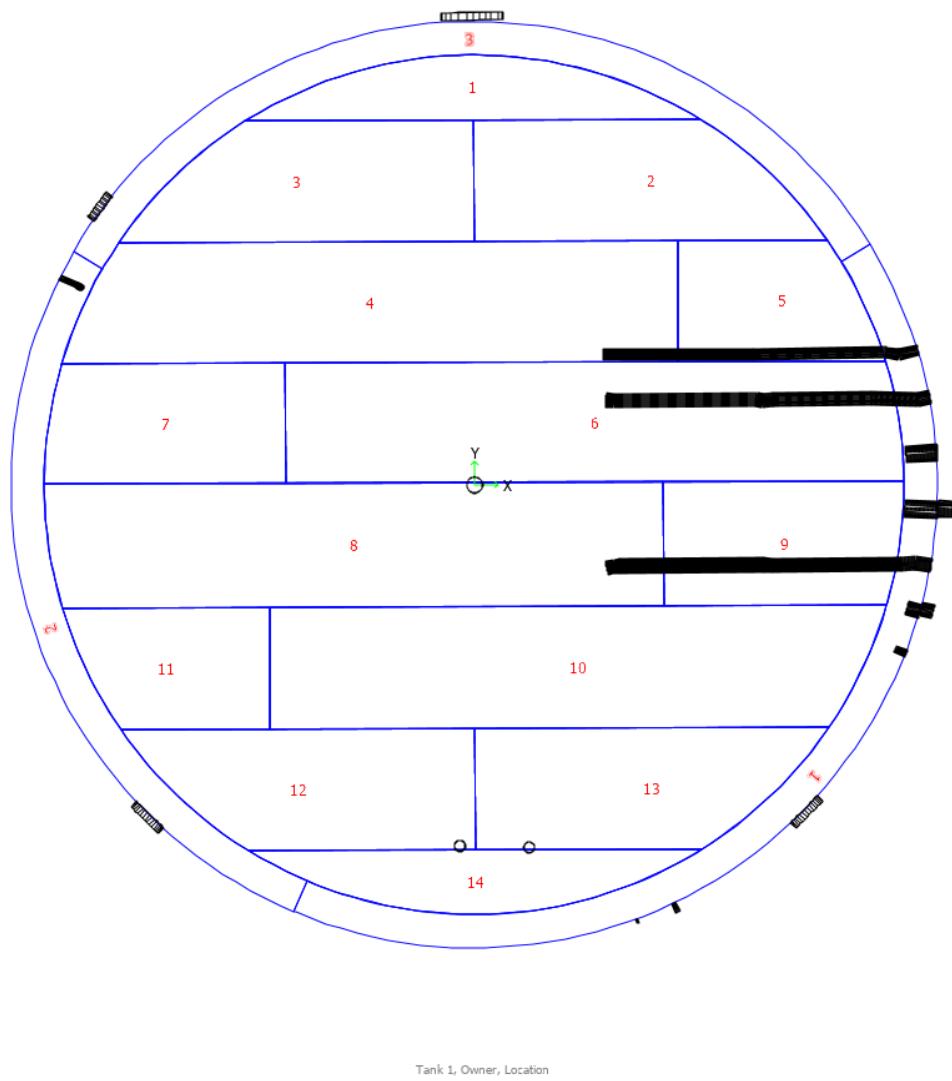


Figure 3: Bottom orientation

Bottom Plate Layout



Tank 1, Owner, Location

Figure 4: Bottom plates

Table 3: Annular plates list

| Name | Bearing (CW) (°) | Shell Dist. From Ref. (CW) (in) | Width (O) (in) | Height (in) |
|------|------------------|------------------------------------|----------------|-------------|
| 1 | 59 | 368 | 904 | 26 |
| 2 | 203 | 1,272 | 610 | 26 |
| 3 | 300 | 1,882 | 743 | 26 |

Table 4: Bottom plates list

| Name | Type | X (in) | Y (in) | Width (in) | Height (in) |
|------|--------|--------|--------|------------|-------------|
| 1 | SKETCH | -176 | 283 | 353 | 51 |
| 2 | SKETCH | 1 | 189 | 274 | 94 |
| 3 | SKETCH | -275 | 189 | 275 | 94 |
| 4 | SKETCH | -319 | 95 | 478 | 94 |
| 5 | SKETCH | 159 | 95 | 161 | 94 |
| 6 | SKETCH | -146 | 2 | 479 | 93 |
| 7 | SKETCH | -333 | 2 | 187 | 93 |
| 8 | SKETCH | -333 | -95 | 480 | 97 |
| 9 | SKETCH | 147 | -95 | 186 | 97 |
| 10 | SKETCH | -159 | -189 | 479 | 94 |
| 11 | SKETCH | -319 | -189 | 160 | 94 |
| 12 | SKETCH | -274 | -283 | 274 | 94 |
| 13 | SKETCH | -0 | -283 | 274 | 94 |
| 14 | SKETCH | -176 | -333 | 351 | 50 |

3 ANALYSIS

3.1 SHELL

The Manway was used as the point of reference for shell analysis. All circumferential measurements are distances from the Manway along the shell in a clockwise manner. All elevation measurements are heights from the bottom to shell weld at the Manway.

Table 5: Shell analysis properties

| | |
|----------------------------------|-------------------------------------|
| Shell height | 40 ft 1.37 in |
| Shell inner radius | 29 ft 11.52 in |
| Shell tilt | 0.11° |
| Shell tilt bearing | 211.58° (CW) |
| Internal floating roof | Yes |
| External analysis | No |
| Analysis direction | clockwise |
| Standard | API 650/653 |
| Station 1 reference | Manway |
| Station 1 bearing (CW) | 0.00° |
| Shell data precision (1σ) | 0.06 in |
| Data accuracy (1σ) | 0.1 in (Manufacturer specification) |

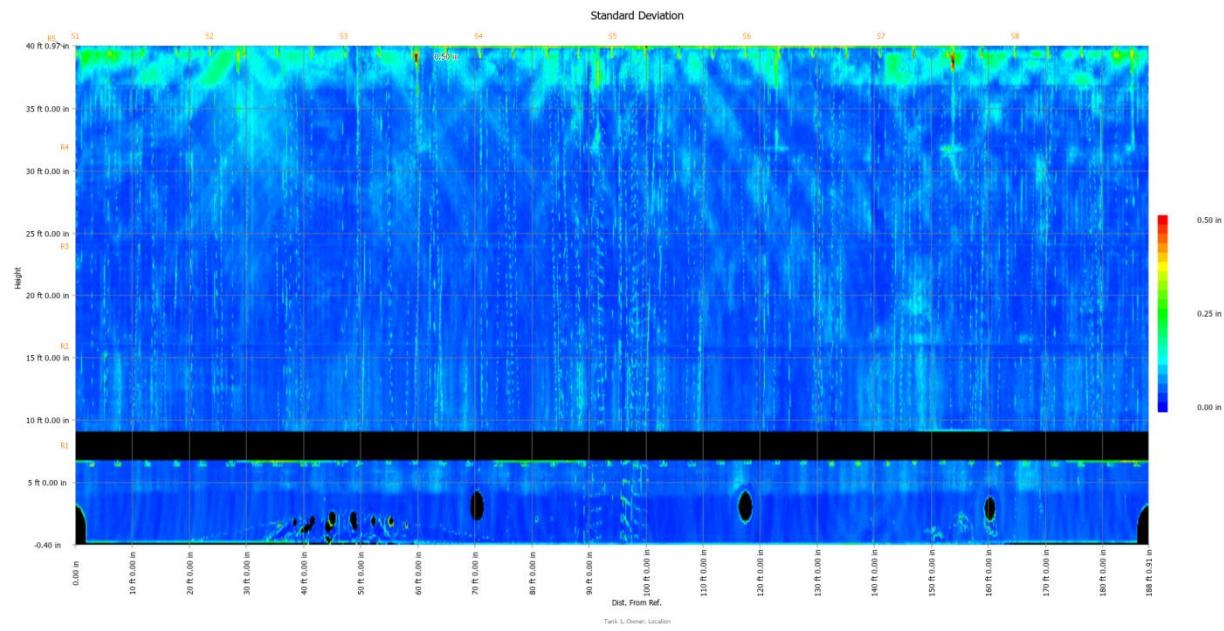


Figure 5: Standard deviation of shell grids

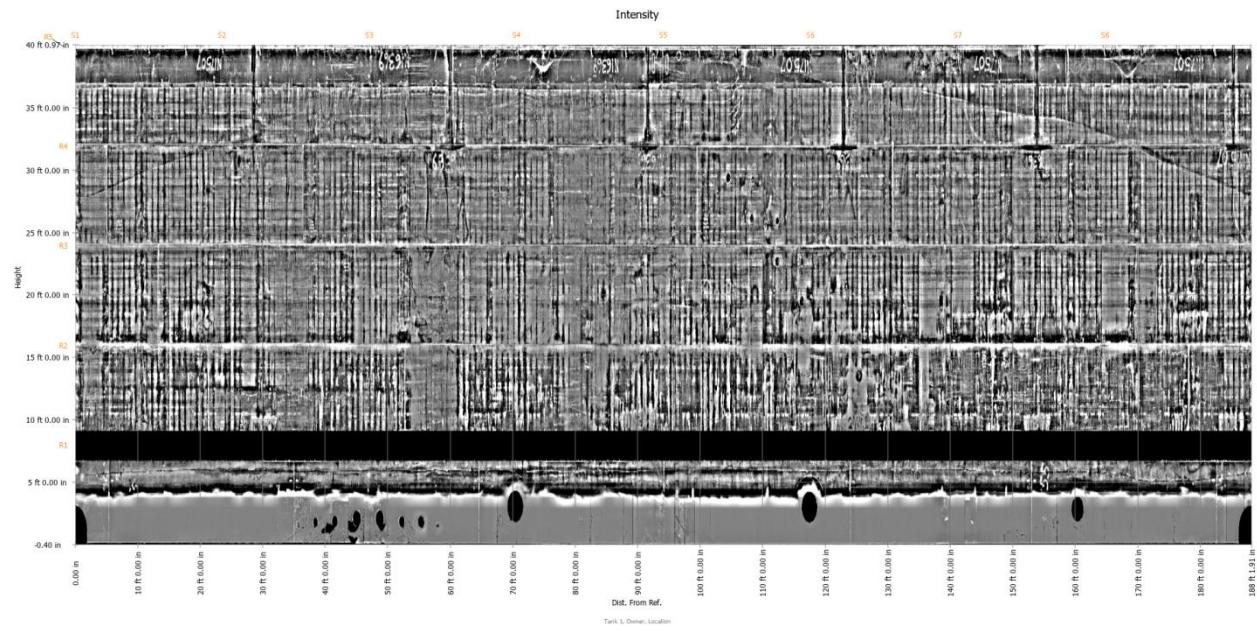


Figure 6: Shell image

3.1.1 SHELL ALIGNMENT

Alignment analysis is used to assess deflections in the shell. It gives a good overview of the shell's condition and is a good indicator of plumbness and roundness, which are assessed independently in subsequent sections. Alignment compares shell radii as measured from the best-fit center of the tank. The tolerances used are the 95% confidence intervals of the shell radii. Positive values (red) indicate a deflection outwards while negative values (blue) indicate a deflection inwards. Minimum and maximum values are as follows:

| Dist. From Ref. | Height | Alignment |
|-----------------|---------------|-----------|
| 146 ft 11.15 in | 40 ft 0.97 in | -2.41 in |
| 5 ft 1.97 in | 9 ft 1.46 in | 1.45 in |

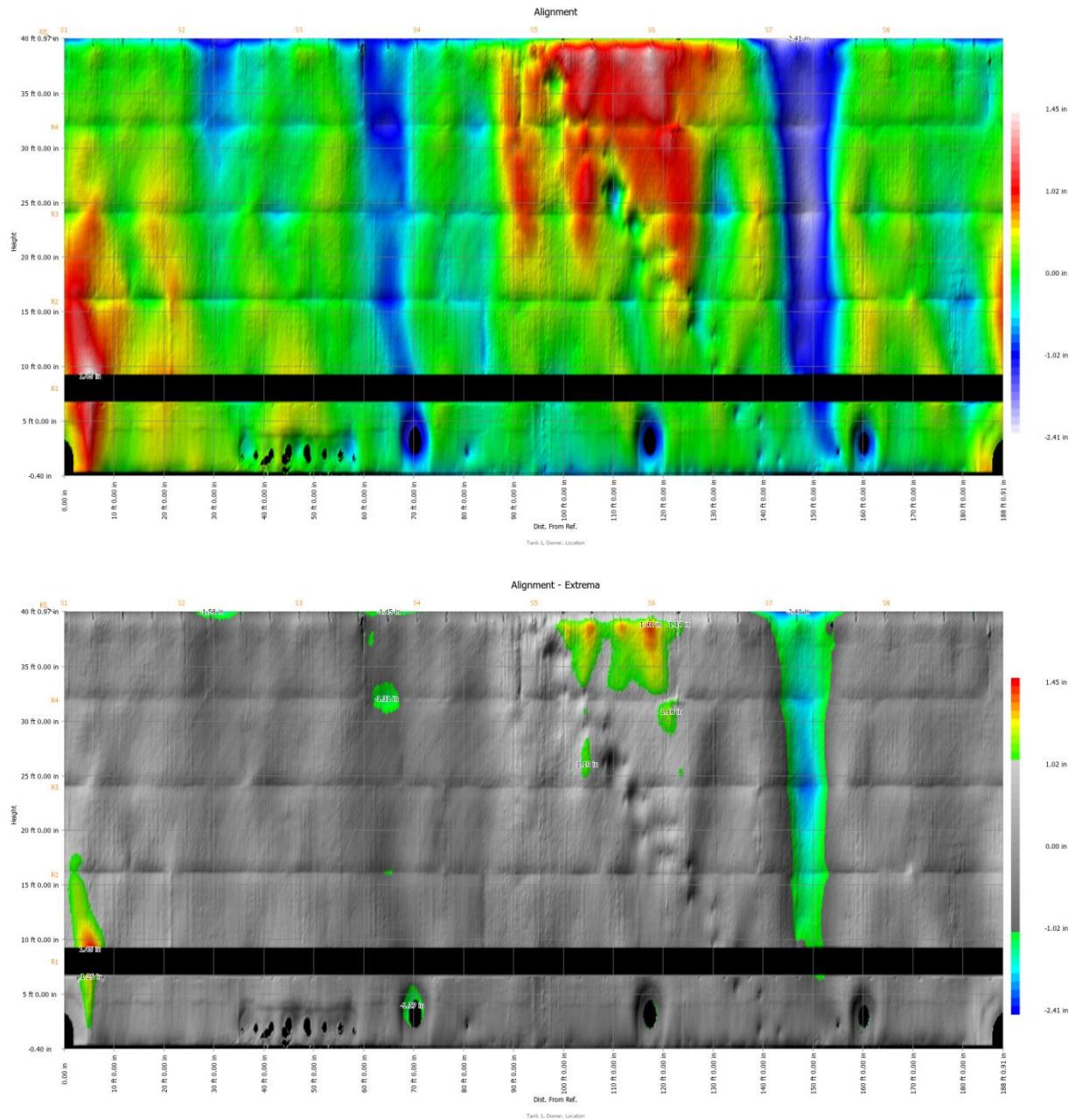


Figure 7: Alignment of entire tank

3.1.2 SHELL PLUMBNESS

The API allowable tolerance for deflection from plumb is 2.41" for a new tank of this height (API 650 Section 7.5.2 Plumbness).

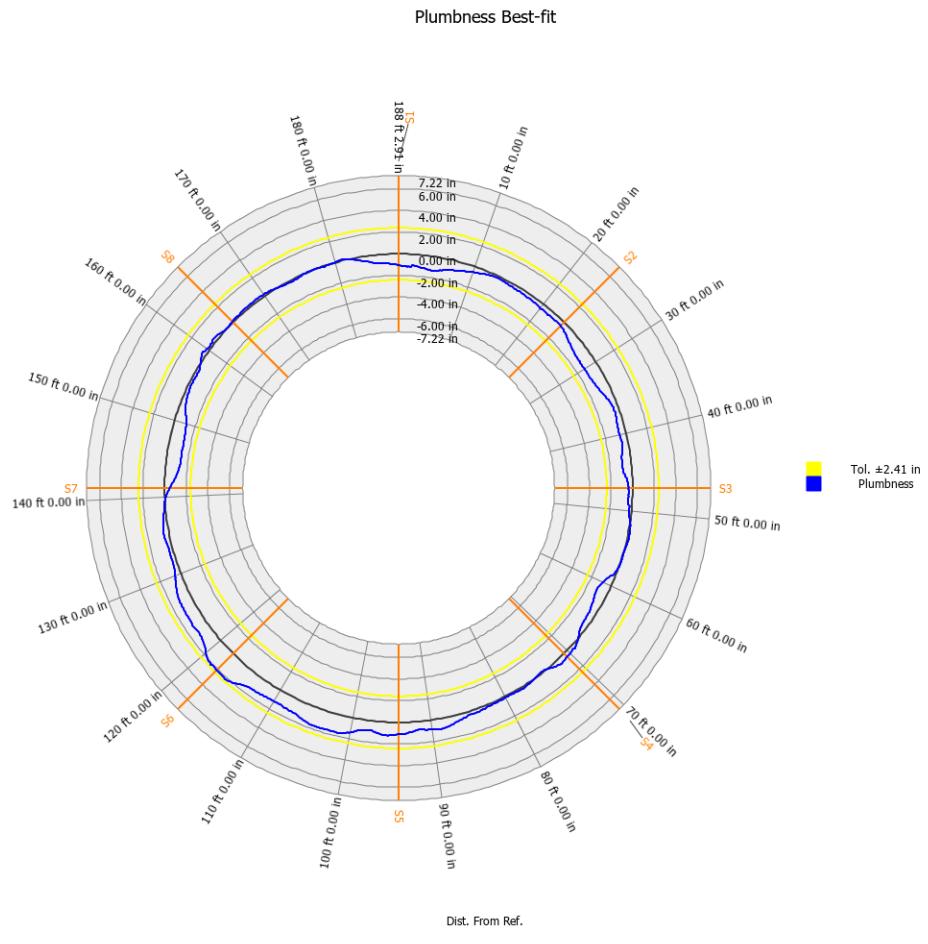


Figure 8: Plumbness (Best-fit)

Table 6: Plumbness values (Best-fit)

| Units: [in] | S1 (0°) | S2 (45°) | S3 (90°) | S4 (135°) | S5 (180°) | S6 (225°) | S7 (270°) | S8 (315°) |
|---------------------------|---------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| Plumbness Best-fit | -1.09 | -0.45 | -0.38 | 0.42 | 1.09 | 2.16 | -0.43 | 0.09 |
| Pass/Fail | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |

Plumbness Top-Bottom [Ref. 1 ft]

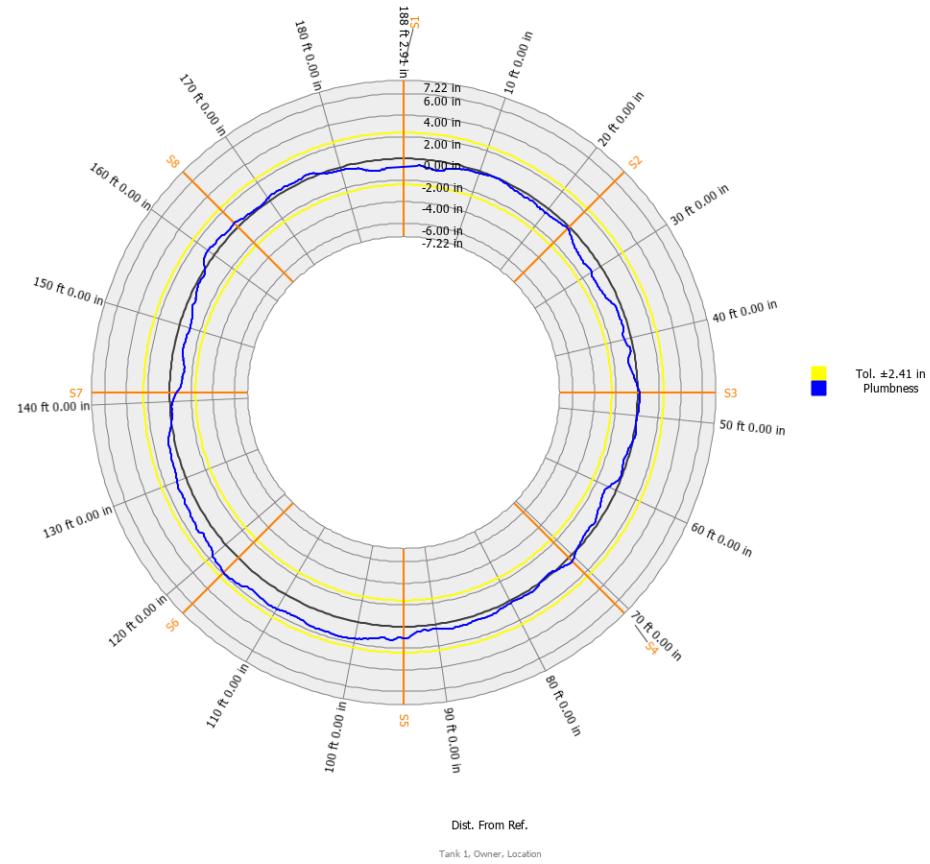


Figure 9: Plumbness (Top-bottom)

Table 7: Plumbness values (Top-bottom)

| Units: [in] | S1 (0°) | S2 (45°) | S3 (90°) | S4 (135°) | S5 (180°) | S6 (225°) | S7 (270°) | S8 (315°) |
|-------------|---------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| Plumbness | -0.66 | -0.16 | 0.19 | 0.42 | 1.08 | 1.92 | -0.60 | 0.53 |
| Top-Bottom | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |

Positive values (red) indicate a slope outwards while negative values (blue) indicate a slope inwards. Minimum and maximum values are as follows:

| Dist. From Ref. | Height | Plumbness [Ref. 1 ft] |
|-----------------|----------------|-----------------------|
| 146 ft 11.15 in | 40 ft 0.97 in | -2.04 in |
| 117 ft 5.32 in | 38 ft 10.99 in | 1.98 in |

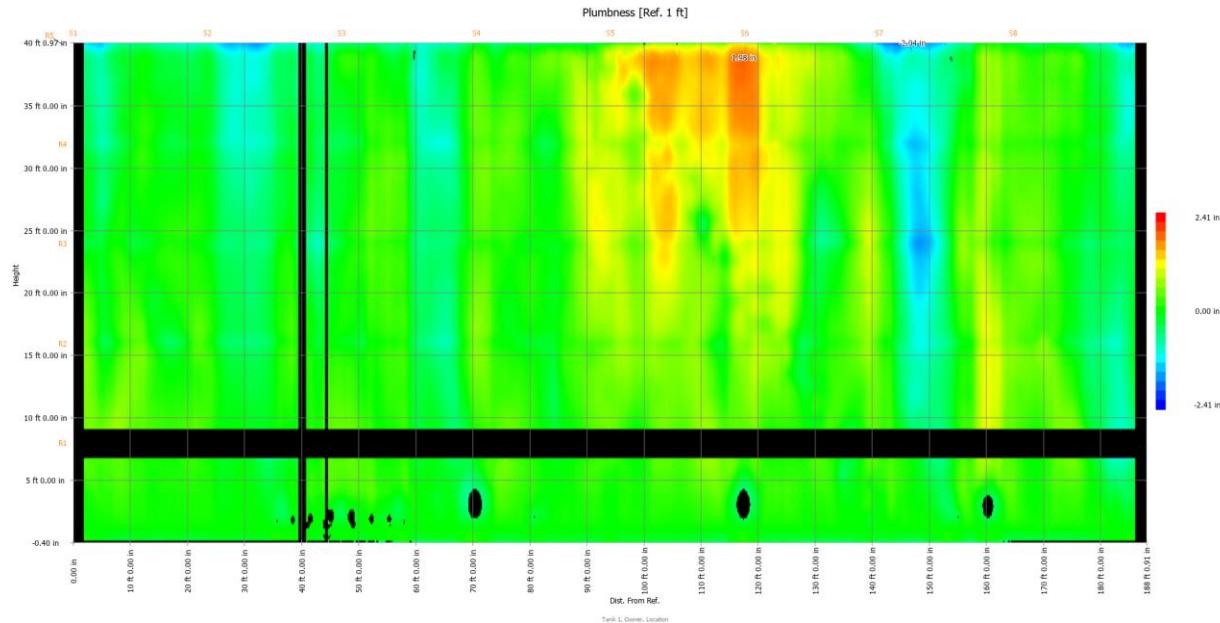


Figure 10: Plumbness of entire tank

Table 8: Plumbness values

| Units: [in] | S1 (0°) | S2 (45°) | S3 (90°) | S4 (135°) | S5 (180°) | S6 (225°) | S7 (270°) | S8 (315°) |
|-------------------------|---------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| 1 ft (R1 B+1ft) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4 ft (R1 50%) | 0.10 | 0.16 | | | 0.04 | | 0.03 | 0.40 |
| 7 ft (R1 T-1ft) | | | | | | | | |
| 9 ft (R2 B+1ft) | | | | | | | | |
| 12 ft (R2 50%) | 0.23 | 0.32 | 0.40 | 0.47 | 0.57 | 0.39 | 0.50 | |
| 15 ft (R2 T-1ft) | 0.25 | 0.14 | 0.62 | 0.59 | 0.67 | 0.36 | 0.65 | |
| 17 ft (R3 B+1ft) | 0.25 | 0.06 | 0.64 | 0.66 | 0.78 | 0.43 | 0.52 | |
| 20 ft (R3 50%) | 0.13 | 0.10 | 0.54 | 0.74 | 0.80 | 0.61 | 0.47 | |
| 23 ft (R3 T-1ft) | -0.02 | -0.01 | 0.35 | 1.01 | 1.05 | 0.60 | 0.39 | |
| 25 ft (R4 B+1ft) | -0.02 | -0.09 | 0.35 | 1.03 | 1.22 | 0.60 | 0.38 | |
| 28 ft (R4 50%) | -0.02 | -0.16 | 0.47 | 0.93 | 1.42 | 0.40 | 0.43 | |
| 31 ft (R4 T-1ft) | -0.08 | -0.22 | 0.48 | 0.96 | 1.51 | 0.14 | 0.38 | |
| 33 ft (R5 B+1ft) | -0.15 | -0.30 | 0.46 | 0.95 | 1.63 | 0.01 | 0.38 | |
| 36 ft (R5 50%) | -0.18 | -0.12 | 0.49 | 1.12 | 1.81 | -0.30 | 0.53 | |
| 39 ft (R5 T-1ft) | -0.16 | 0.22 | 0.45 | 1.06 | 1.95 | -0.64 | 0.55 | |
| Min | -0.18 | -0.30 | 0.00 | 0.00 | 0.00 | -0.64 | 0.00 | |
| Max | 0.25 | 0.32 | 0.64 | 1.12 | 1.95 | 0.61 | 0.65 | |
| Pass/Fail | N/A | Pass | Pass | Pass | Pass | Pass | Pass | |

3.1.3 SHELL ROUNDNESS

The API allowable tolerance for roundness at 1 ft is 0.75" for a new tank of this diameter (API 650 Section 7.5.3 Roundness).

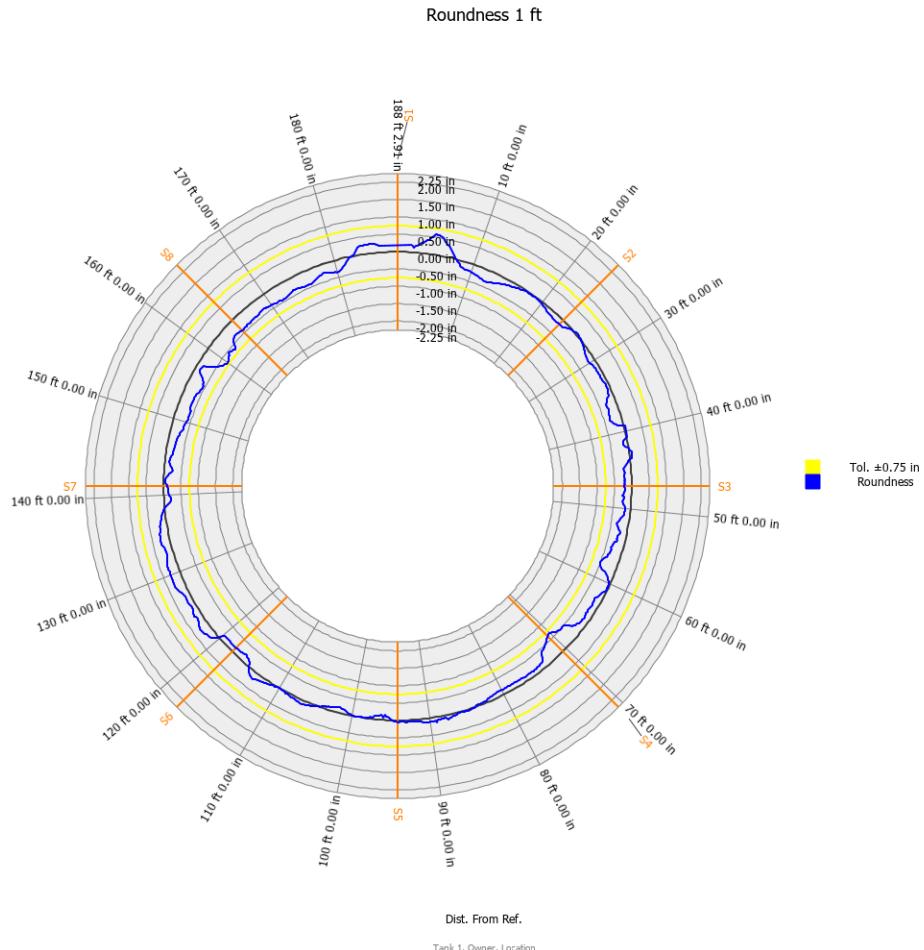


Figure 11: Roundness at 1 ft from the bottom

Table 9: Roundness values at 1 ft from the bottom

| Units: [in] | S1 (0°) | S2 (45°) | S3 (90°) | S4 (135°) | S5 (180°) | S6 (225°) | S7 (270°) | S8 (315°) |
|------------------|---------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| Roundness | 0.22 | -0.15 | -0.20 | -0.62 | 0.06 | -0.16 | -0.10 | -0.41 |
| Pass/Fail | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |

Positive values (red) indicate a deflection outwards while negative values (blue) indicate a deflection inwards.
 Minimum and maximum values are as follows:

| Dist. From Ref. | Height | Roundness |
|-----------------|---------------|-----------|
| 146 ft 11.15 in | 40 ft 0.97 in | -2.57 in |
| 5 ft 1.97 in | 9 ft 1.46 in | 1.23 in |

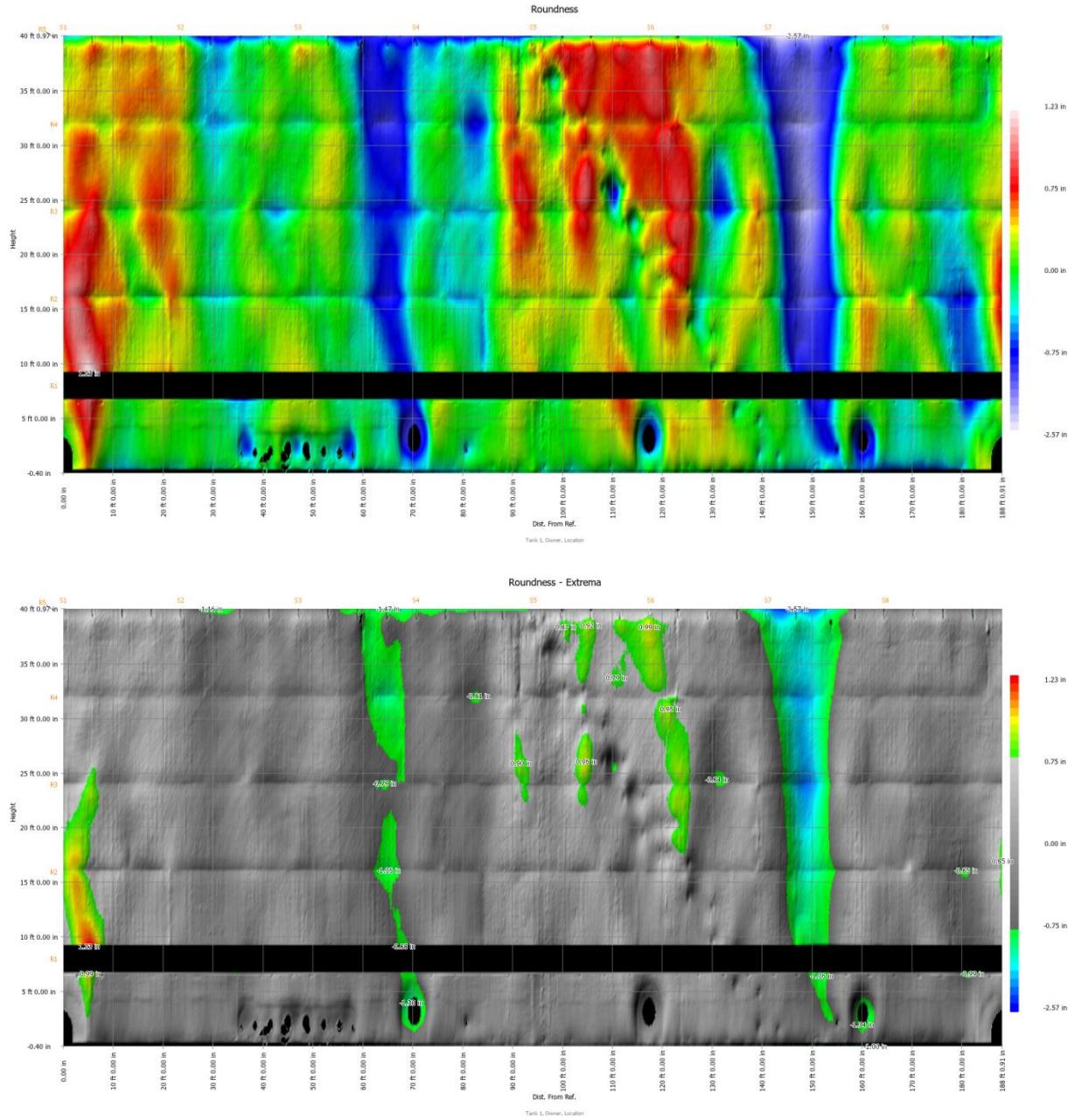


Figure 12: Roundness of entire tank

Table 10: Roundness values

| Units: [in] | S1 (0°) | S2 (45°) | S3 (90°) | S4 (135°) | S5 (180°) | S6 (225°) | S7 (270°) | S8 (315°) |
|-------------------------|---------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| 1 ft (R1 B+1ft) | | -0.15 | -0.20 | -0.62 | 0.06 | -0.16 | -0.09 | -0.41 |
| 4 ft (R1 50%) | 0.01 | 0.01 | -0.01 | | 0.04 | | -0.10 | 0.00 |
| 7 ft (R1 T-1ft) | | | | | | | | |
| 9 ft (R2 B+1ft) | | | | | | | | |
| 12 ft (R2 50%) | 0.64 | 0.32 | 0.25 | -0.28 | 0.32 | 0.18 | 0.17 | 0.14 |
| 15 ft (R2 T-1ft) | 0.85 | 0.40 | 0.10 | -0.07 | 0.39 | 0.22 | 0.11 | 0.31 |
| 17 ft (R3 B+1ft) | 0.86 | 0.44 | 0.04 | -0.07 | 0.41 | 0.28 | 0.15 | 0.19 |
| 20 ft (R3 50%) | 0.69 | 0.39 | 0.11 | -0.18 | 0.45 | 0.23 | 0.29 | 0.15 |
| 23 ft (R3 T-1ft) | 0.42 | 0.31 | 0.04 | -0.38 | 0.65 | 0.42 | 0.26 | 0.09 |
| 25 ft (R4 B+1ft) | 0.36 | 0.35 | -0.02 | -0.39 | 0.63 | 0.55 | 0.23 | 0.09 |
| 28 ft (R4 50%) | 0.37 | 0.41 | -0.05 | -0.29 | 0.48 | 0.68 | -0.00 | 0.16 |
| 31 ft (R4 T-1ft) | 0.31 | 0.42 | -0.08 | -0.30 | 0.46 | 0.71 | -0.29 | 0.12 |
| 33 ft (R5 B+1ft) | 0.32 | 0.39 | -0.13 | -0.33 | 0.41 | 0.79 | -0.45 | 0.14 |
| 36 ft (R5 50%) | 0.26 | 0.42 | 0.08 | -0.31 | 0.52 | 0.90 | -0.80 | 0.30 |
| 39 ft (R5 T-1ft) | 0.28 | 0.51 | 0.46 | -0.37 | 0.40 | 0.98 | -1.17 | 0.33 |
| Min | 0.01 | -0.15 | -0.20 | -0.62 | 0.04 | -0.16 | -1.17 | -0.41 |
| Max | 0.86 | 0.51 | 0.46 | -0.07 | 0.65 | 0.98 | 0.29 | 0.33 |
| Pass/Fail | Fail | Pass | Pass | Pass | Pass | Fail | Fail | Pass |

3.1.4 SHELL PEAKING

Peaking is horizontal discontinuities in roundness, typically occurring at vertical weld joints. The API allowable tolerance for peaking is 0.50" for a new tank (API 650 Section 7.5.4 Local Deviations). Small areas identified near the top and bottom of the shell are likely a result of structures affixed to the shell that cause discontinuities along its surface.

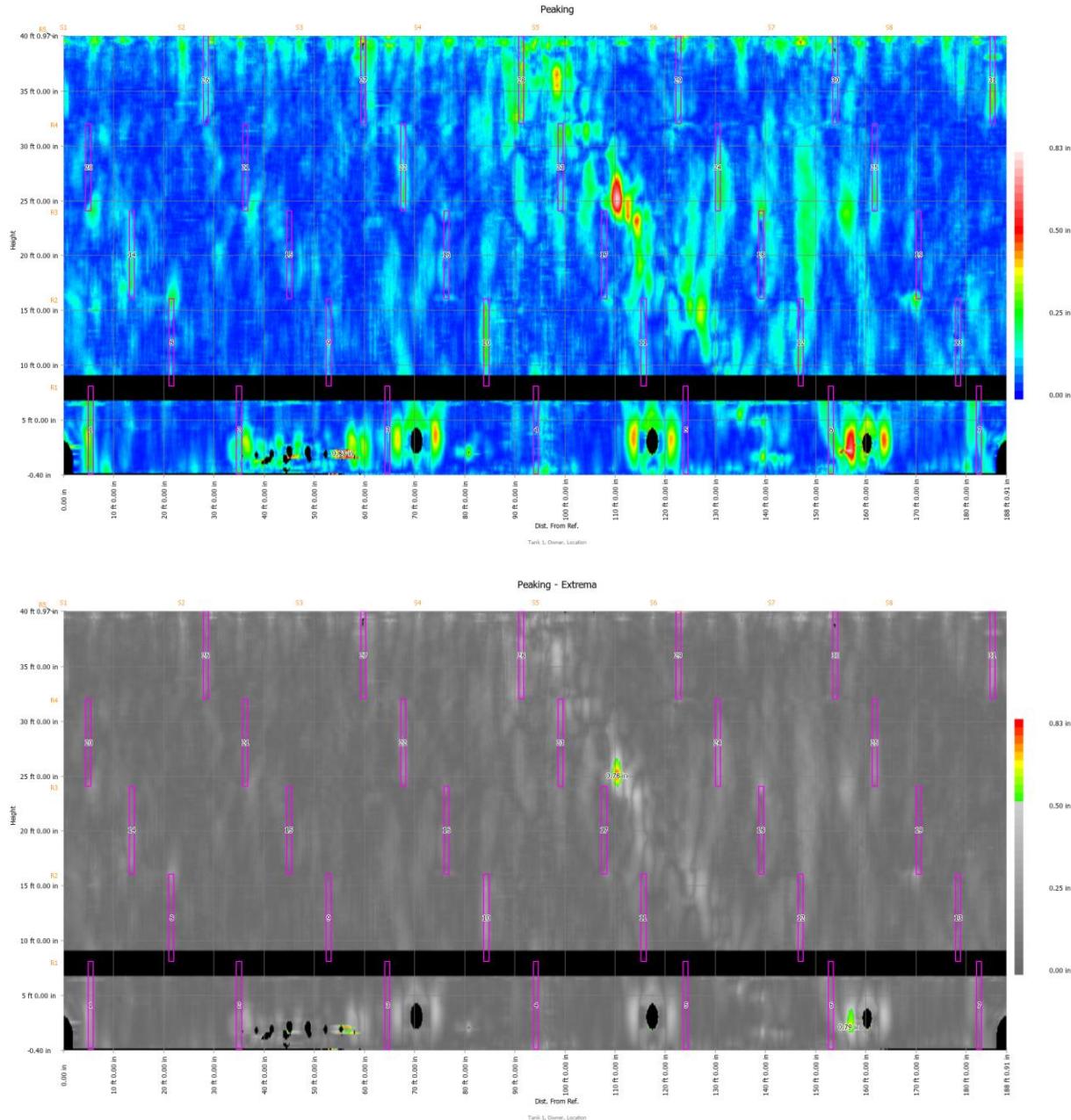


Figure 13: Peaking

3.1.5 SHELL BANDING

Banding is vertical discontinuities in flatness, typically occurring at horizontal weld joints. The API allowable tolerance for banding is 0.50" for a new tank (API 650 Section 7.5.4 Local Deviations). Small areas identified near the top and bottom of the shell are likely a result of structures affixed to the shell that cause discontinuities along its surface.

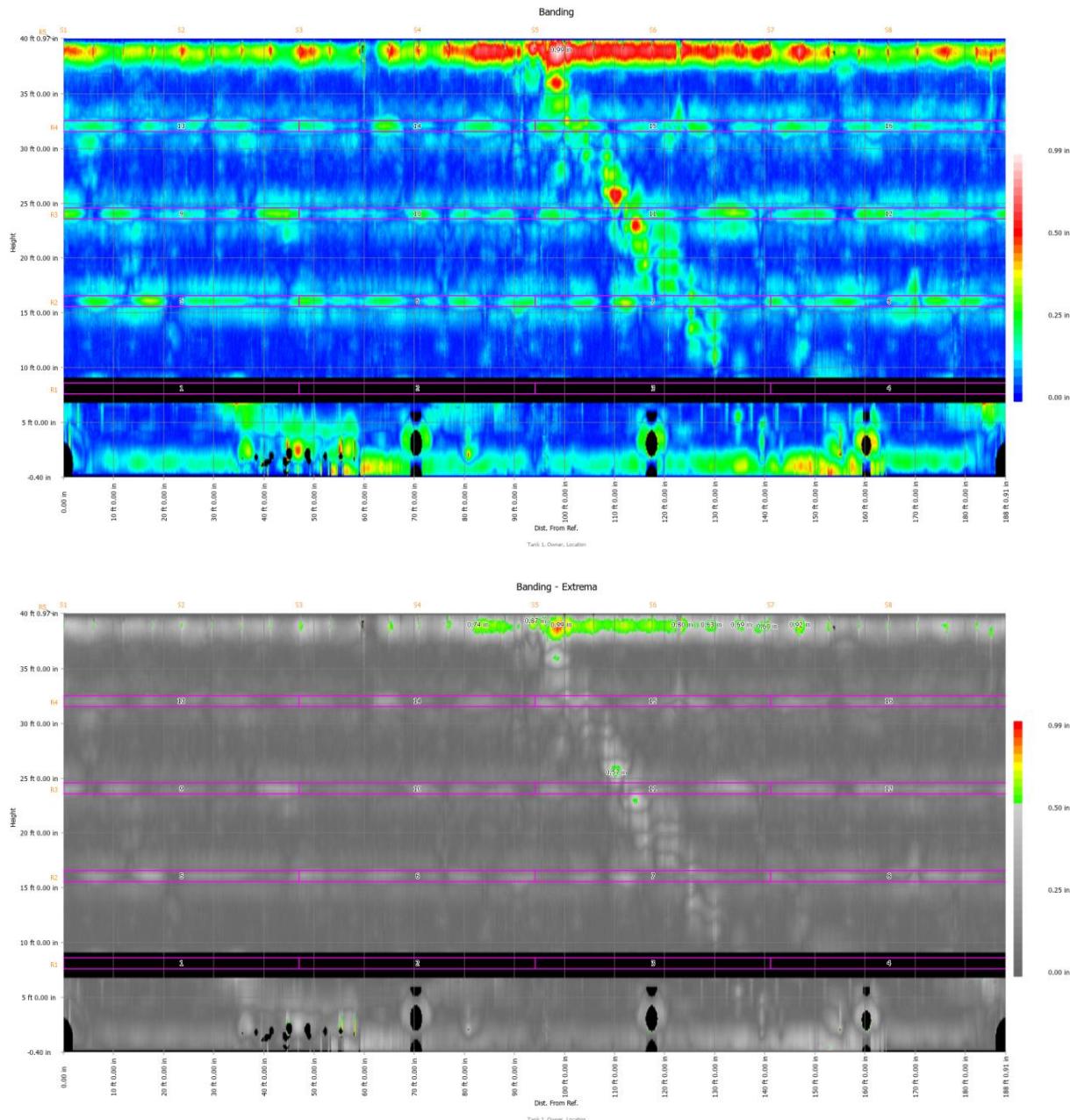


Figure 14: Banding

3.2 BOTTOM

The Manway was used as the point of reference for bottom analysis. All circumferential measurements are distances from the Manway along the shell in a clockwise manner.

Table 11: Analysis properties

| | |
|------------------------------------|-------------------------------------|
| Bottom tilt | 1.43 in (0.11°) |
| Bottom peak direction | 27° (CW) |
| Bottom trough direction | 207° (CW) |
| Bottom cosine R² | 0.92 |
| Yield Strength (Y): | 36,000.00 psi |
| Young's Modulus (E): | 29,000,000.00 psi |
| Fixed Roof: | Yes |
| Analysis direction | clockwise |
| Standard | API 650/653 |
| Station 1 reference | Manway |
| Station 1 bearing (CW) | 0.00° |
| Bottom data precision (1σ) | 0.06 in |
| Data accuracy (1σ) | 0.1 in (Manufacturer specification) |

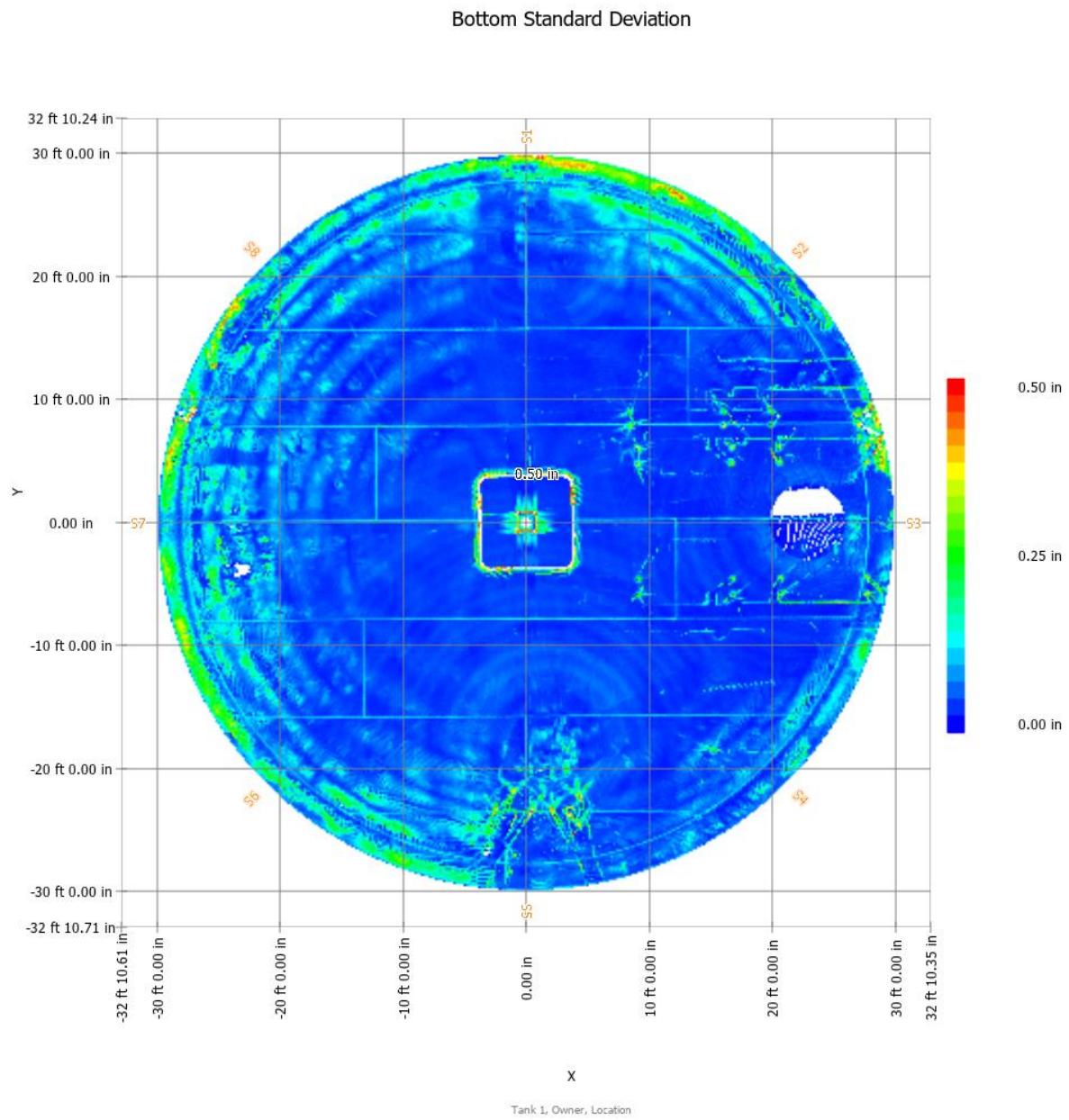


Figure 15: Standard deviation of bottom grids

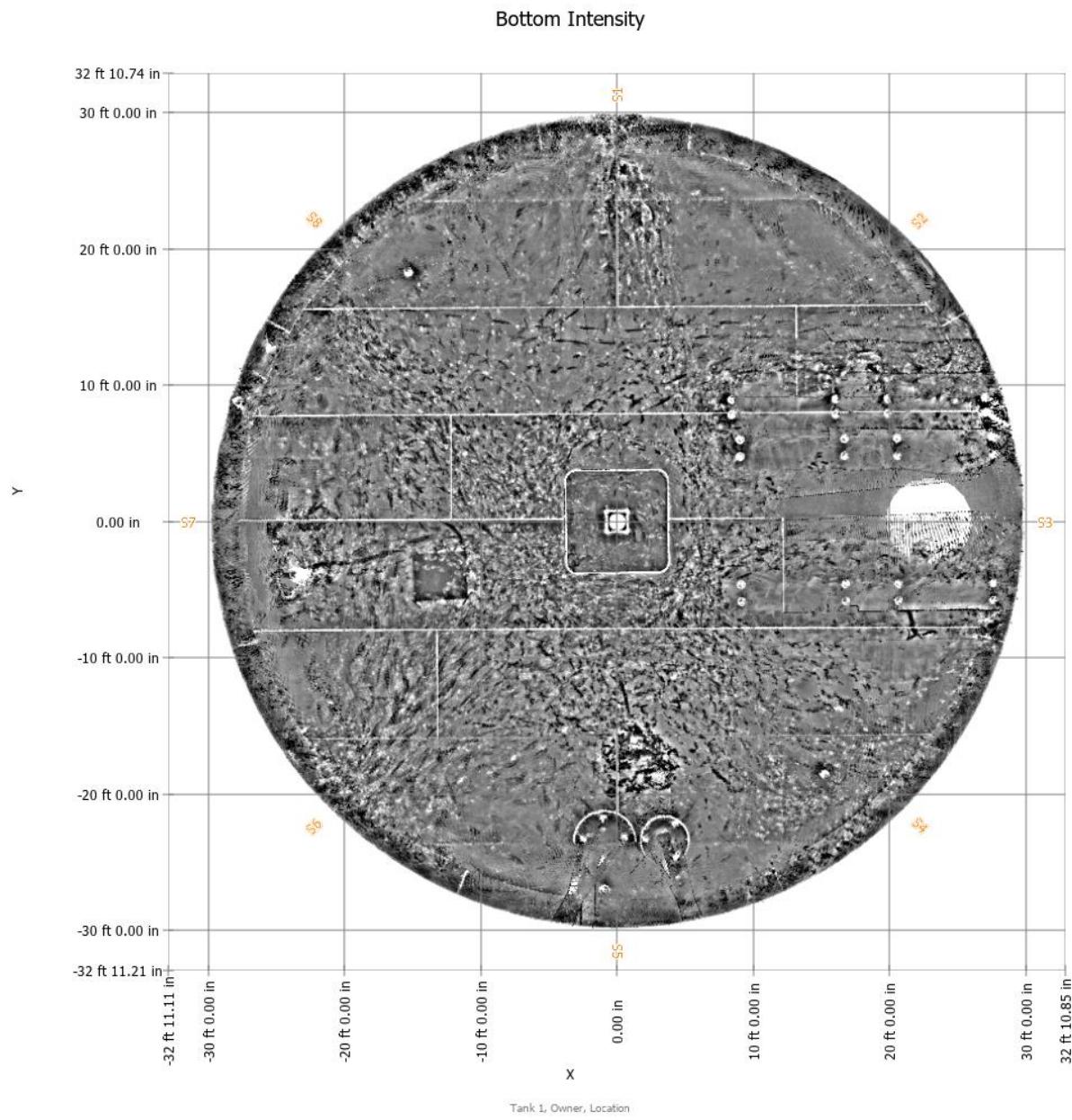


Figure 16: Bottom image

3.2.1 BOTTOM PROFILE

The following shows the as scanned bottom profile.

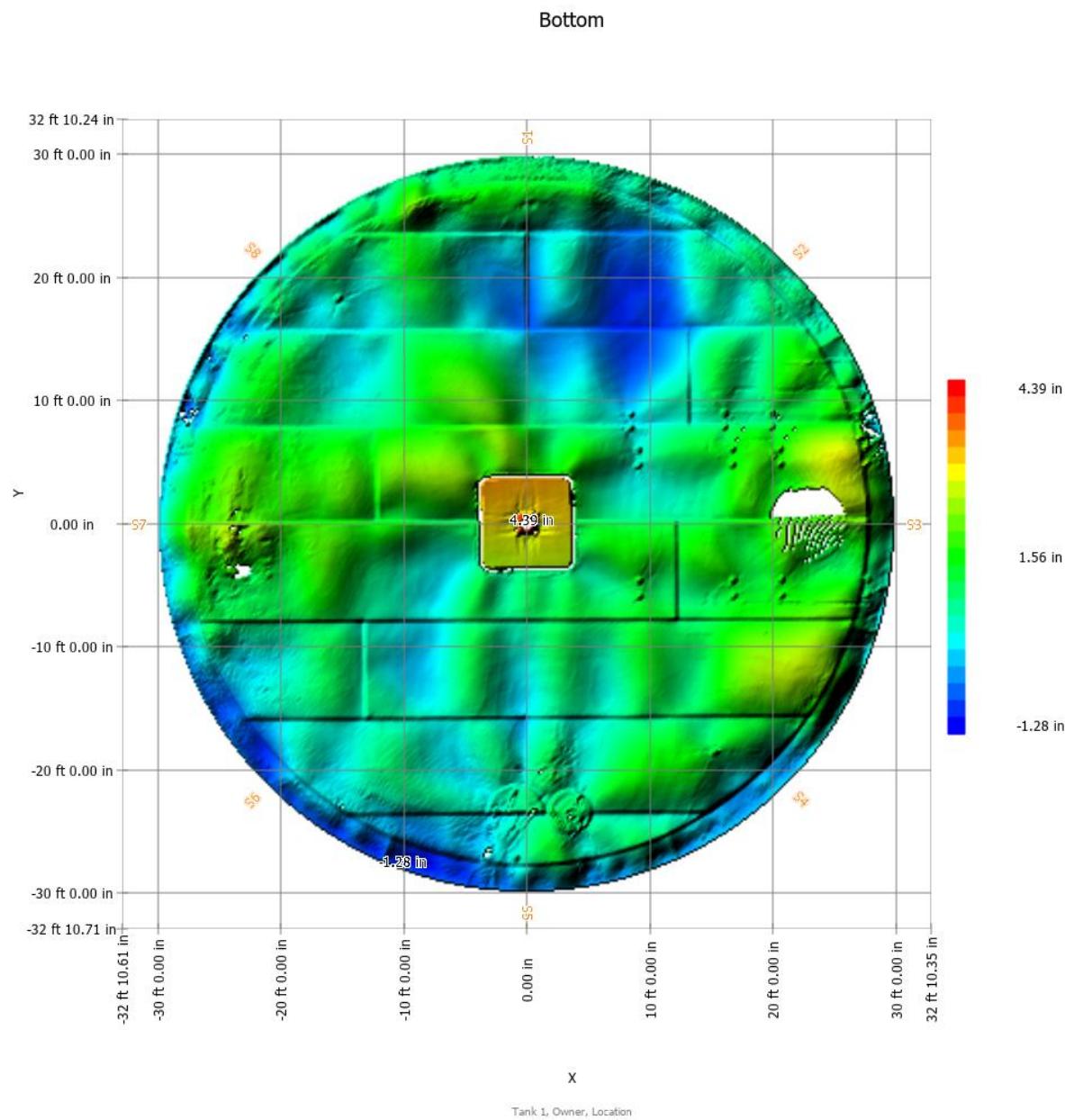
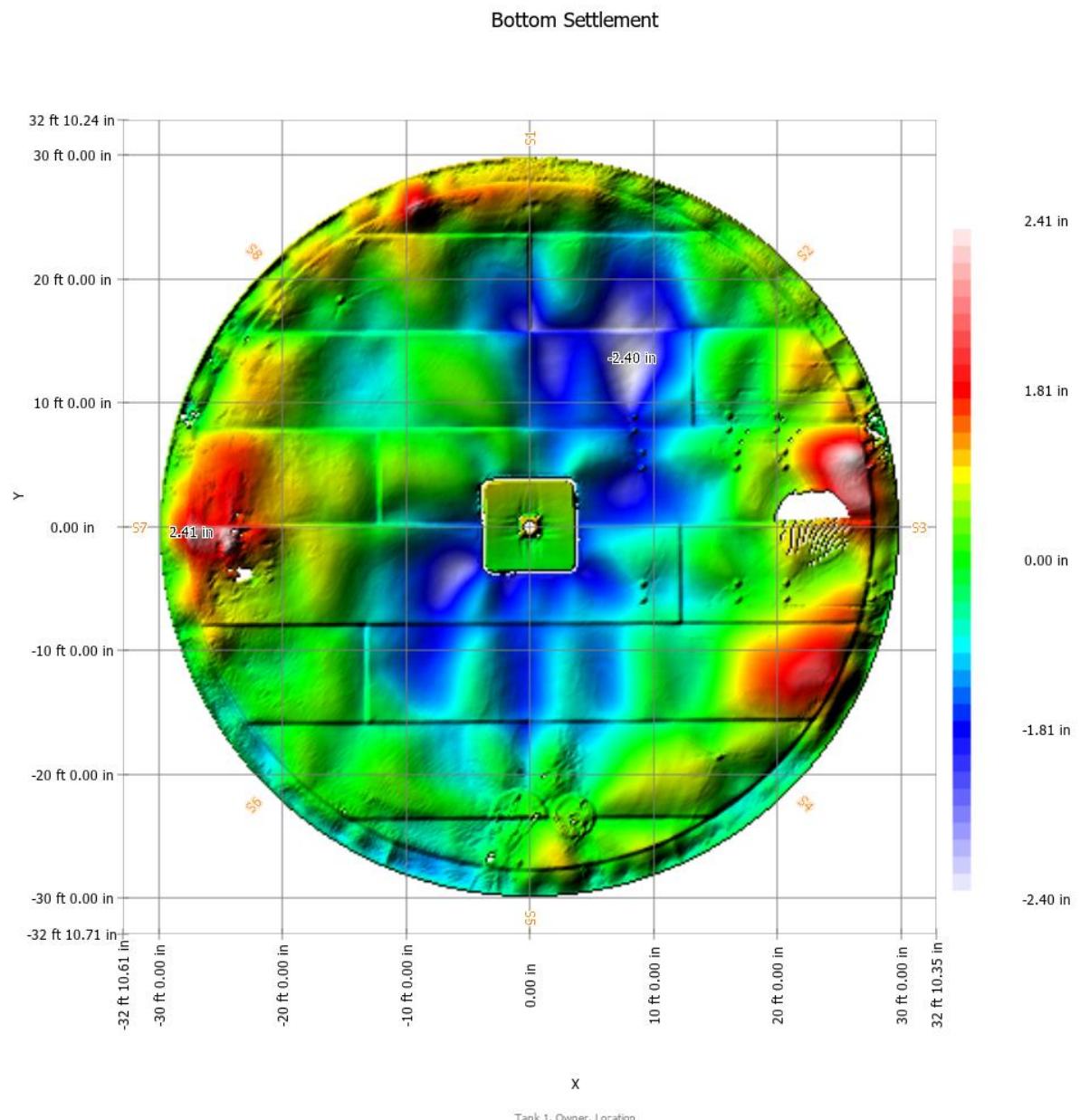


Figure 17: Bottom profile

3.2.2 BOTTOM SETTLEMENT

The following shows the bottom settlement by removing a best-fit cone with a slope of 0.49° . Positive values (red) indicate a bulge upwards while negative values (blue) indicate a depression downwards. Minimum and maximum values are as follows:

| X | Y | Bottom Settlement |
|----------------|---------------|-------------------|
| 8 ft 1.99 in | 13 ft 7.96 in | -2.40 in |
| -27 ft 4.53 in | -4.24 in | 2.41 in |



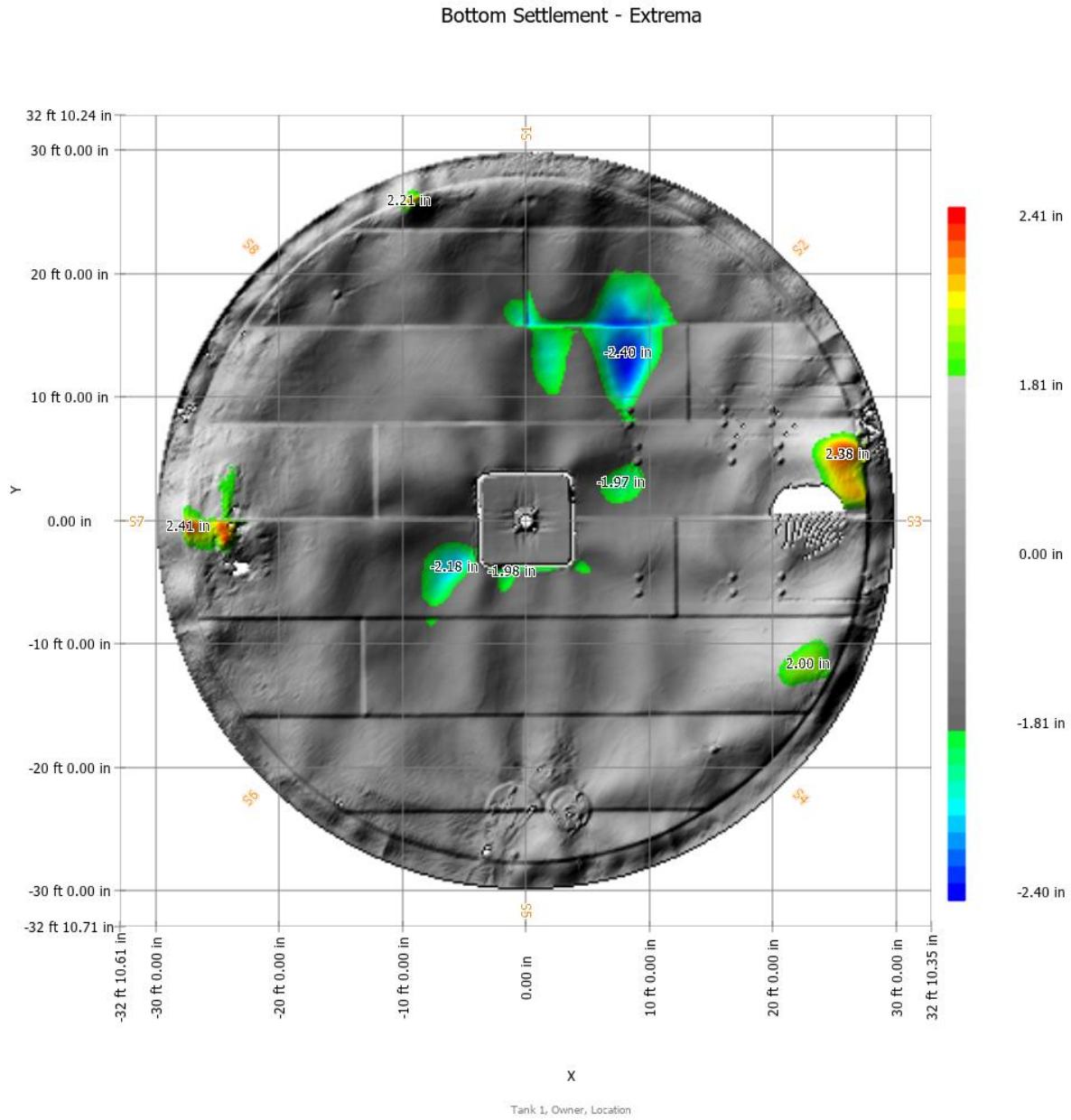


Figure 18: Bottom settlement

3.2.3 SHELL SETTLEMENT B.3.2.1

The API allowable tolerance for shell settlement is 1.13" (API 653 Section B.3.2.1 Permissible Out-of-plane Settlement).

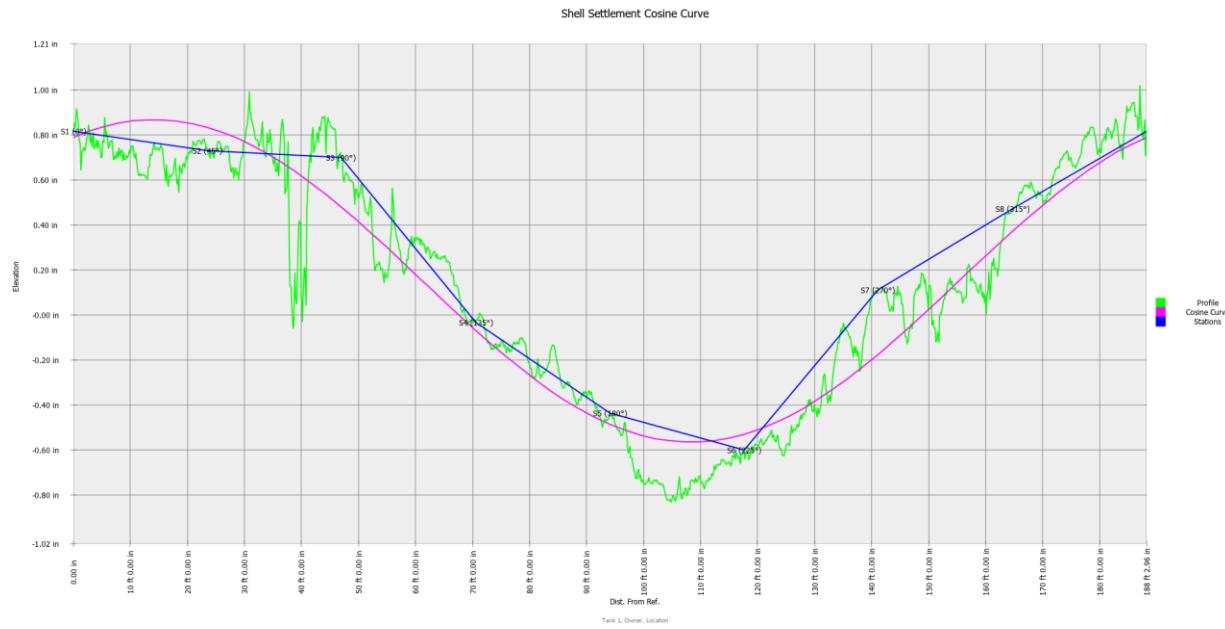


Figure 19: Cosine curve

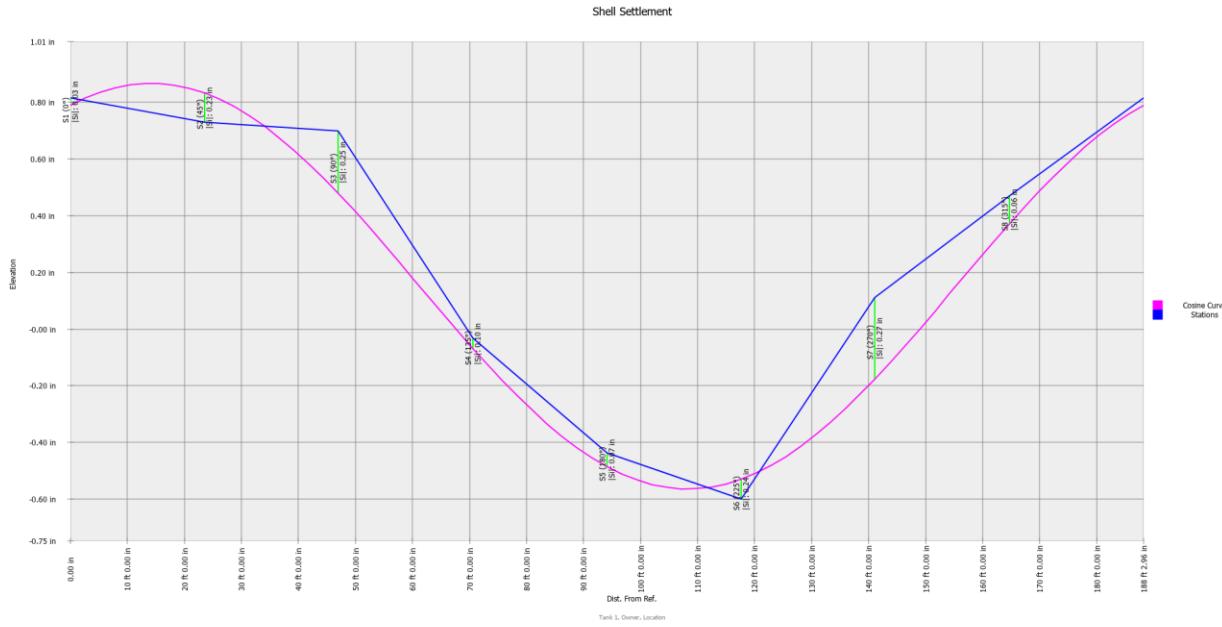


Figure 20: Shell settlement B.3.2.1

Table 12: Shell settlement values B.3.2.1

| Station | Dist. From Ref. (ft-in) | Elevation (in) | Ui (in) | Si (in) | Smax (in) | Pass/Fail |
|-----------|-------------------------|----------------|---------|----------|-----------|-----------|
| S1 (0°) | 0.00" | 0.82 | 0.03 | 0.03 | 1.13 | Pass |
| S2 (45°) | 23' 5.87" | 0.73 | -0.10 | 0.23 | 1.13 | Pass |
| S3 (90°) | 46' 11.74" | 0.70 | 0.22 | 0.25 | 1.13 | Pass |
| S4 (135°) | 70' 7.61" | -0.03 | 0.04 | 0.10 | 1.13 | Pass |
| S5 (180°) | 94' 1.48" | -0.44 | 0.05 | 0.07 | 1.13 | Pass |
| S6 (225°) | 117' 7.35" | -0.60 | -0.07 | 0.24 | 1.13 | Pass |
| S7 (270°) | 141' 1.22" | 0.11 | 0.29 | 0.27 | 1.13 | Pass |
| S8 (315°) | 164' 9.09" | 0.47 | 0.10 | 0.06 | 1.13 | Pass |

3.2.4 EDGE SETTLEMENT

The API allowable tolerance for edge settlement is shown in Figure 21 (API 653 Section B.3.4 Edge Settlement). A bottom slope of 0.00000 was accounted for during edge settlement analysis. Positive bottom slope indicates cone up while negative bottom slope indicates cone down.

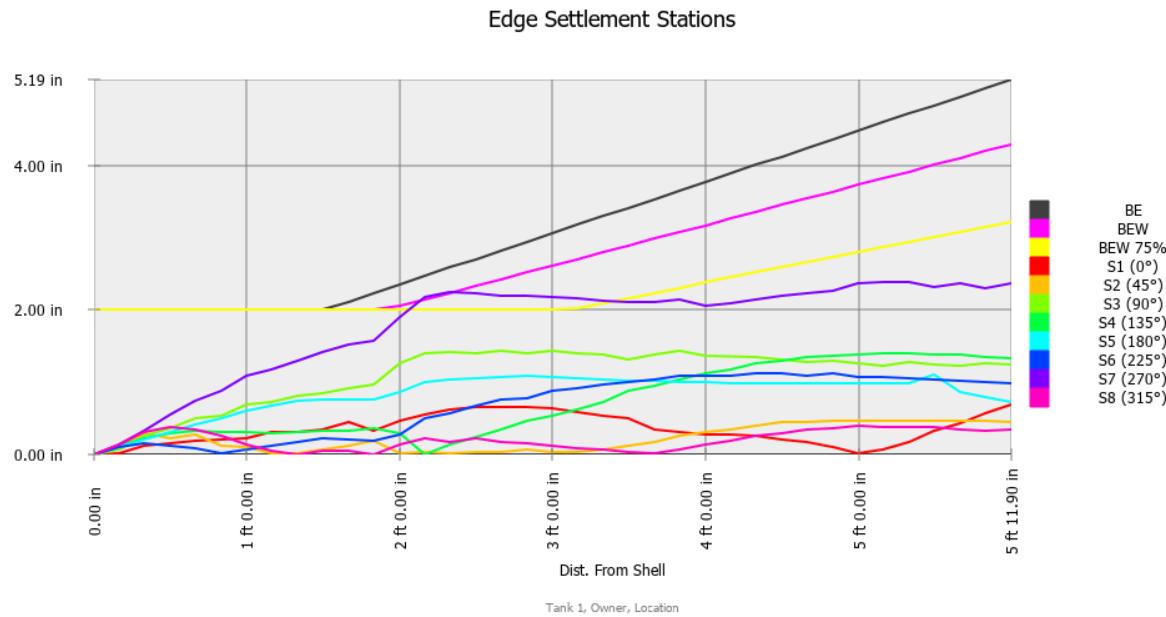


Figure 21: Edge settlement at stations

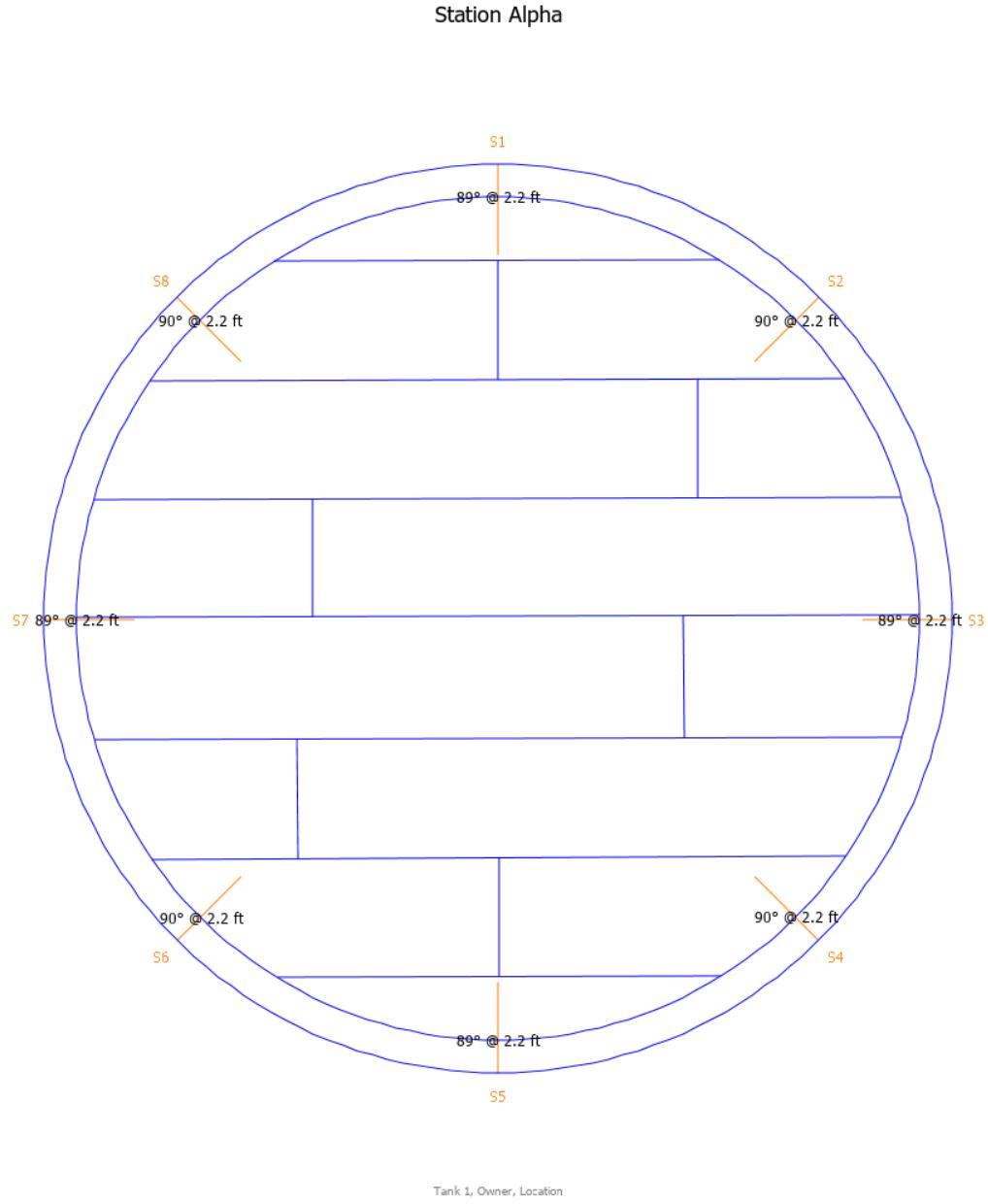


Figure 22: Station alpha angles

Table 13: Edge settlement station values

| Dist. From Shell / Units: [in] | BE | BEW | BEA | BEA 75% | S1 (0°) | BEA | BEA 75% | S2 (45°) |
|---|-----------|------------|------------|----------------|------------------|------------|----------------|------------------|
| Alpha | 0° | 90° | 90° | | | 90° | | |
| 0 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.00 | 2.00 | 2.00 | 0.00 |
| 0.5 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.15 | 2.00 | 2.00 | 0.22 |
| 1 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.23 | 2.00 | 2.00 | 0.11 |
| 1.5 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.35 | 2.00 | 2.00 | 0.07 |
| 2 ft | 2.35 | 2.05 | 2.05 | 2.00 | 0.47 | 2.05 | 2.00 | 0.01 |
| 2.5 ft | 2.71 | 2.33 | 2.33 | 2.00 | 0.66 | 2.33 | 2.00 | 0.04 |
| 3 ft | 3.06 | 2.61 | 2.61 | 2.00 | 0.64 | 2.61 | 2.00 | 0.03 |
| 3.5 ft | 3.42 | 2.89 | 2.89 | 2.17 | 0.50 | 2.89 | 2.17 | 0.11 |
| 4 ft | 3.77 | 3.17 | 3.17 | 2.38 | 0.28 | 3.17 | 2.38 | 0.31 |
| 4.5 ft | 4.13 | 3.45 | 3.45 | 2.59 | 0.20 | 3.45 | 2.59 | 0.44 |
| 5 ft | 4.48 | 3.73 | 3.73 | 2.80 | 0.02 | 3.73 | 2.80 | 0.47 |
| 5.5 ft | 4.84 | 4.01 | 4.01 | 3.01 | 0.32 | 4.01 | 3.01 | 0.46 |
| 6 ft | 5.19 | 4.29 | 4.29 | 3.22 | 0.69 | 4.29 | 3.22 | 0.45 |
| Pass/Fail | | | | | Pass | | | Pass |
| Dist. From Shell / Units: [in] | BE | BEW | BEA | BEA 75% | S3 (90°) | BEA | BEA 75% | S4 (135°) |
| Alpha | 0° | 90° | 90° | | | 90° | | |
| 0 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.00 | 2.00 | 2.00 | 0.00 |
| 0.5 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.37 | 2.00 | 2.00 | 0.30 |
| 1 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.69 | 2.00 | 2.00 | 0.32 |
| 1.5 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.85 | 2.00 | 2.00 | 0.32 |
| 2 ft | 2.35 | 2.05 | 2.05 | 2.00 | 1.27 | 2.05 | 2.00 | 0.30 |
| 2.5 ft | 2.71 | 2.33 | 2.33 | 2.00 | 1.41 | 2.33 | 2.00 | 0.24 |
| 3 ft | 3.06 | 2.61 | 2.61 | 2.00 | 1.44 | 2.61 | 2.00 | 0.54 |
| 3.5 ft | 3.42 | 2.89 | 2.89 | 2.17 | 1.32 | 2.89 | 2.17 | 0.89 |
| 4 ft | 3.77 | 3.17 | 3.17 | 2.38 | 1.37 | 3.17 | 2.38 | 1.12 |
| 4.5 ft | 4.13 | 3.45 | 3.45 | 2.59 | 1.32 | 3.45 | 2.59 | 1.30 |
| 5 ft | 4.48 | 3.73 | 3.73 | 2.80 | 1.26 | 3.73 | 2.80 | 1.39 |
| 5.5 ft | 4.84 | 4.01 | 4.01 | 3.01 | 1.25 | 4.01 | 3.01 | 1.39 |
| 6 ft | 5.19 | 4.29 | 4.29 | 3.22 | 1.24 | 4.29 | 3.22 | 1.33 |
| Pass/Fail | | | | | Pass | | | Pass |
| Dist. From Shell / Units: [in] | BE | BEW | BEA | BEA 75% | S5 (180°) | BEA | BEA 75% | S6 (225°) |
| Alpha | 0° | 90° | 90° | | | 90° | | |
| 0 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.00 | 2.00 | 2.00 | 0.00 |
| 0.5 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.31 | 2.00 | 2.00 | 0.12 |
| 1 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.60 | 2.00 | 2.00 | 0.07 |
| 1.5 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.77 | 2.00 | 2.00 | 0.22 |
| 2 ft | 2.35 | 2.05 | 2.05 | 2.00 | 0.86 | 2.05 | 2.00 | 0.28 |
| 2.5 ft | 2.71 | 2.33 | 2.33 | 2.00 | 1.05 | 2.33 | 2.00 | 0.67 |
| 3 ft | 3.06 | 2.61 | 2.61 | 2.00 | 1.08 | 2.61 | 2.00 | 0.88 |
| 3.5 ft | 3.42 | 2.89 | 2.89 | 2.17 | 1.02 | 2.89 | 2.17 | 1.00 |
| 4 ft | 3.77 | 3.17 | 3.17 | 2.38 | 1.01 | 3.17 | 2.38 | 1.09 |
| 4.5 ft | 4.13 | 3.45 | 3.45 | 2.59 | 0.99 | 3.45 | 2.59 | 1.12 |
| 5 ft | 4.48 | 3.73 | 3.73 | 2.80 | 0.99 | 3.73 | 2.80 | 1.07 |
| 5.5 ft | 4.84 | 4.01 | 4.01 | 3.01 | 1.11 | 4.01 | 3.01 | 1.04 |
| 6 ft | 5.19 | 4.29 | 4.29 | 3.22 | 0.72 | 4.29 | 3.22 | 0.98 |
| Pass/Fail | | | | | Pass | | | Pass |
| Dist. From Shell / Units: [in] | BE | BEW | BEA | BEA 75% | S7 (270°) | BEA | BEA 75% | S8 (315°) |
| Alpha | 0° | 90° | 90° | | | 90° | | |
| 0 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.00 | 2.00 | 2.00 | 0.00 |
| 0.5 ft | 2.00 | 2.00 | 2.00 | 2.00 | 0.56 | 2.00 | 2.00 | 0.38 |
| 1 ft | 2.00 | 2.00 | 2.00 | 2.00 | 1.08 | 2.00 | 2.00 | 0.13 |
| 1.5 ft | 2.00 | 2.00 | 2.00 | 2.00 | 1.42 | 2.00 | 2.00 | 0.05 |
| 2 ft | 2.35 | 2.05 | 2.05 | 2.00 | 1.91 | 2.05 | 2.00 | 0.14 |
| 2.5 ft | 2.71 | 2.33 | 2.33 | 2.00 | 2.24 | 2.33 | 2.00 | 0.23 |
| 3 ft | 3.06 | 2.61 | 2.61 | 2.00 | 2.18 | 2.61 | 2.00 | 0.12 |
| 3.5 ft | 3.42 | 2.89 | 2.89 | 2.17 | 2.11 | 2.89 | 2.17 | 0.03 |
| 4 ft | 3.77 | 3.17 | 3.17 | 2.38 | 2.07 | 3.17 | 2.38 | 0.14 |
| 4.5 ft | 4.13 | 3.45 | 3.45 | 2.59 | 2.20 | 3.45 | 2.59 | 0.29 |
| 5 ft | 4.48 | 3.73 | 3.73 | 2.80 | 2.37 | 3.73 | 2.80 | 0.40 |
| 5.5 ft | 4.84 | 4.01 | 4.01 | 3.01 | 2.31 | 4.01 | 3.01 | 0.37 |
| 6 ft | 5.19 | 4.29 | 4.29 | 3.22 | 2.37 | 4.29 | 3.22 | 0.35 |
| Pass/Fail | | | | | Inspect | | | Pass |

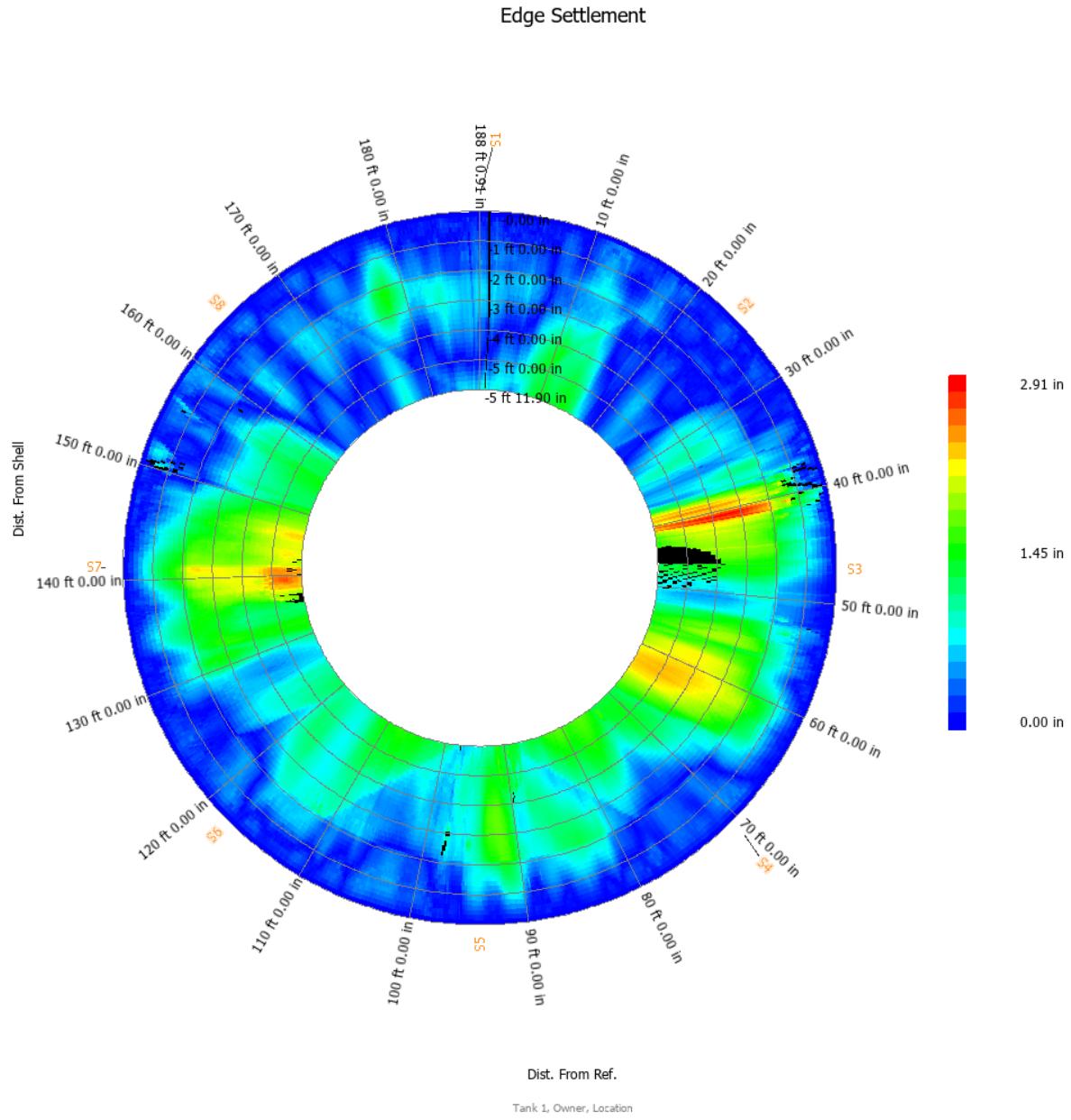
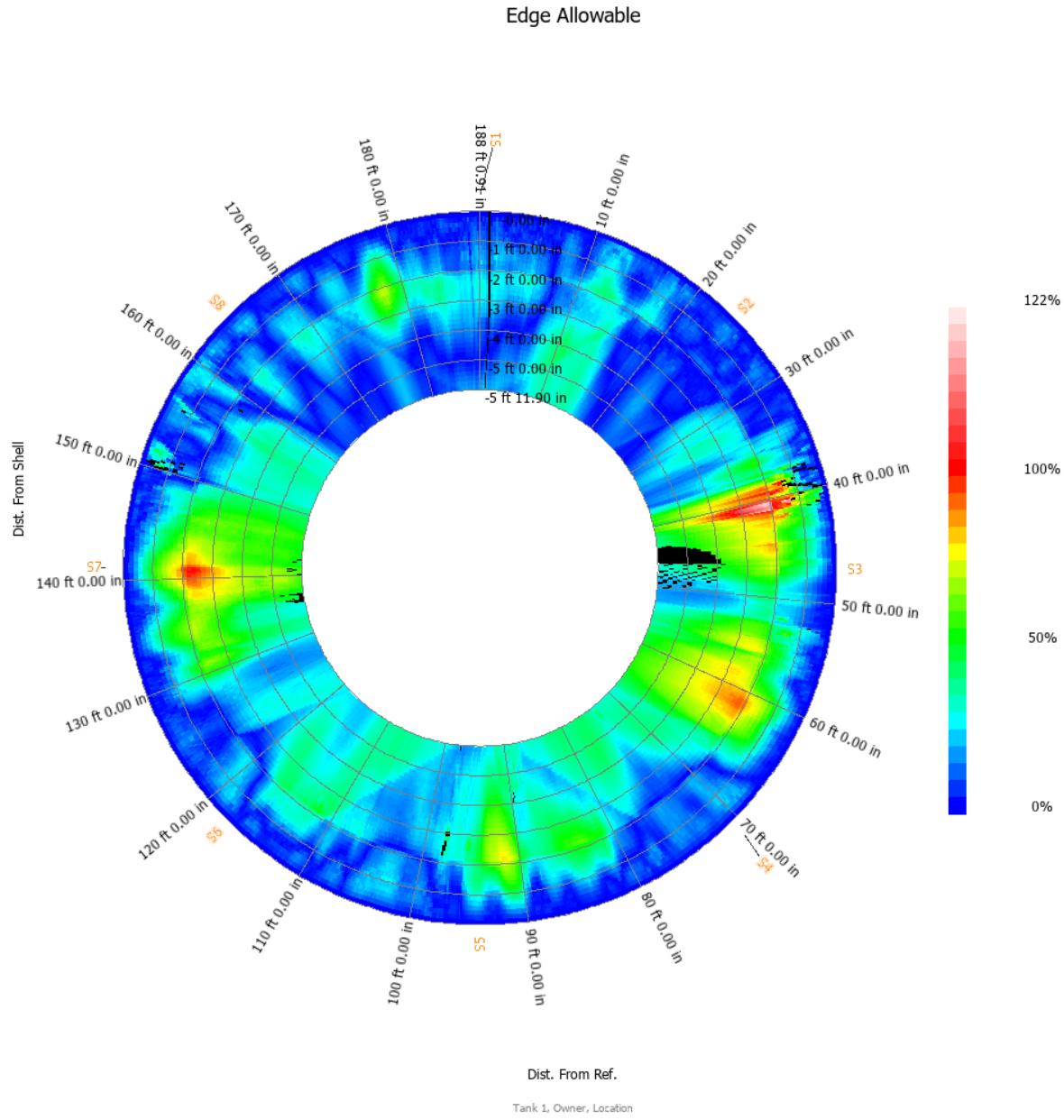


Figure 23: Edge settlement height



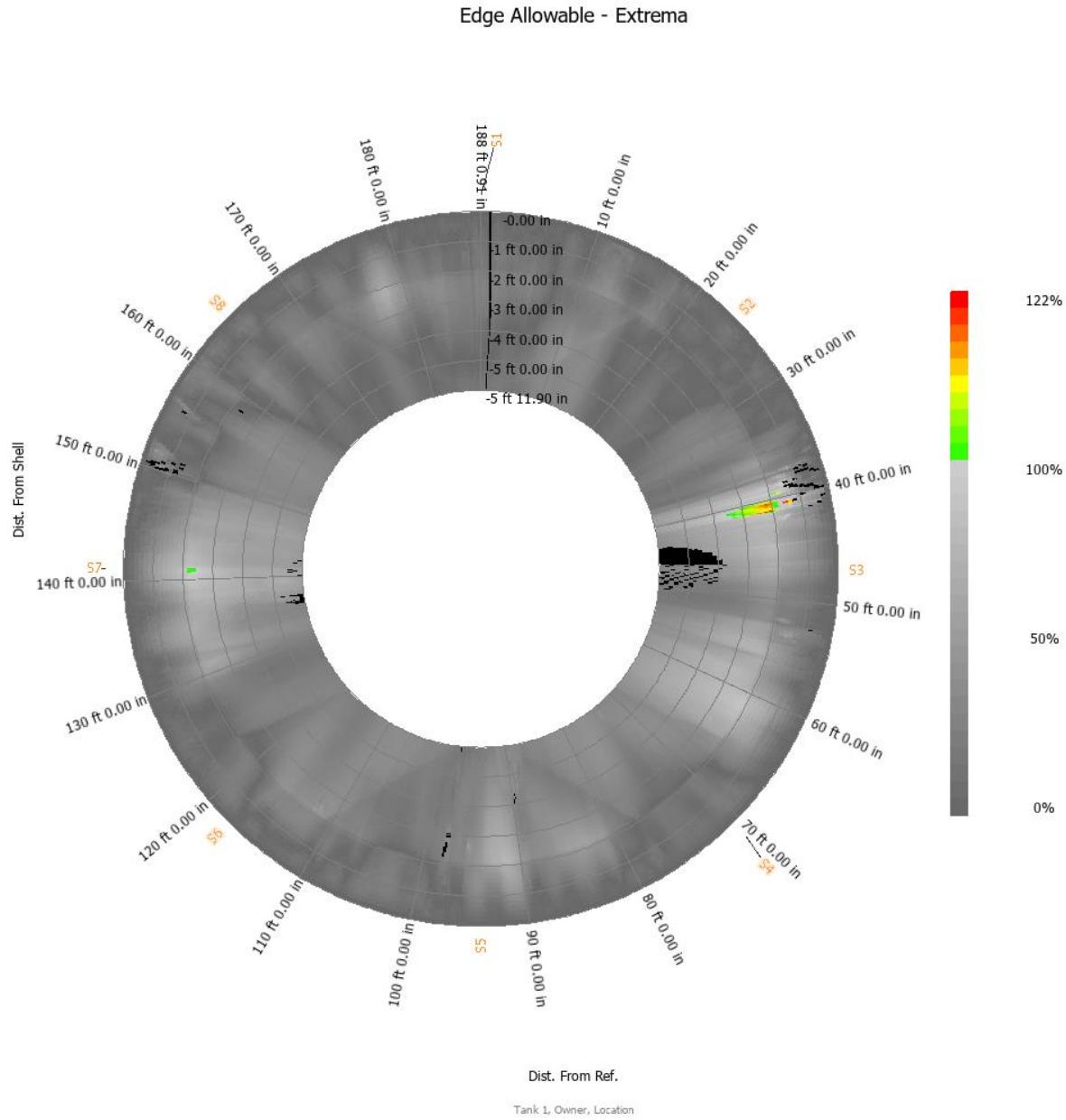


Figure 24: Allowable edge settlement

3.3 ROOF

The Manway was used as the point of reference for roof analysis.

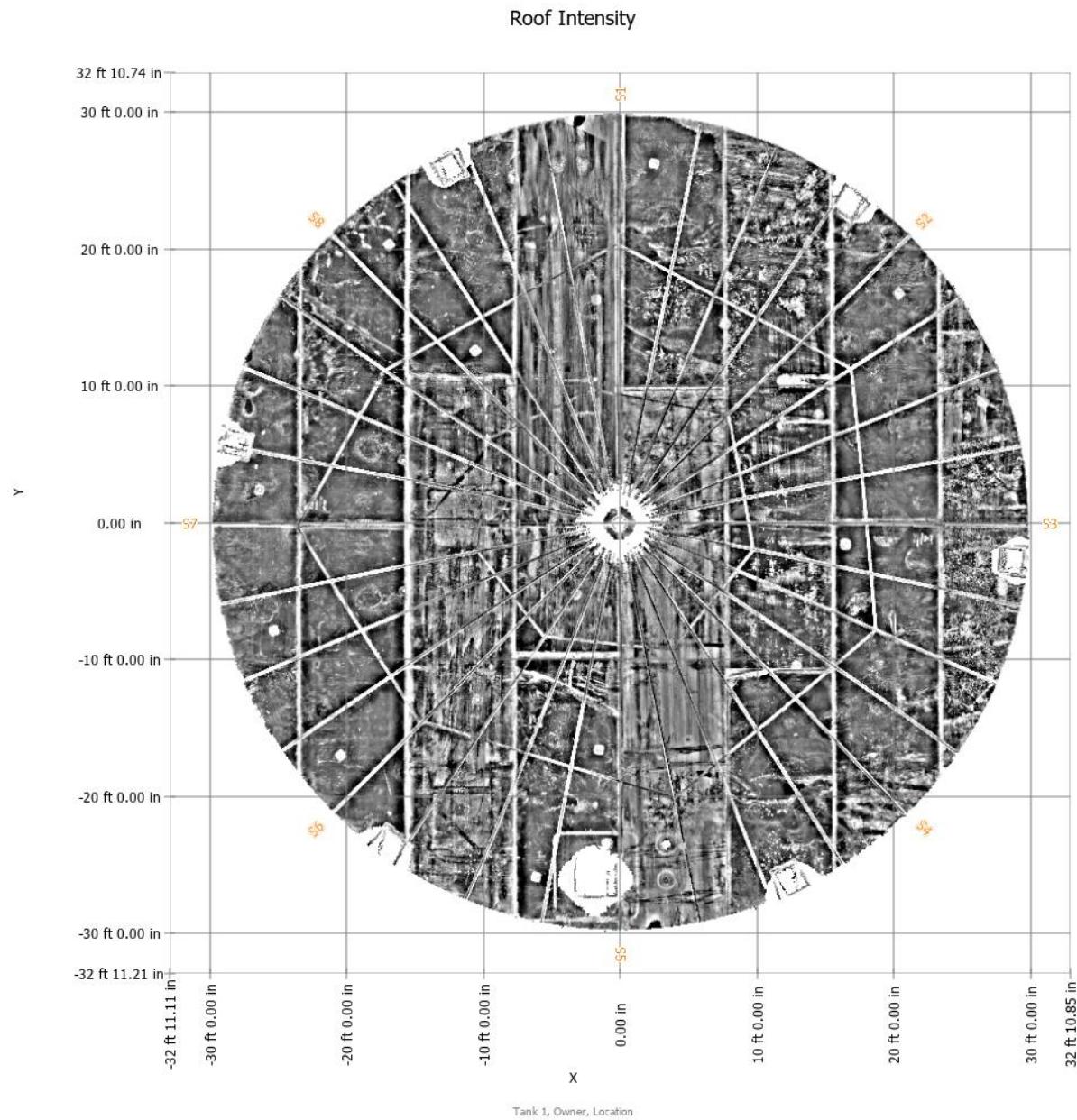


Figure 25: Roof image

3.3.1 ROOF PROFILE

The following shows the as scanned roof profile.

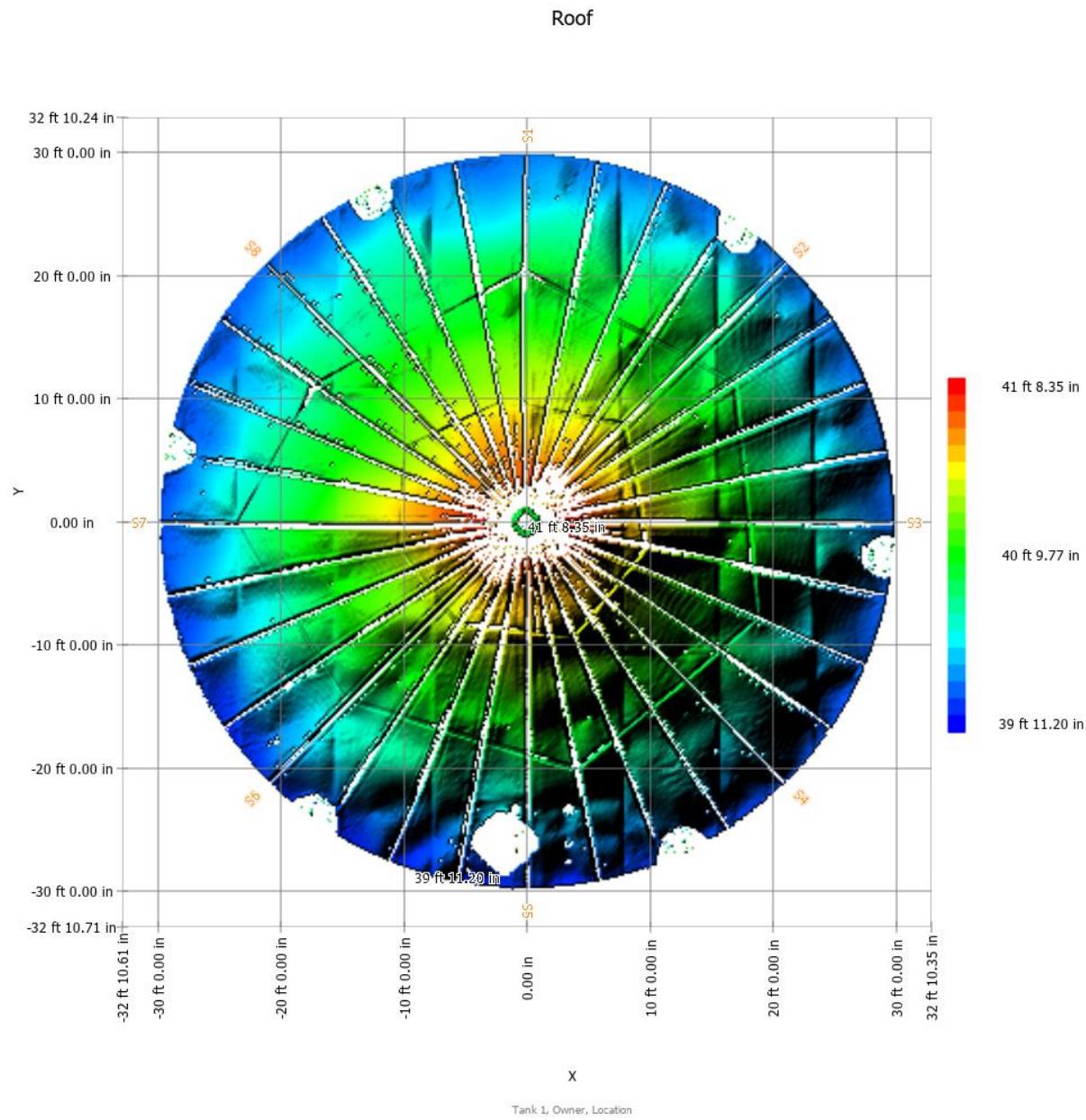
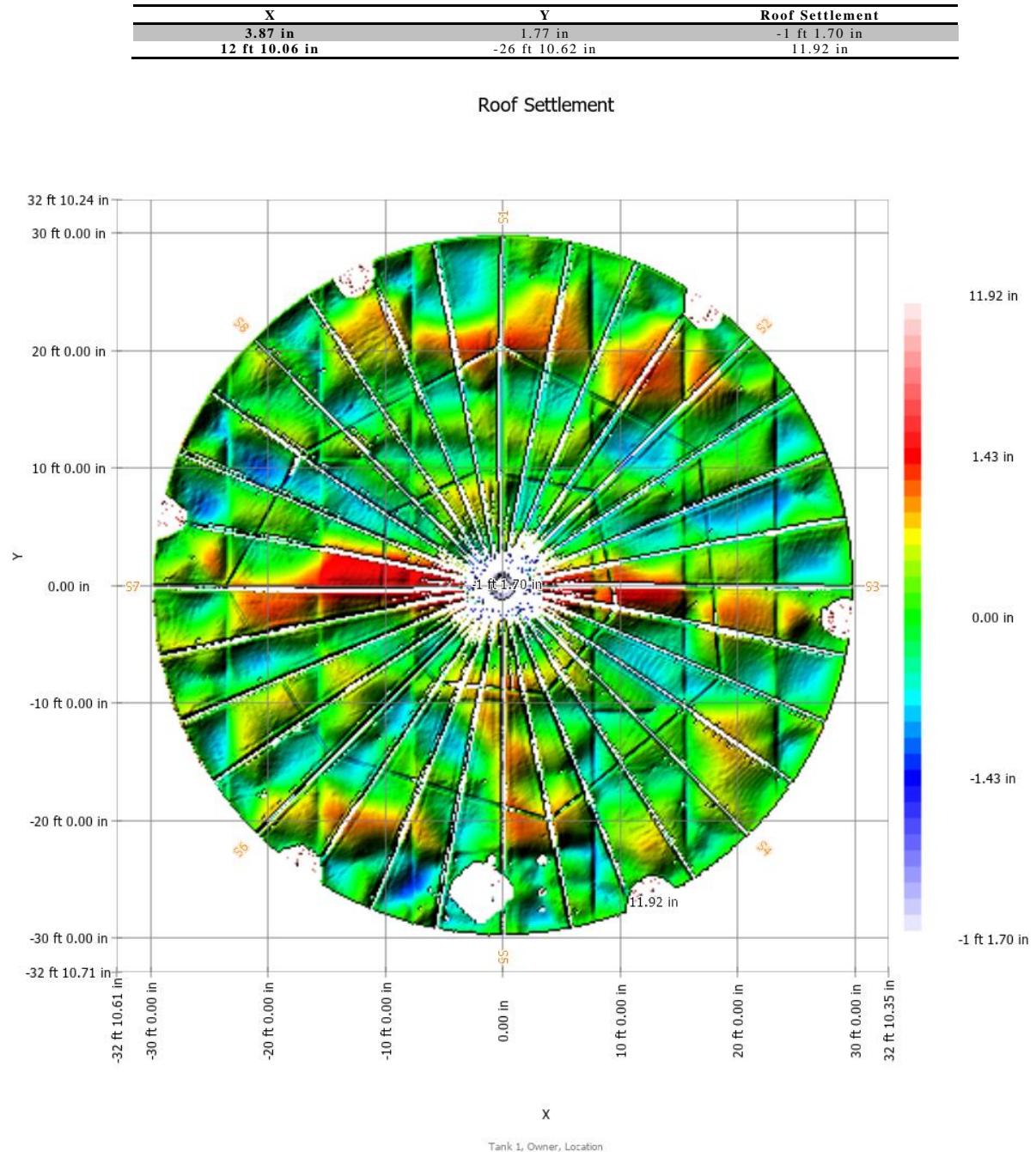


Figure 26: Roof profile

3.3.2 ROOF SETTLEMENT

The following shows the roof settlement by removing a best-fit cone with a slope of 3.18° . Positive values (red) indicate a bulge upwards while negative values (blue) indicate a depression downwards. Minimum and maximum values are as follows:



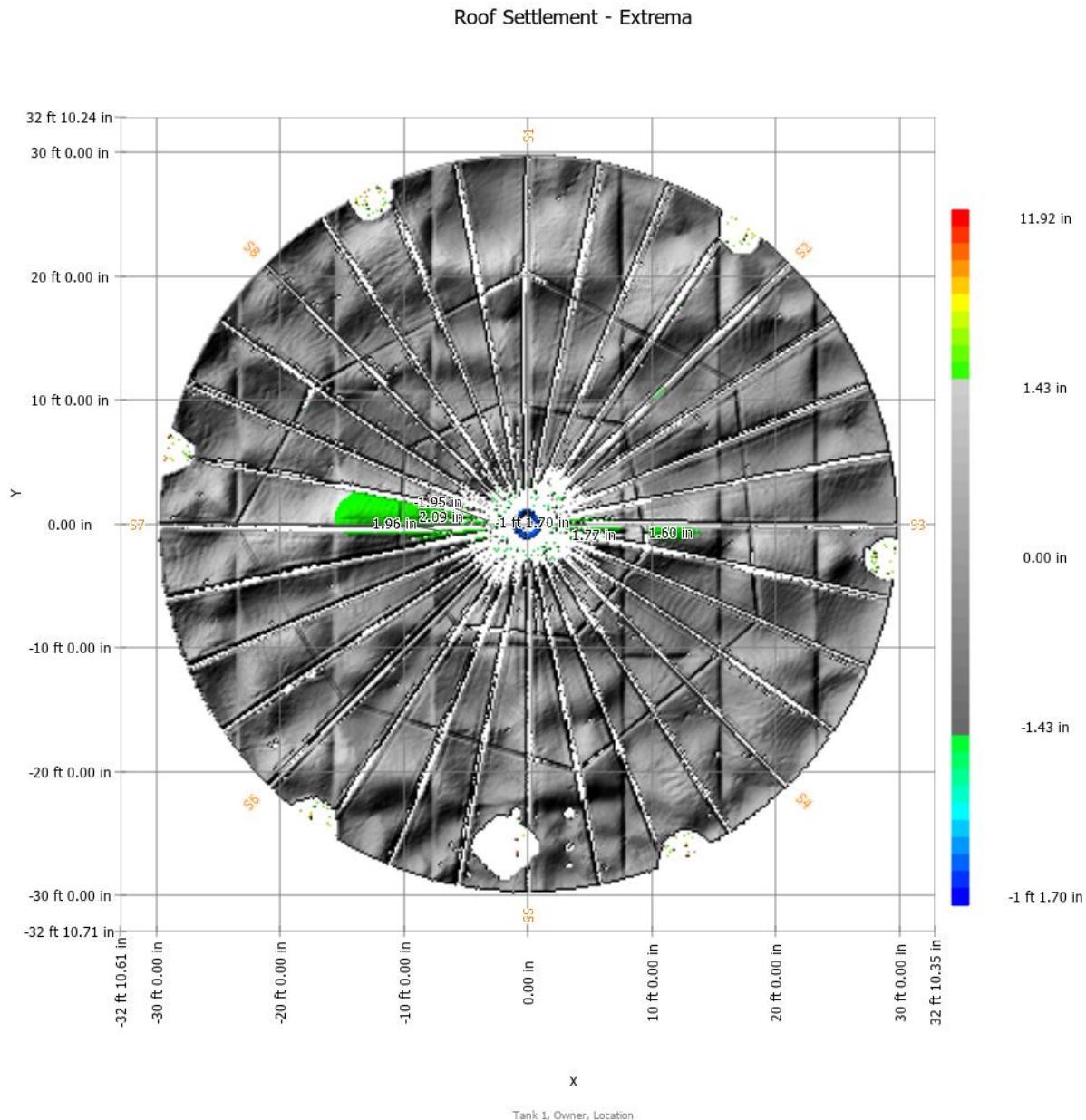


Figure 27: Roof settlement

3.4 RIM SPACE

The Manway was used as the point of reference for rim space analysis. All circumferential measurements are distances from the Manway along the shell in a clockwise manner. All elevation measurements are heights from the bottom to shell weld at the Manway.

Table 14: Rim space analysis properties

| | |
|--|--|
| Shell inner radius | 29 ft 11.52 in |
| Floating roof outer rim radius | 29 ft 5.65 in |
| Rim Space (as scanned) | 5.85 in |
| Rim Space (roof centered) | 5.85 in |
| Floating roof misalignment | 1.17 in |
| Floating roof misalignment bearing (CW) | 329.33° (CW) |
| Floating roof reference height | 8 ft 3.88 in |
| Floating roof reference to outer rim offset | 0.00 in |
| Primary Seal Minimum | 2.00 in |
| Primary Seal Maximum | 10.00 in |
| Secondary Seal Minimum | 2.00 in |
| Secondary Seal Maximum | 10.00 in |
| External analysis | No |
| Course heights | 8 ft 0.00 in; 8 ft 0.00 in; 8 ft 0.00 in; 8 ft 0.00 in; 8 ft 0.00 in |
| Course thicknesses | 0.25 in; 0.19 in; 0.15 in; 0.13 in; 0.13 in |
| Analysis direction | clockwise |
| Station 1 reference | Manway |
| Station 1 bearing (CW) | 0.00° |
| Shell data precision (1σ) | 0.06 in |
| Data accuracy (1σ) | 0.1 in (Manufacturer specification) |

3.4.1 FLOATING ROOF OUTER RIM

The following shows the floating roof outer rim. The radii show the roundness of the floating roof. The cross-sectional radii show areas with the largest and smallest diameters. The cross-sectional radii are the average of diametrically opposed radii.

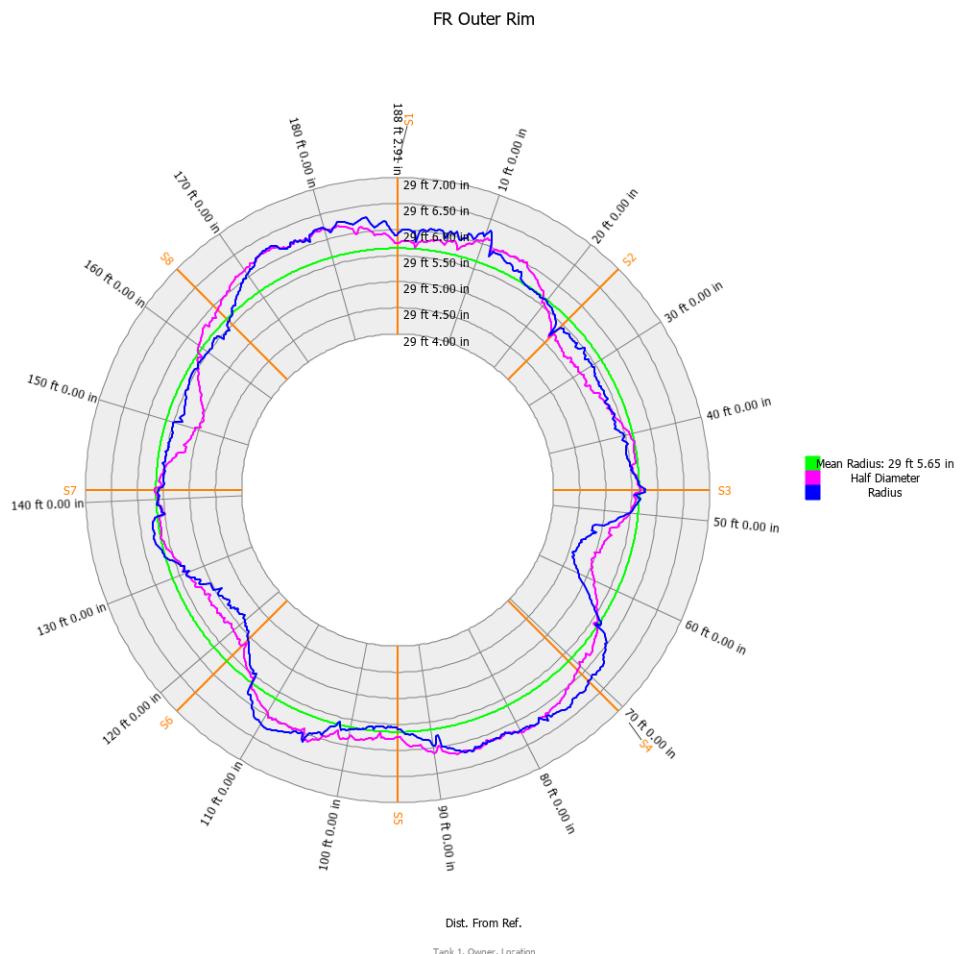


Figure 28: Floating roof outer rim

Table 15: Floating roof outer rim values

| Units: [ft-in] | S1 (0°) | S2 (45°) | S3 (90°) | S4 (135°) | S5 (180°) | S6 (225°) | S7 (270°) | S8 (315°) |
|---------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| FR Outer Rim | 29' 5.91" | 29' 5.32" | 29' 5.75" | 29' 6.18" | 29' 5.59" | 29' 5.07" | 29' 5.60" | 29' 5.59" |

3.4.2 SHELL CENTERLINE

The following shows the centerline profile of the shell at each elevation.

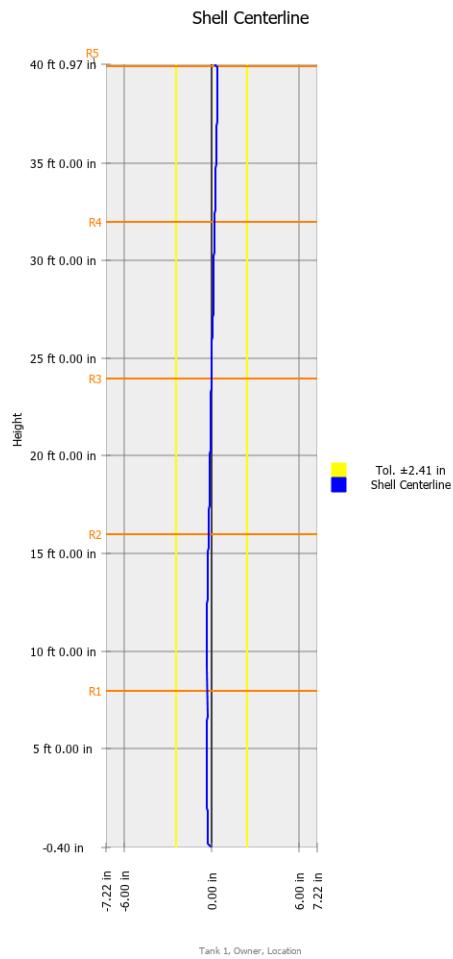


Figure 29: Shell centerline

Table 16: Shell centerline values

| Units: [in] | Shell Centerline | Pass/Fail |
|------------------|------------------|-----------|
| 1 ft (R1 B+1ft) | -0.28 | Pass |
| 4 ft (R1 50 %) | -0.31 | Pass |
| 7 ft (R1 T-1ft) | -0.28 | Pass |
| 9 ft (R2 B+1ft) | -0.32 | Pass |
| 12 ft (R2 50 %) | -0.31 | Pass |
| 15 ft (R2 T-1ft) | -0.23 | Pass |
| 17 ft (R3 B+1ft) | -0.17 | Pass |
| 20 ft (R3 50 %) | -0.10 | Pass |
| 23 ft (R3 T-1ft) | -0.05 | Pass |
| 25 ft (R4 B+1ft) | 0.02 | Pass |
| 28 ft (R4 50 %) | 0.12 | Pass |
| 31 ft (R4 T-1ft) | 0.18 | Pass |
| 33 ft (R5 B+1ft) | 0.24 | Pass |
| 36 ft (R5 50 %) | 0.32 | Pass |
| 39 ft (R5 T-1ft) | 0.39 | Pass |

3.4.3 RIM SPACE AS SCANNED

The following shows the as scanned rim space between the floating roof outer rim and the inner shell. Positive values (red) indicate a widening of the rim space while negative values (blue) indicate a narrowing of the rim space.

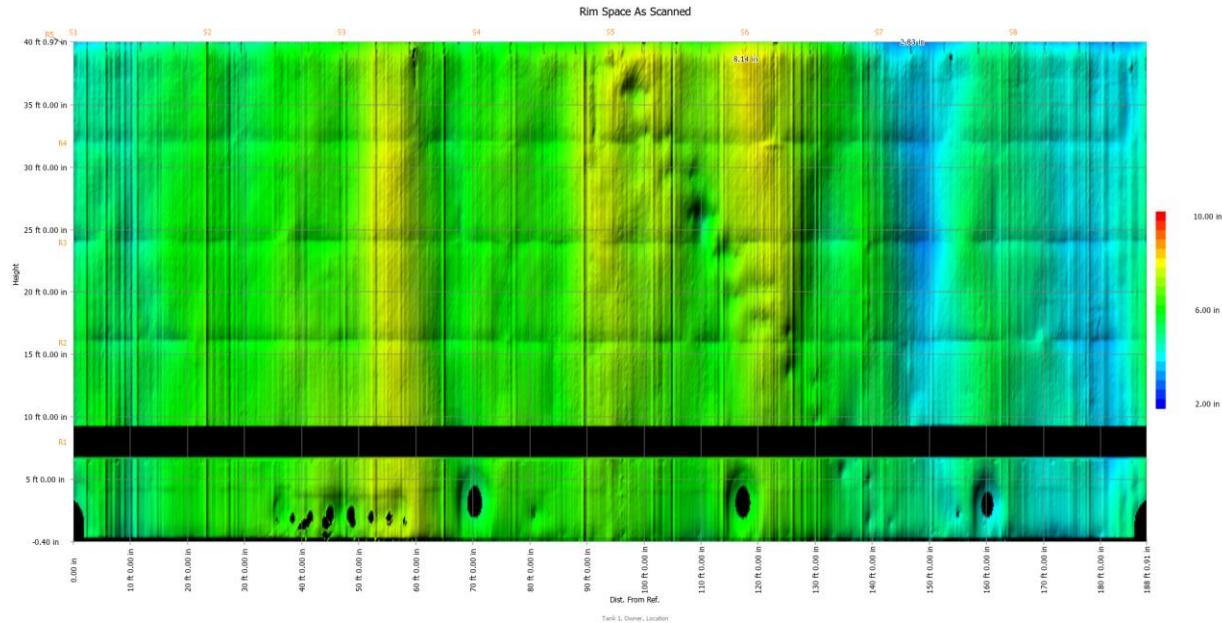


Figure 30: Rim space as scanned

Table 17: Rim space as scanned values

| Units: [in] | S1 (0°) | S2 (45°) | S3 (90°) | S4 (135°) | S5 (180°) | S6 (225°) | S7 (270°) | S8 (315°) |
|-------------------------|---------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| 1 ft (R1 B+1ft) | | 6.05 | 6.36 | 5.76 | 6.63 | 6.17 | 5.02 | 4.48 |
| 4 ft (R1 50%) | 4.89 | 6.14 | 6.52 | | 6.67 | | 5.05 | 4.87 |
| 7 ft (R1 T-1ft) | | | | | | | | |
| 9 ft (R2 B+1ft) | | | | | | | | |
| 12 ft (R2 50%) | 5.37 | 6.28 | 6.68 | 6.16 | 7.10 | 6.74 | 5.42 | 4.98 |
| 15 ft (R2 T-1ft) | 5.52 | 6.30 | 6.50 | 6.38 | 7.23 | 6.84 | 5.39 | 5.13 |
| 17 ft (R3 B+1ft) | 5.49 | 6.29 | 6.42 | 6.39 | 7.29 | 6.95 | 5.45 | 5.00 |
| 20 ft (R3 50%) | 5.27 | 6.18 | 6.46 | 6.30 | 7.38 | 6.97 | 5.63 | 4.94 |
| 23 ft (R3 T-1ft) | 4.94 | 6.03 | 6.35 | 6.11 | 7.64 | 7.22 | 5.63 | 4.87 |
| 25 ft (R4 B+1ft) | 4.84 | 6.03 | 6.27 | 6.11 | 7.66 | 7.39 | 5.62 | 4.86 |
| 28 ft (R4 50%) | 4.80 | 6.02 | 6.20 | 6.23 | 7.56 | 7.58 | 5.43 | 4.91 |
| 31 ft (R4 T-1ft) | 4.68 | 5.97 | 6.14 | 6.24 | 7.59 | 7.68 | 5.17 | 4.86 |
| 33 ft (R5 B+1ft) | 4.65 | 5.90 | 6.06 | 6.22 | 7.59 | 7.80 | 5.04 | 4.86 |
| 36 ft (R5 50%) | 4.54 | 5.87 | 6.24 | 6.25 | 7.76 | 7.98 | 4.72 | 5.01 |
| 39 ft (R5 T-1ft) | 4.50 | 5.89 | 6.58 | 6.21 | 7.69 | 8.12 | 4.39 | 5.02 |
| Min | 4.50 | 5.87 | 6.06 | 5.76 | 6.63 | 6.17 | 4.39 | 4.48 |
| Max | 5.52 | 6.30 | 6.68 | 6.39 | 7.76 | 8.12 | 5.63 | 5.13 |
| Pass/Fail | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |

The following shows the minimum, maximum, and average rim space at each elevation.

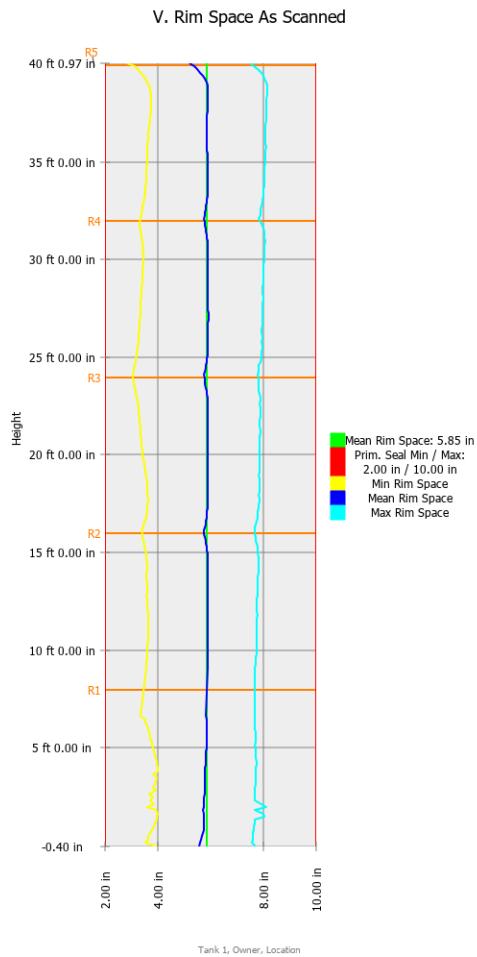


Figure 31: Minimum, maximum, and average rim space at each elevation

Table 18: Minimum, maximum, and average rim space values at each elevation

| Units: [in] | Min Rim Space | Mean Rim Space | Max Rim Space | Pass/Fail |
|------------------|---------------|----------------|---------------|-----------|
| 1 ft (R1 B+1ft) | 3.85 | 5.74 | 7.65 | Pass |
| 4 ft (R1 50%) | 4.00 | 5.80 | 7.71 | Pass |
| 7 ft (R1 T-1ft) | 3.35 | 5.81 | 7.68 | Pass |
| 9 ft (R2 B+1ft) | 3.56 | 5.89 | 7.68 | Pass |
| 12 ft (R2 50%) | 3.62 | 5.89 | 7.75 | Pass |
| 15 ft (R2 T-1ft) | 3.55 | 5.88 | 7.80 | Pass |
| 17 ft (R3 B+1ft) | 3.57 | 5.86 | 7.77 | Pass |
| 20 ft (R3 50%) | 3.44 | 5.89 | 7.85 | Pass |
| 23 ft (R3 T-1ft) | 3.20 | 5.87 | 7.88 | Pass |
| 25 ft (R4 B+1ft) | 3.16 | 5.87 | 7.91 | Pass |
| 28 ft (R4 50%) | 3.35 | 5.91 | 7.99 | Pass |
| 31 ft (R4 T-1ft) | 3.42 | 5.88 | 8.06 | Pass |
| 33 ft (R5 B+1ft) | 3.45 | 5.85 | 7.96 | Pass |
| 36 ft (R5 50%) | 3.61 | 5.86 | 8.08 | Pass |
| 39 ft (R5 T-1ft) | 3.67 | 5.87 | 8.13 | Pass |

The following shows the minimum, maximum, and average rim space at each radial line.

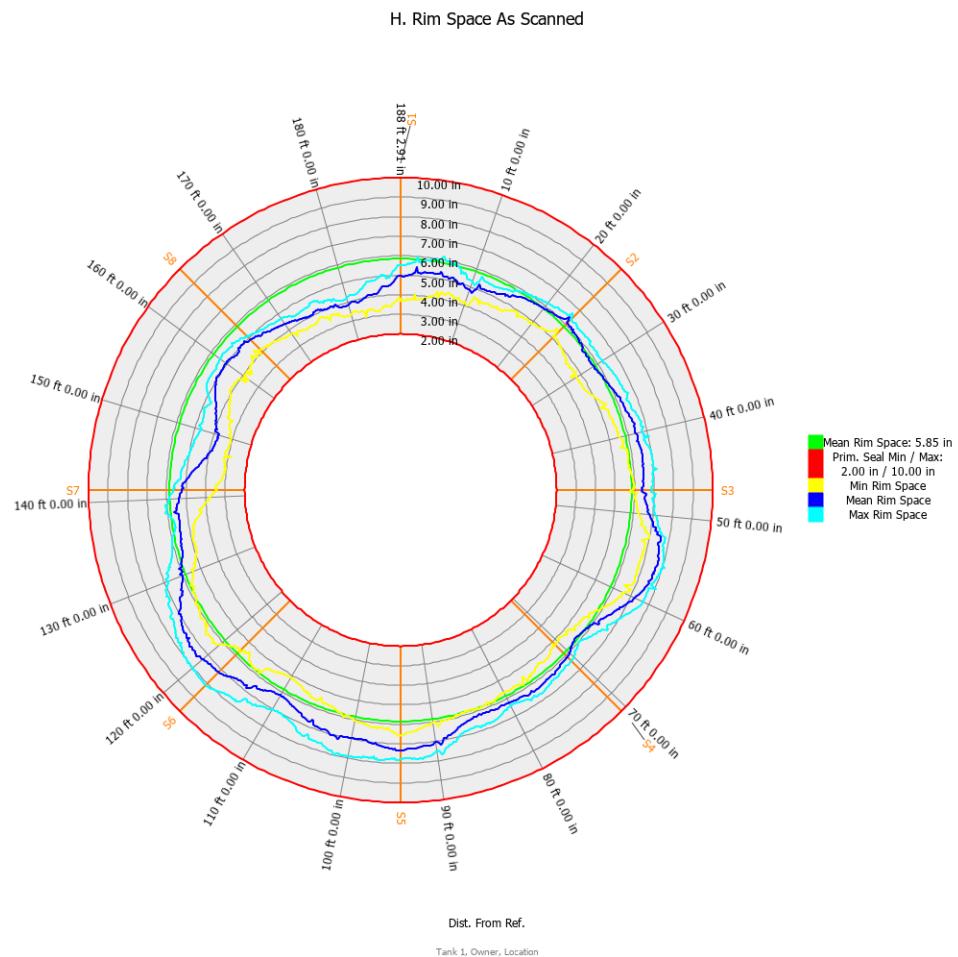


Figure 32: Minimum, maximum, and average rim space at each radial line

Table 19: Minimum, maximum, and average rim space values at each radial line

| Units: [in] | S1 (0°) | S2 (45°) | S3 (90°) | S4 (135°) | S5 (180°) | S6 (225°) | S7 (270°) | S8 (315°) |
|----------------|---------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| Min Rim Space | 3.67 | 5.06 | 5.78 | 5.23 | 6.56 | 5.68 | 3.42 | 4.17 |
| Mean Rim Space | 4.96 | 6.07 | 6.38 | 6.13 | 7.32 | 7.19 | 5.22 | 4.90 |
| Max Rim Space | 5.52 | 6.32 | 6.85 | 6.41 | 7.76 | 8.12 | 5.67 | 5.16 |
| Pass/Fail | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |

3.4.4 RIM SPACE ROOF CENTERED

The following shows the roof centered rim space between the floating roof outer rim and the inner shell. This positions the center of the floating roof at the center of the shell at each elevation to simulate ideal operating conditions. Positive values (red) indicate a widening of the rim space while negative values (blue) indicate a narrowing of the rim space.

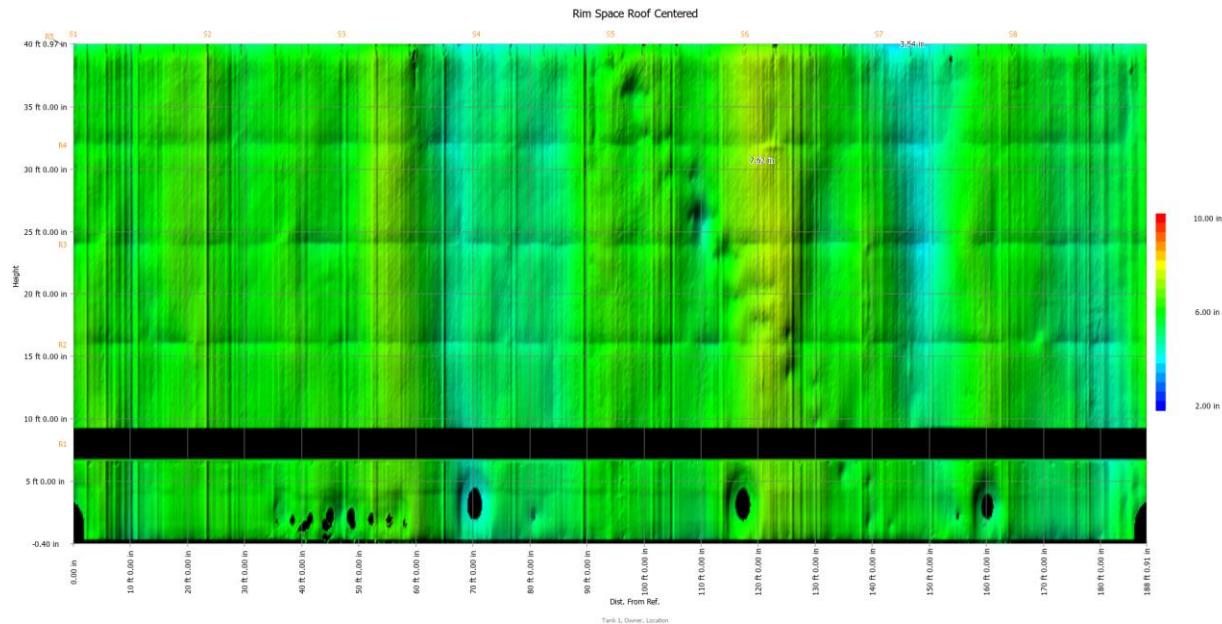


Figure 33: Rim space roof centered

Table 20: Rim space roof centered values

| Units: [in] | S1 (0°) | S2 (45°) | S3 (90°) | S4 (135°) | S5 (180°) | S6 (225°) | S7 (270°) | S8 (315°) |
|-------------------------|---------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| 1 ft (R1 B+1ft) | | 6.12 | 5.59 | 4.69 | 5.92 | 6.21 | 5.79 | 5.55 |
| 4 ft (R1 50%) | 5.67 | 6.25 | 5.77 | | 5.92 | | 5.80 | 5.96 |
| 7 ft (R1 T-1ft) | | | | | | | | |
| 9 ft (R2 B+1ft) | | | | | | | | |
| 12 ft (R2 50%) | 6.19 | 6.46 | 5.99 | 5.09 | 6.31 | 6.68 | 6.11 | 6.05 |
| 15 ft (R2 T-1ft) | 6.40 | 6.55 | 5.86 | 5.30 | 6.38 | 6.71 | 6.03 | 6.21 |
| 17 ft (R3 B+1ft) | 6.43 | 6.61 | 5.81 | 5.29 | 6.38 | 6.76 | 6.07 | 6.10 |
| 20 ft (R3 50%) | 6.26 | 6.56 | 5.87 | 5.17 | 6.41 | 6.71 | 6.21 | 6.06 |
| 23 ft (R3 T-1ft) | 5.99 | 6.46 | 5.79 | 4.96 | 6.61 | 6.91 | 6.19 | 6.01 |
| 25 ft (R4 B+1ft) | 5.96 | 6.52 | 5.72 | 4.92 | 6.57 | 7.02 | 6.17 | 6.04 |
| 28 ft (R4 50%) | 6.00 | 6.62 | 5.72 | 5.02 | 6.38 | 7.12 | 5.91 | 6.10 |
| 31 ft (R4 T-1ft) | 5.92 | 6.62 | 5.69 | 5.02 | 6.37 | 7.16 | 5.62 | 6.06 |
| 33 ft (R5 B+1ft) | 5.94 | 6.62 | 5.66 | 5.01 | 6.31 | 7.21 | 5.44 | 6.06 |
| 36 ft (R5 50%) | 5.89 | 6.66 | 5.87 | 5.01 | 6.41 | 7.32 | 5.10 | 6.24 |
| 39 ft (R5 T-1ft) | 5.92 | 6.75 | 6.25 | 4.95 | 6.29 | 7.39 | 4.72 | 6.27 |
| Min | 5.67 | 6.12 | 5.59 | 4.69 | 5.92 | 6.21 | 4.72 | 5.55 |
| Max | 6.43 | 6.75 | 6.25 | 5.30 | 6.61 | 7.39 | 6.21 | 6.27 |
| Pass/Fail | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |

The following shows the minimum, maximum, and average rim space at each elevation.

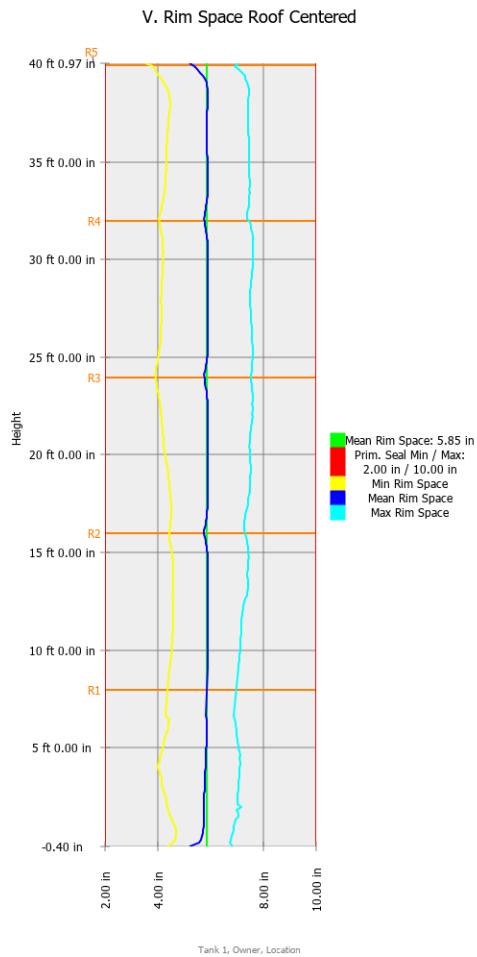


Figure 34: Minimum, maximum, and average rim space at each elevation

Table 21: Minimum, maximum, and average rim space values at each elevation

| Units: [in] | Min Rim Space | Mean Rim Space | Max Rim Space | Pass/Fail |
|------------------|---------------|----------------|---------------|-----------|
| 1 ft (R1 B+1ft) | 4.64 | 5.73 | 6.88 | Pass |
| 4 ft (R1 50 %) | 4.01 | 5.80 | 7.11 | Pass |
| 7 ft (R1 T-1ft) | 4.30 | 5.81 | 6.88 | Pass |
| 9 ft (R2 B+1ft) | 4.44 | 5.89 | 7.05 | Pass |
| 12 ft (R2 50%) | 4.59 | 5.89 | 7.20 | Pass |
| 15 ft (R2 T-1ft) | 4.54 | 5.88 | 7.43 | Pass |
| 17 ft (R3 B+1ft) | 4.51 | 5.86 | 7.32 | Pass |
| 20 ft (R3 50%) | 4.28 | 5.88 | 7.48 | Pass |
| 23 ft (R3 T-1ft) | 4.04 | 5.87 | 7.60 | Pass |
| 25 ft (R4 B+1ft) | 4.01 | 5.87 | 7.59 | Pass |
| 28 ft (R4 50%) | 4.13 | 5.91 | 7.49 | Pass |
| 31 ft (R4 T-1ft) | 4.18 | 5.88 | 7.61 | Pass |
| 33 ft (R5 B+1ft) | 4.18 | 5.85 | 7.47 | Pass |
| 36 ft (R5 50%) | 4.34 | 5.86 | 7.46 | Pass |
| 39 ft (R5 T-1ft) | 4.29 | 5.87 | 7.42 | Pass |

The following shows the minimum, maximum, and average rim space at each radial line.

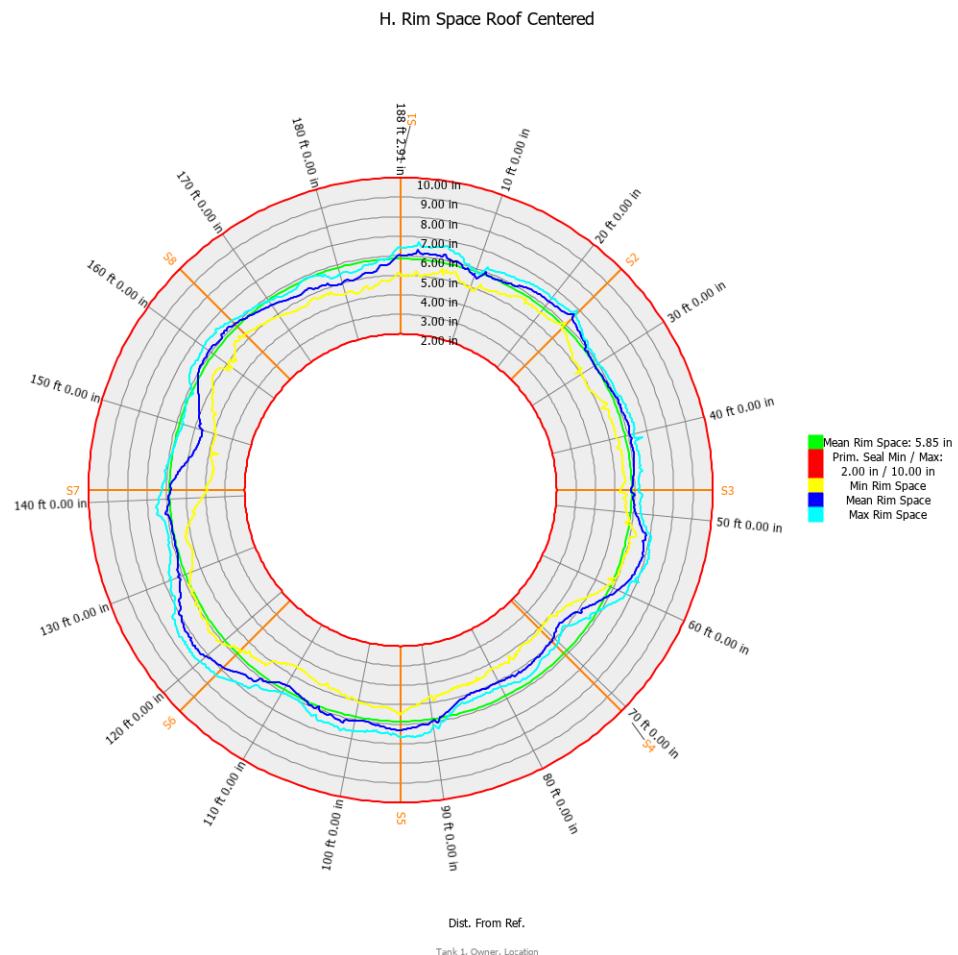


Figure 35: Minimum, maximum, and average rim space at each radial line

Table 22: Minimum, maximum, and average rim space values at each radial line

| Units: [in] | S1 (0°) | S2 (45°) | S3 (90°) | S4 (135°) | S5 (180°) | S6 (225°) | S7 (270°) | S8 (315°) |
|-----------------------|---------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| Min Rim Space | 4.94 | 5.74 | 5.29 | 4.17 | 5.43 | 5.70 | 3.90 | 5.29 |
| Mean Rim Space | 6.02 | 6.50 | 5.81 | 4.97 | 6.30 | 6.86 | 5.81 | 6.04 |
| Max Rim Space | 6.43 | 6.76 | 6.25 | 5.30 | 6.62 | 7.39 | 6.26 | 6.27 |
| Pass/Fail | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |

3.5 COLUMNS

The API allowable maximum deflection from plumb is 2.41" for a new tank of this height (API 650 Section 7.5.2 Plumbness).

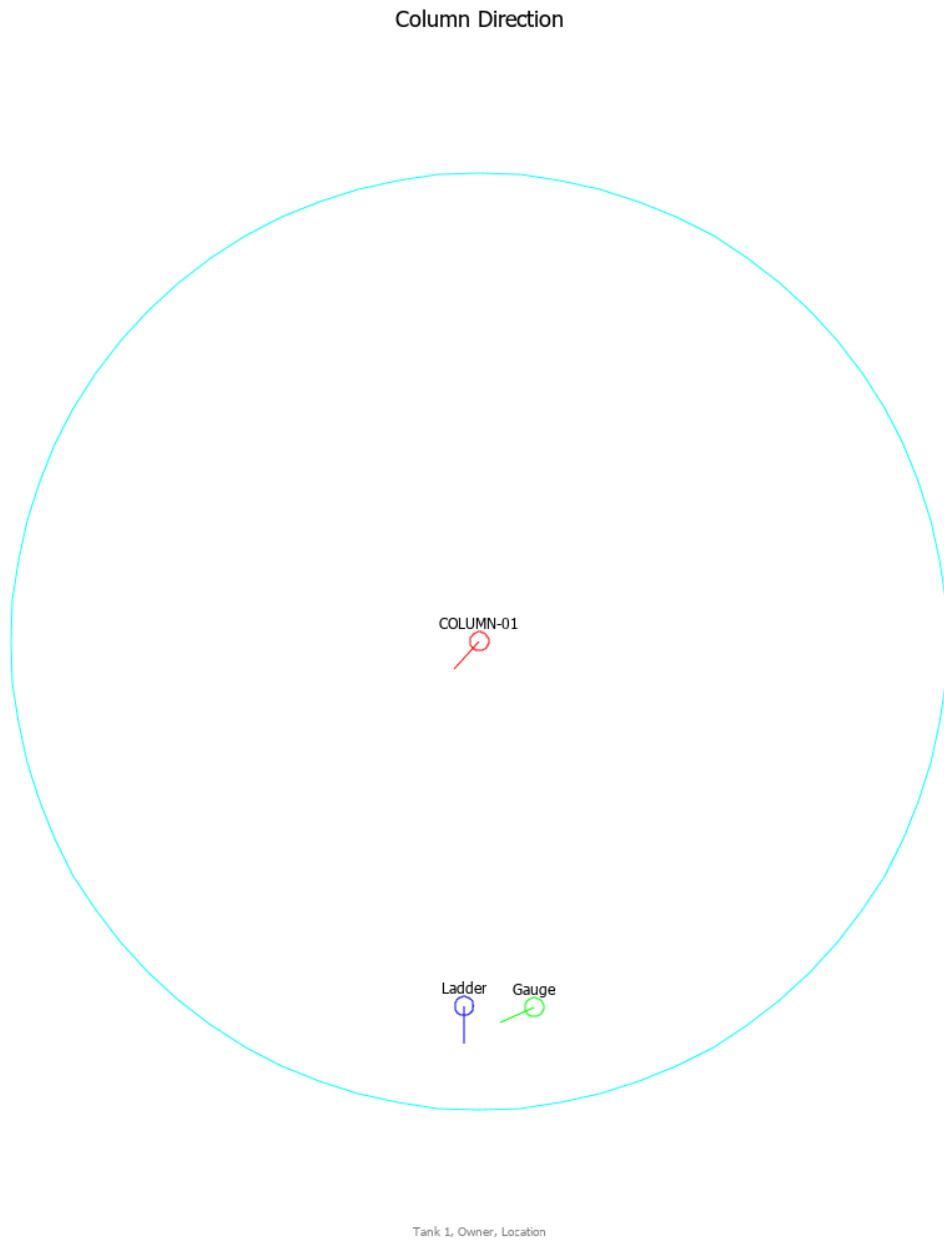


Figure 36: Column deflection direction

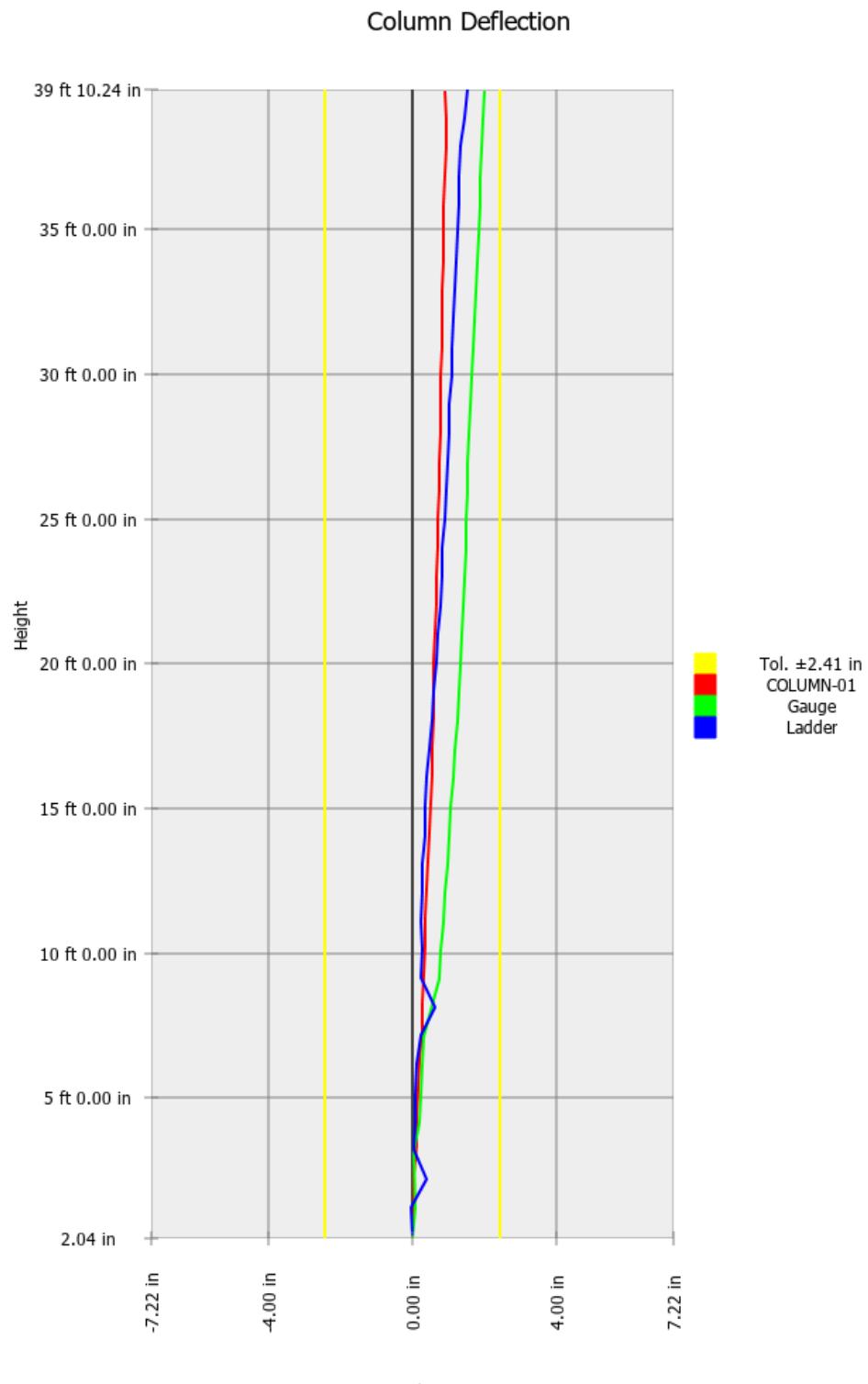


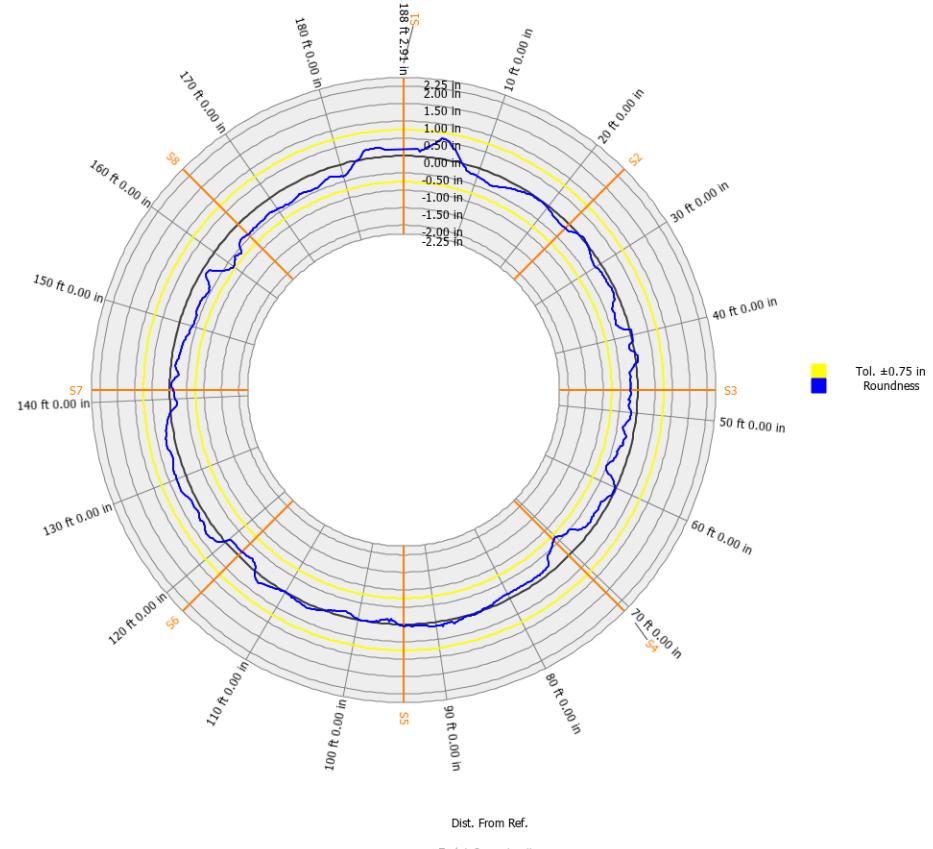
Figure 37: Column deflection

Table 23: Column Analysis Properties

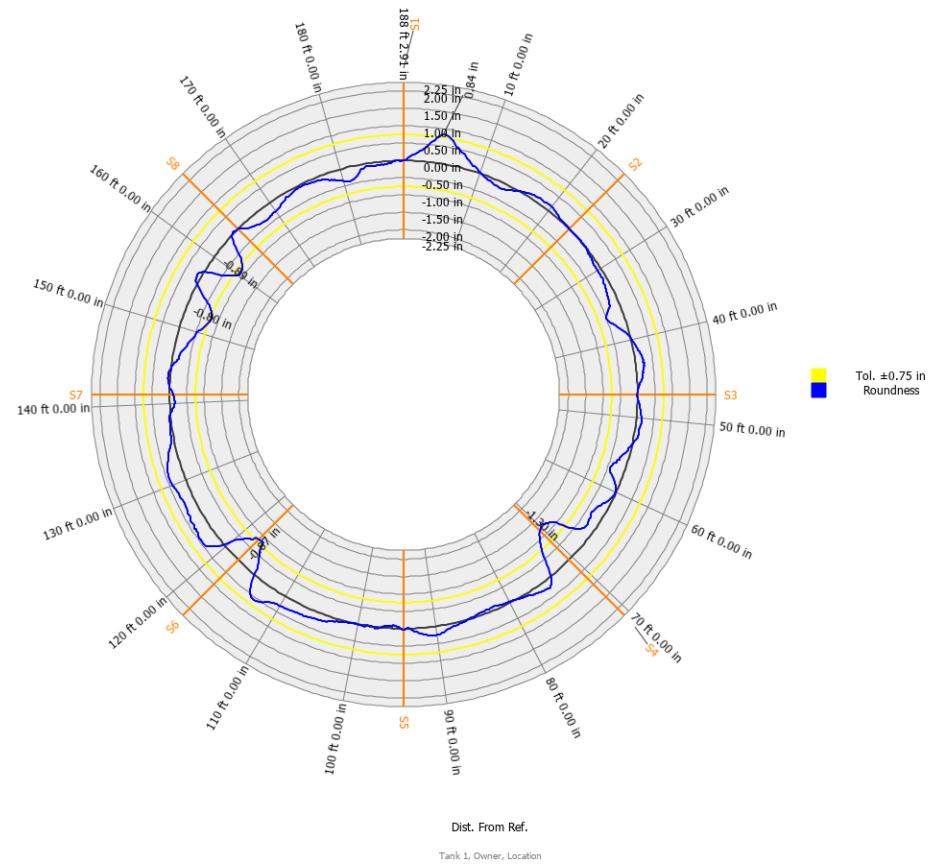
| Column | Diameter | Top to Bottom Offset | Top to Bottom Tilt | Max Deflection | Max Deflection Elevation | Max Deflection Direction (CW) | Pass/Fail |
|------------------|----------|----------------------|--------------------|----------------|--------------------------|-------------------------------|-----------|
| COLUMN-01 | 12.77 in | 0.89 in | 0.11° | 0.93 in | 38 ft 9.76 in | 223.11° | Pass |
| Gauge | 8.60 in | 1.99 in | 0.24° | 1.99 in | 39 ft 9.40 in | 246.03° | Pass |
| Ladder | 8.68 in | 1.51 in | 0.18° | 1.51 in | 39 ft 10.24 in | 180.22° | Pass |

4 APPENDIX A: SHELL ROUNDNESS CROSS-SECTIONS

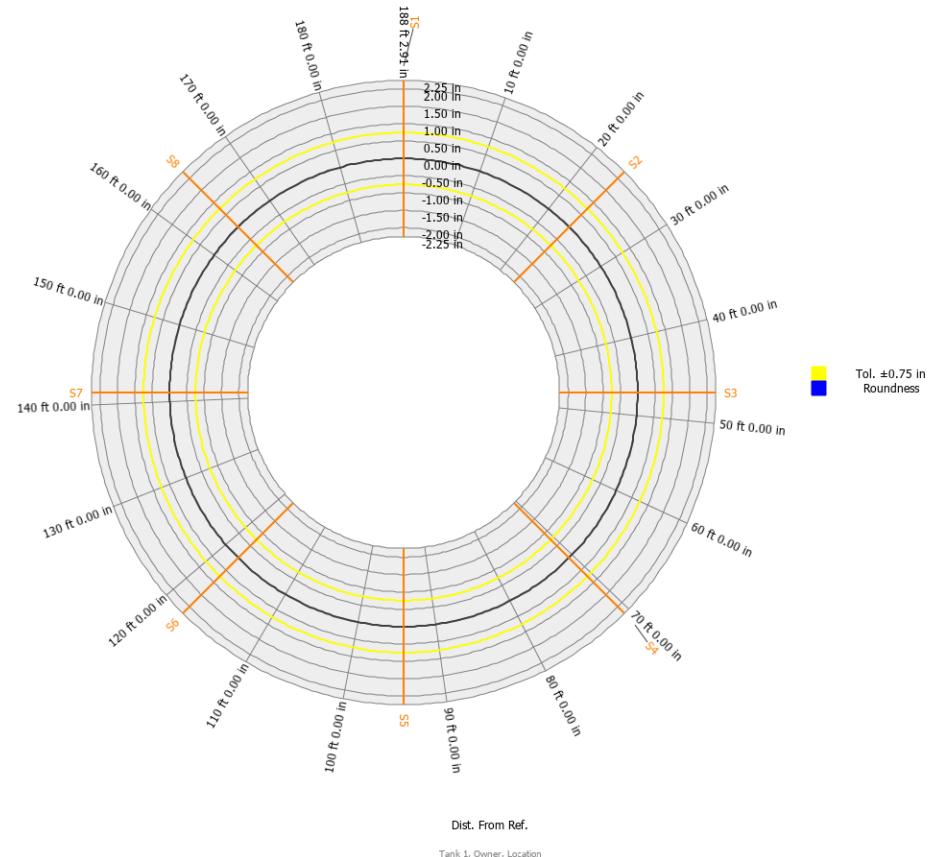
H. Roundness at 1 ft (R1 B+1ft)



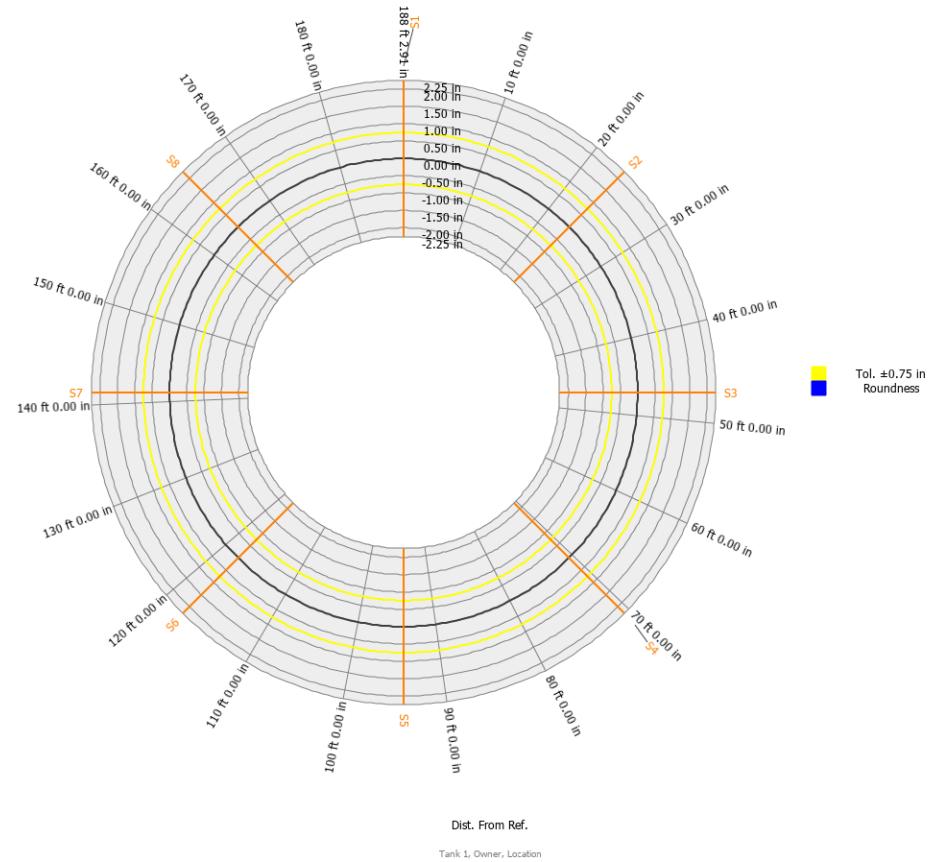
H. Roundness at 4 ft (R1 50%)



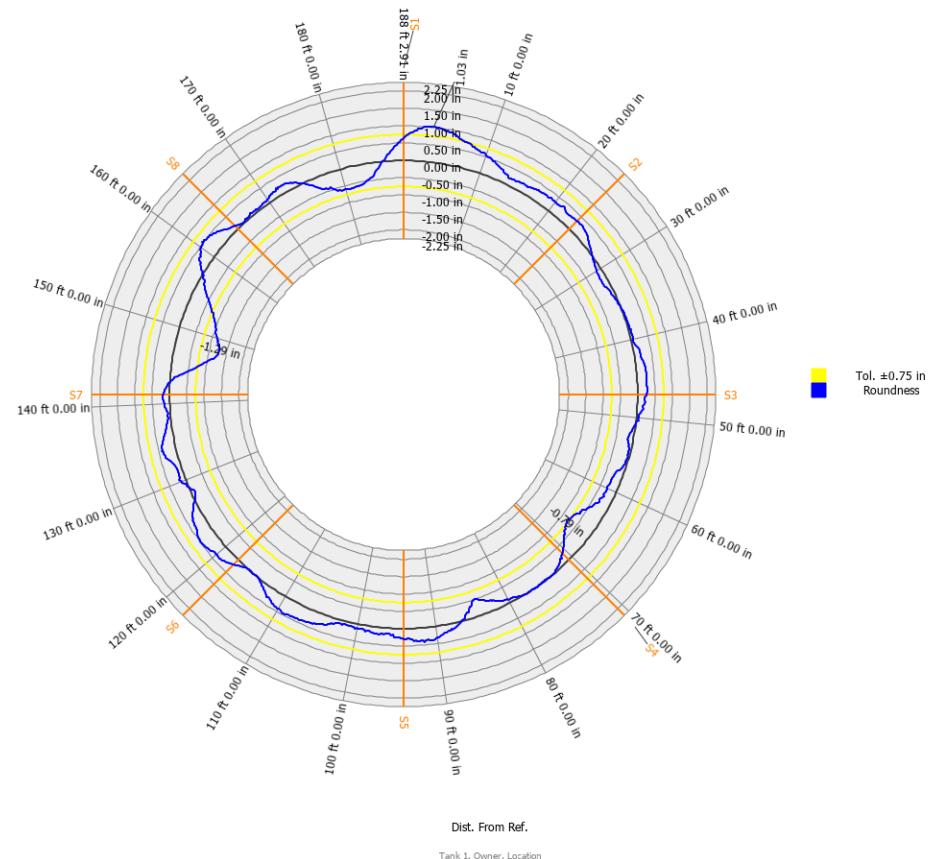
H. Roundness at 7 ft (R1 T-1ft)



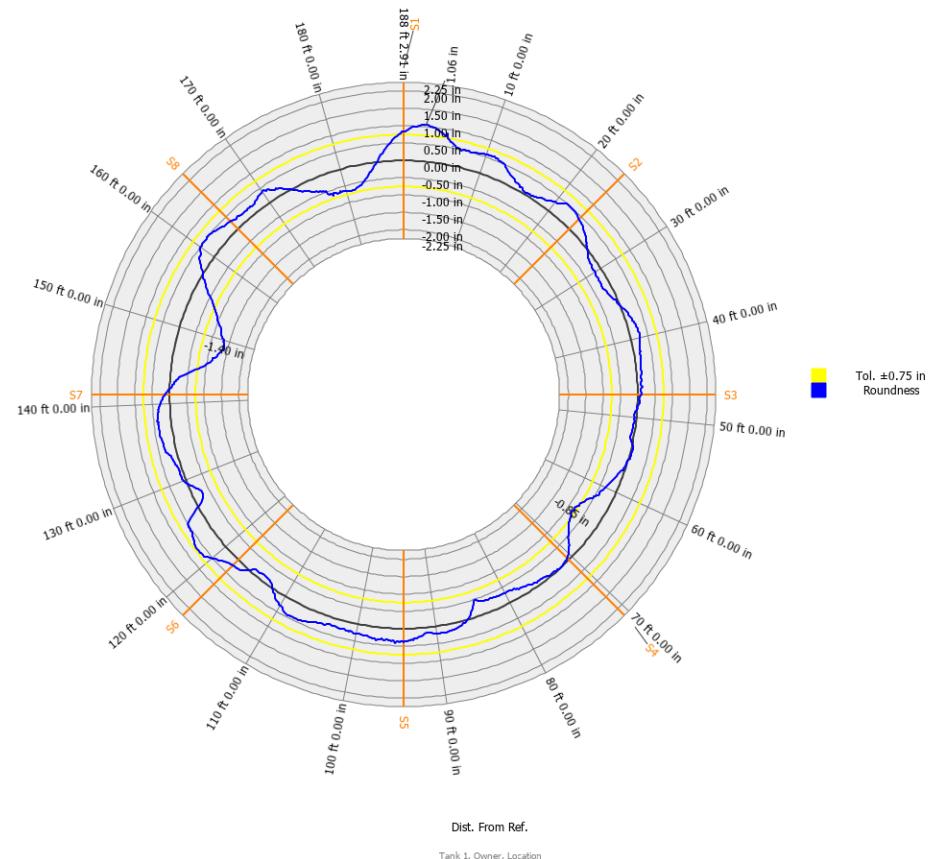
H. Roundness at 9 ft (R2 B+1ft)



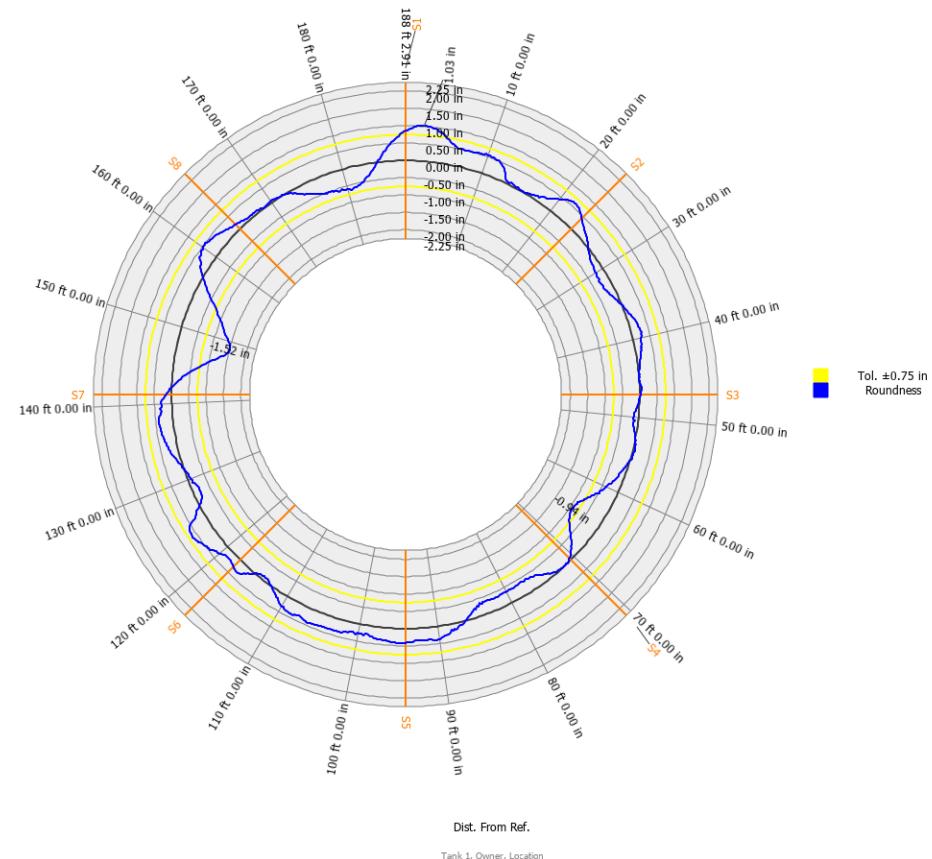
H. Roundness at 12 ft (R2 50%)



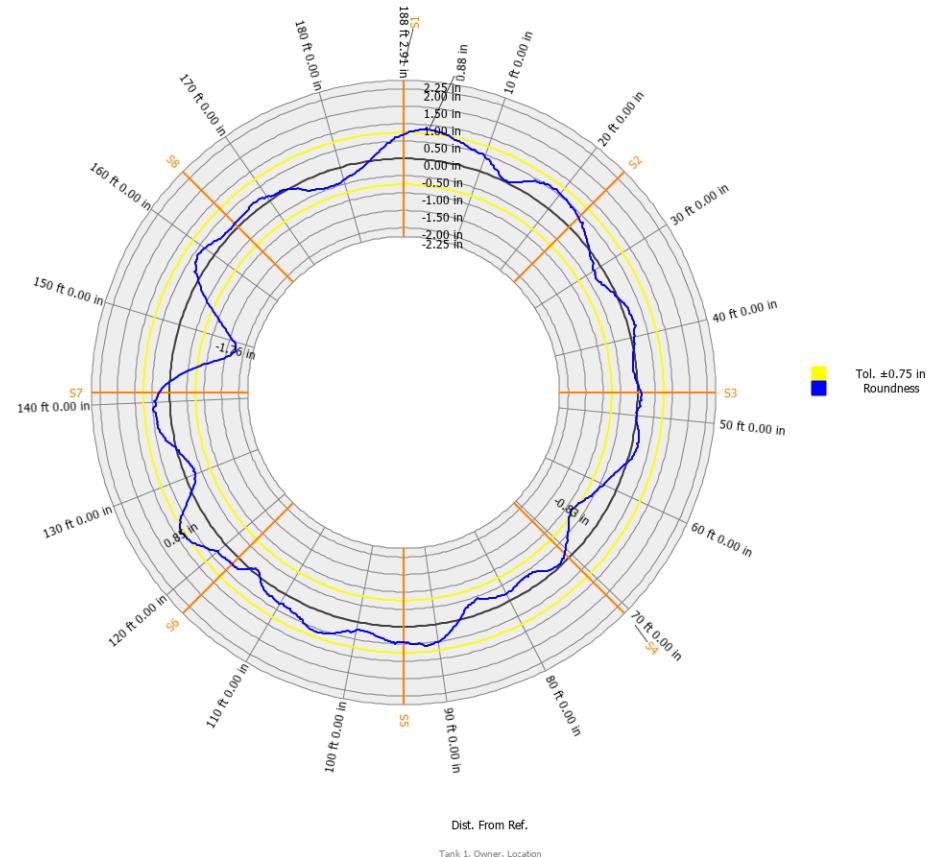
H. Roundness at 15 ft (R2 T-1ft)



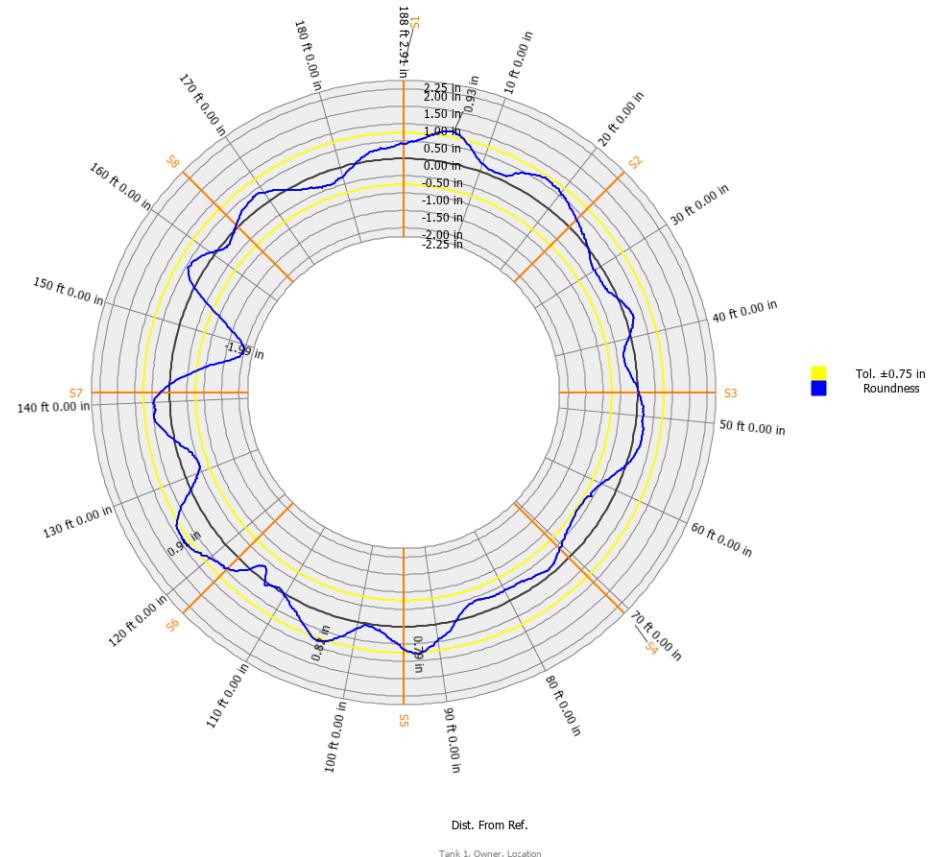
H. Roundness at 17 ft (R3 B+1ft)



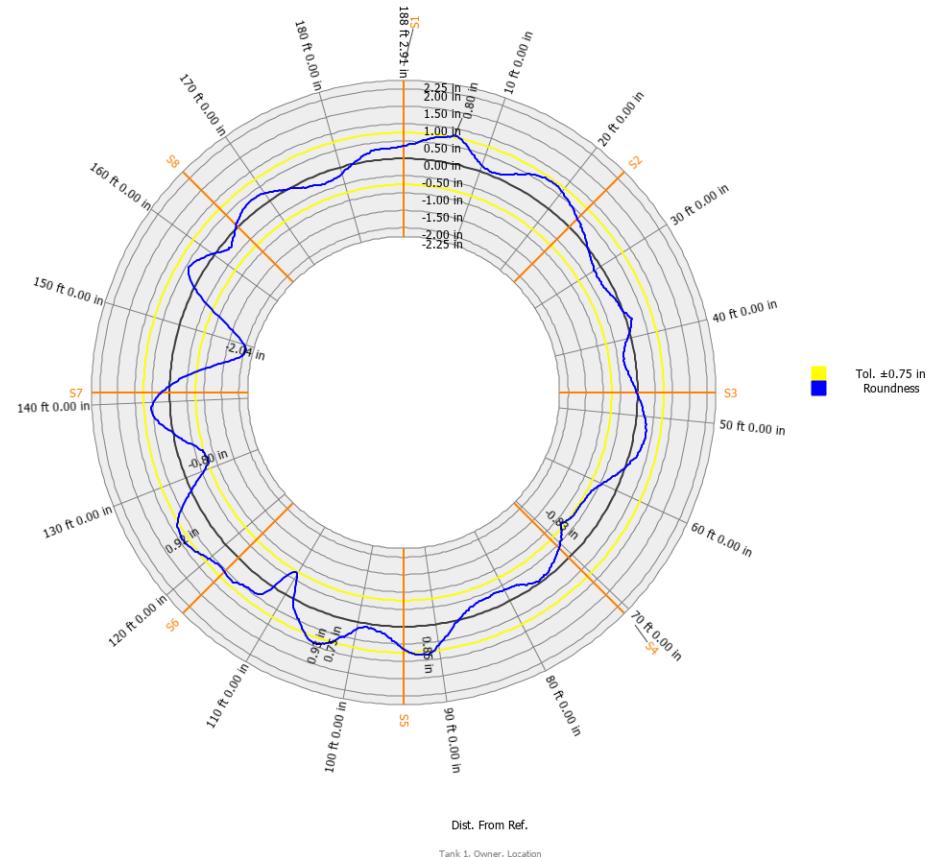
H. Roundness at 20 ft (R3 50%)



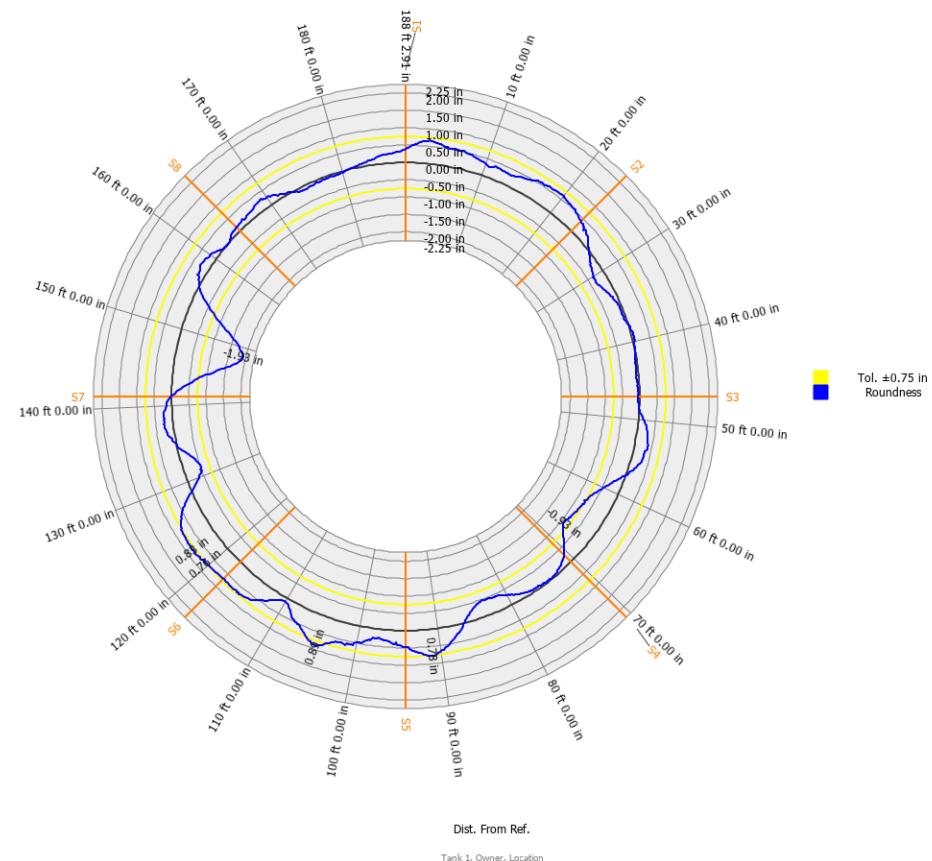
H. Roundness at 23 ft (R3 T-1ft)



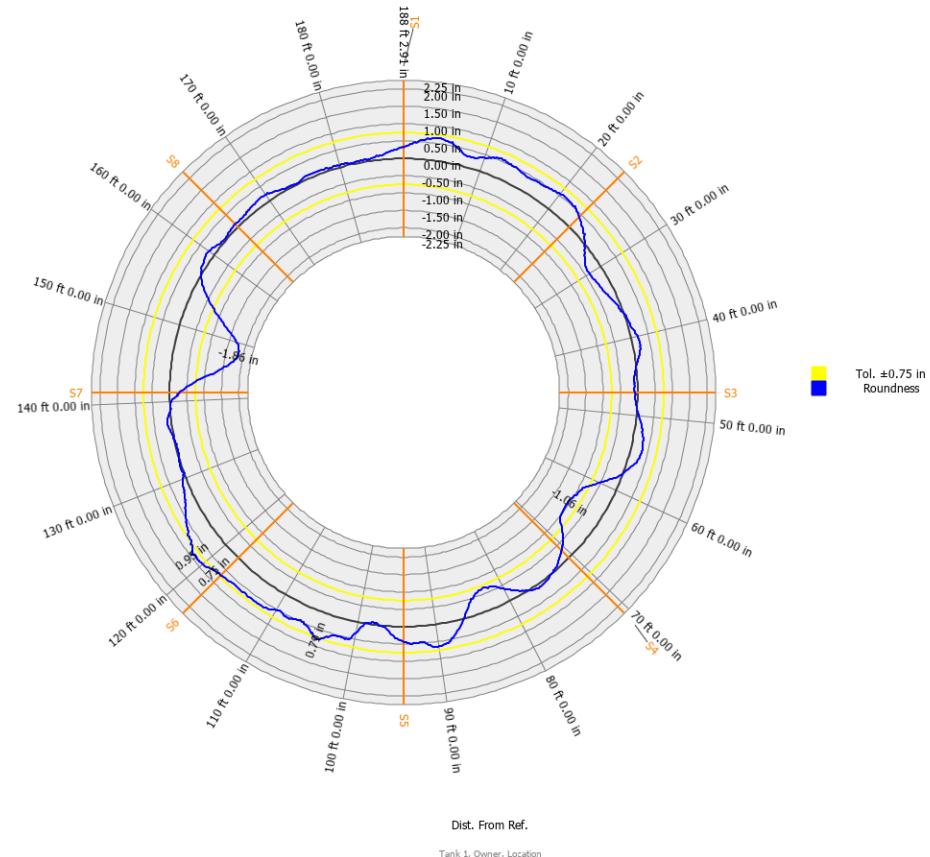
H. Roundness at 25 ft (R4 B+1ft)



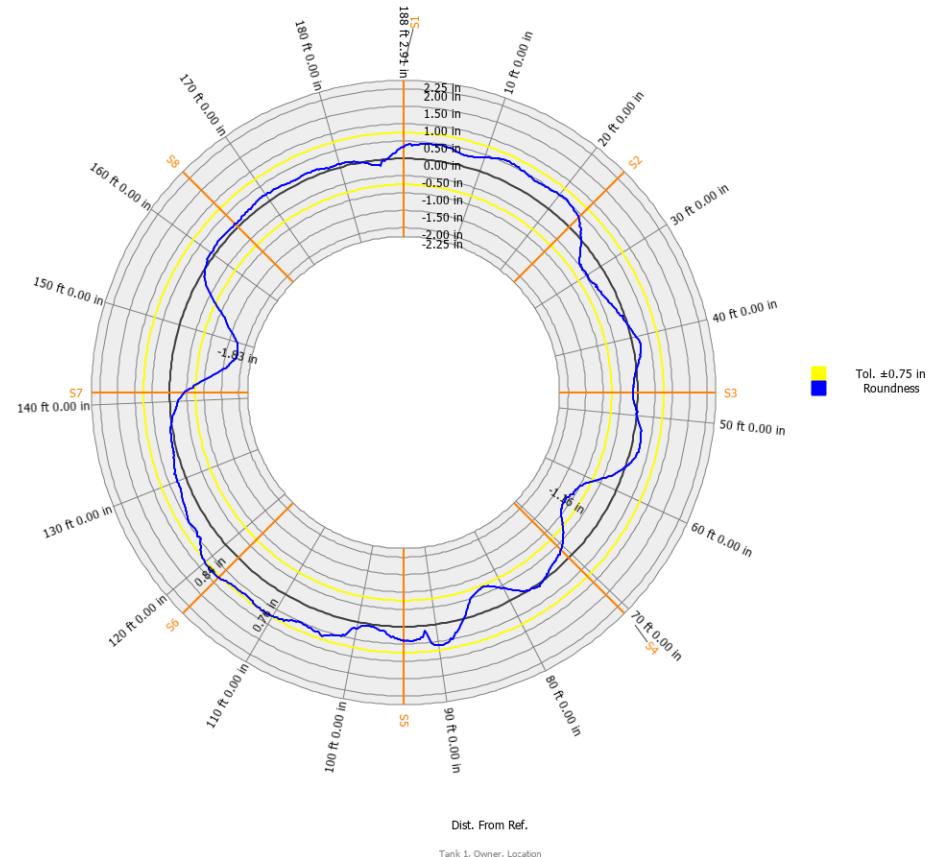
H. Roundness at 28 ft (R4 50%)



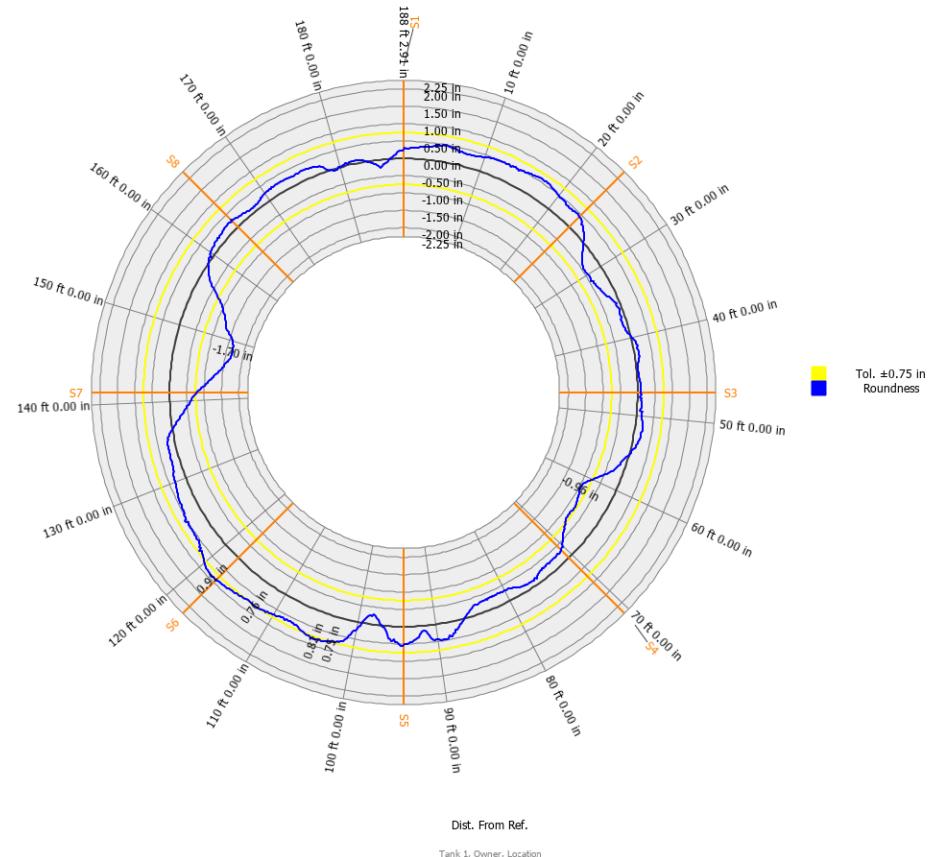
H. Roundness at 31 ft (R4 T-1ft)



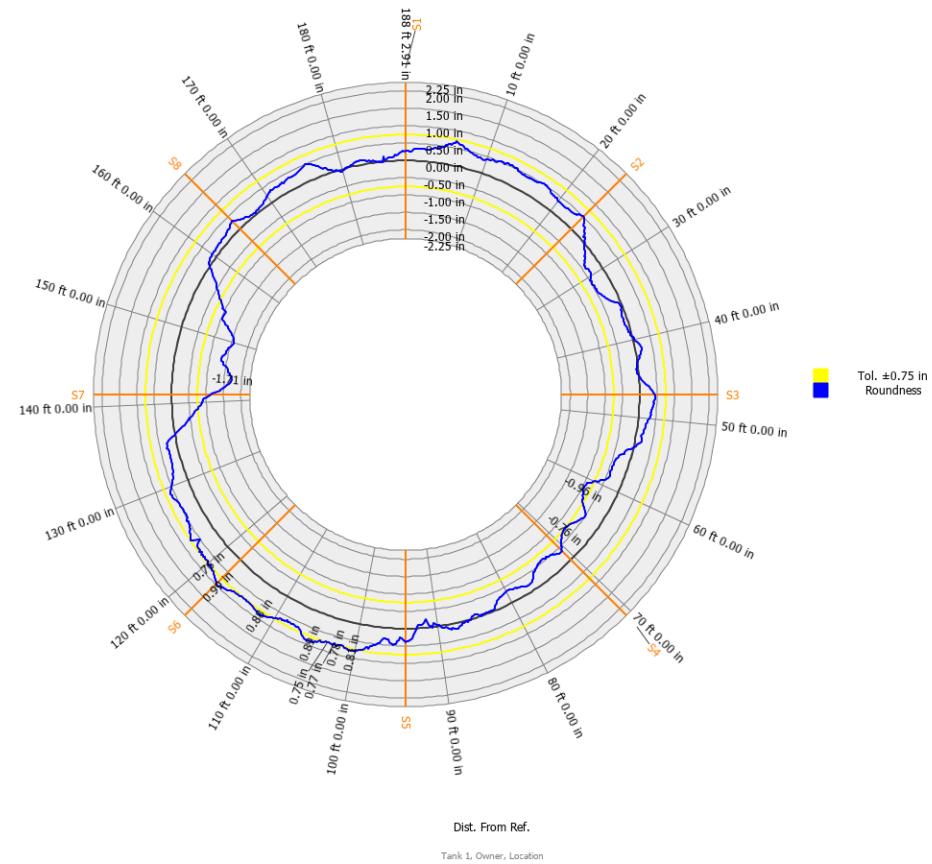
H. Roundness at 33 ft (R5 B+1ft)



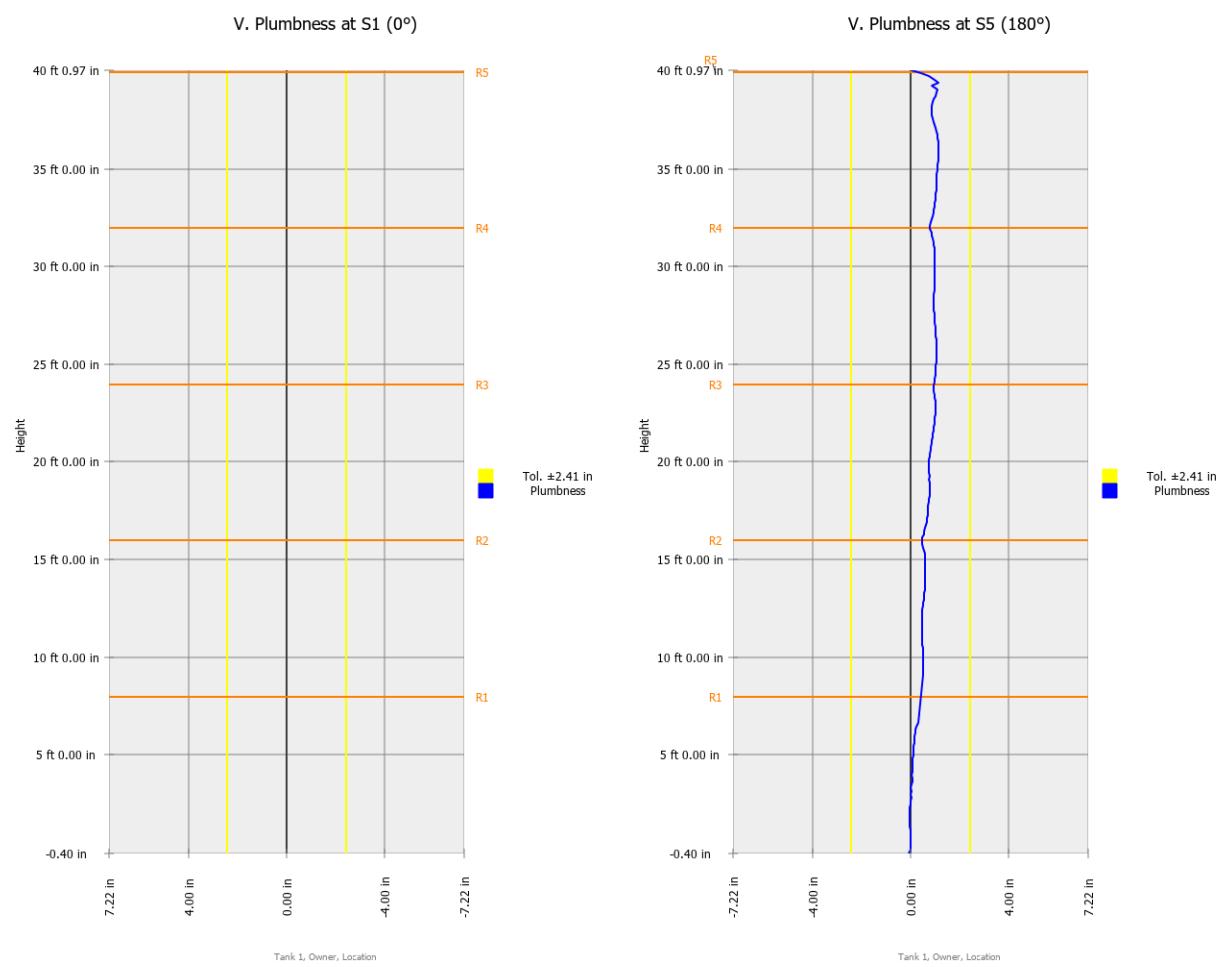
H. Roundness at 36 ft (R5 50%)

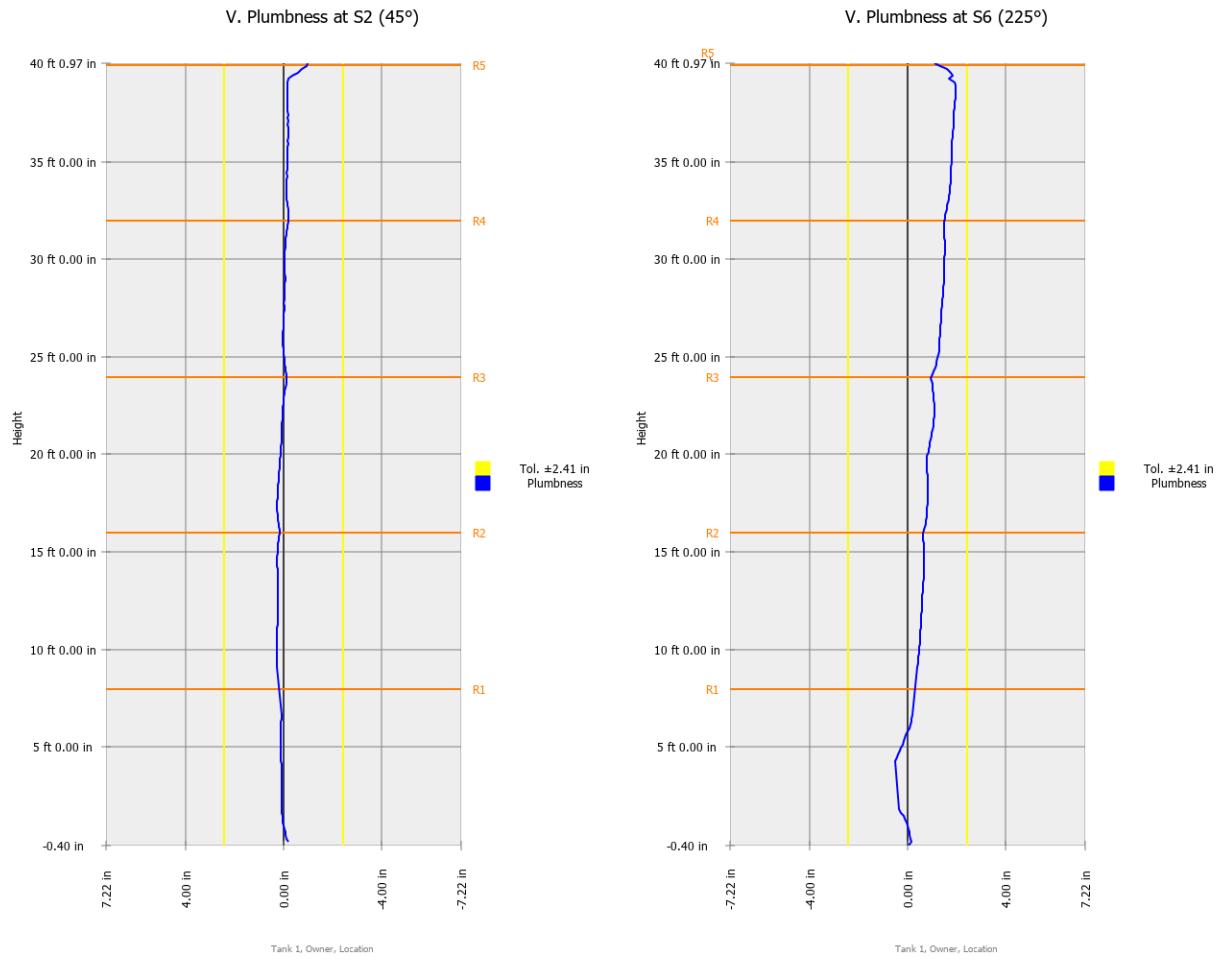


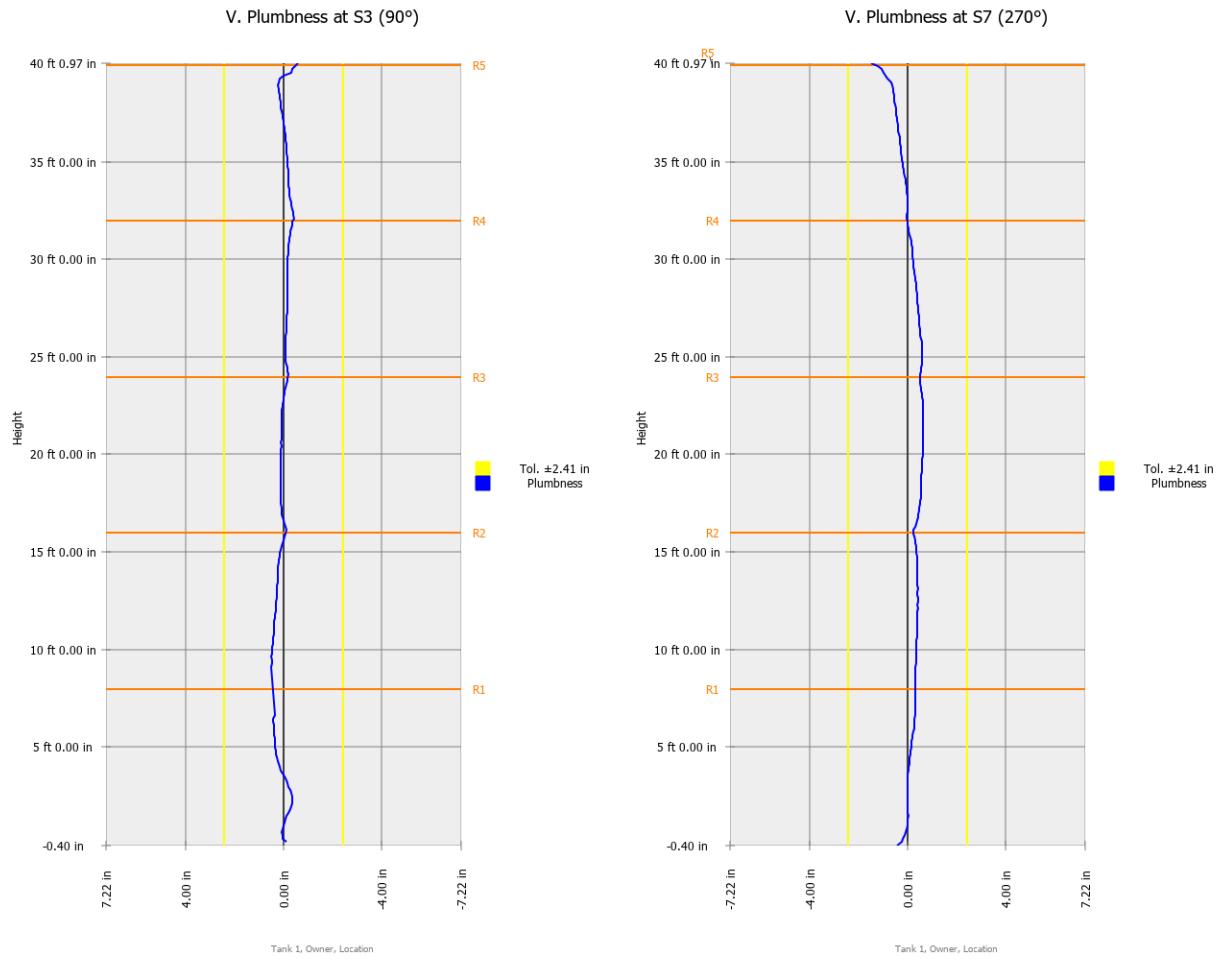
H. Roundness at 39 ft (R5 T-1ft)

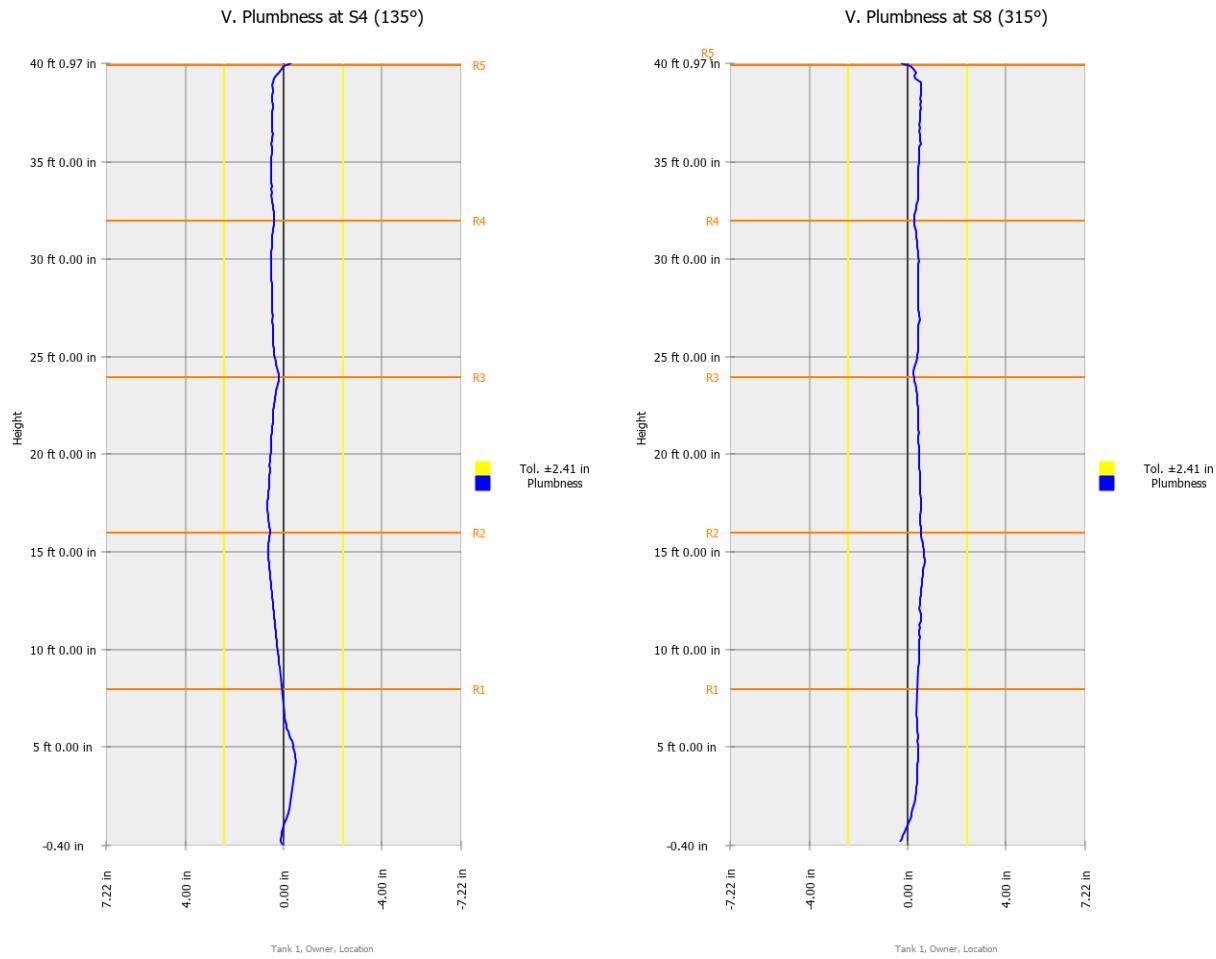


5 APPENDIX B: SHELL PLUMBNESS CROSS-SECTIONS



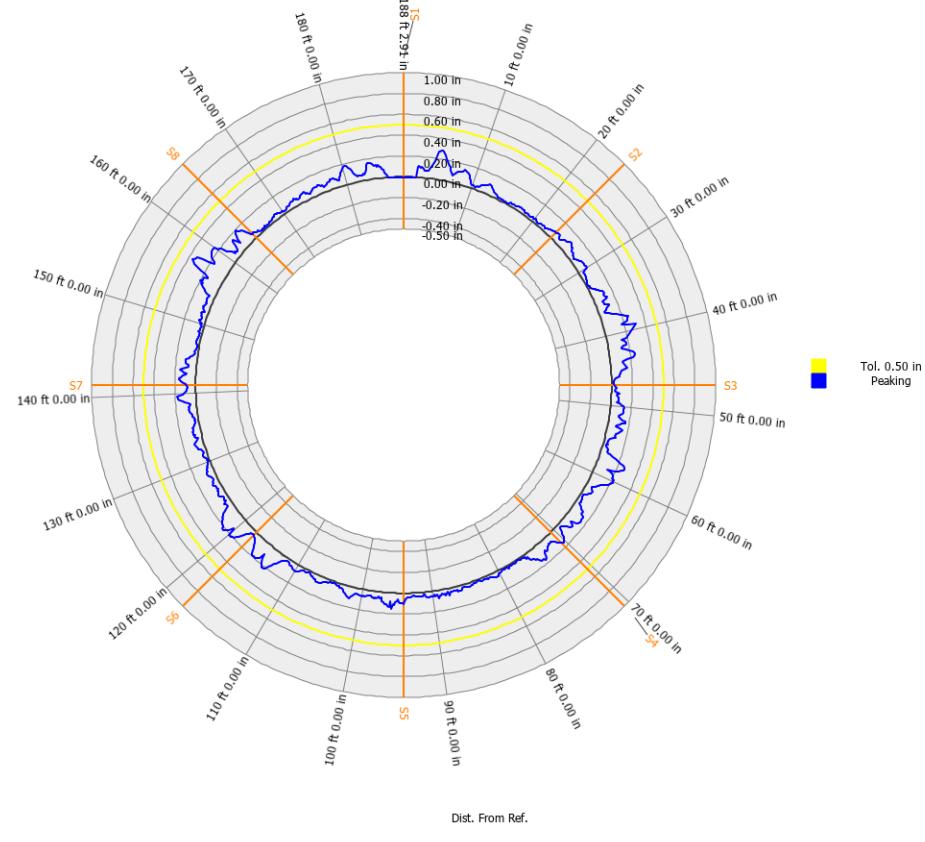




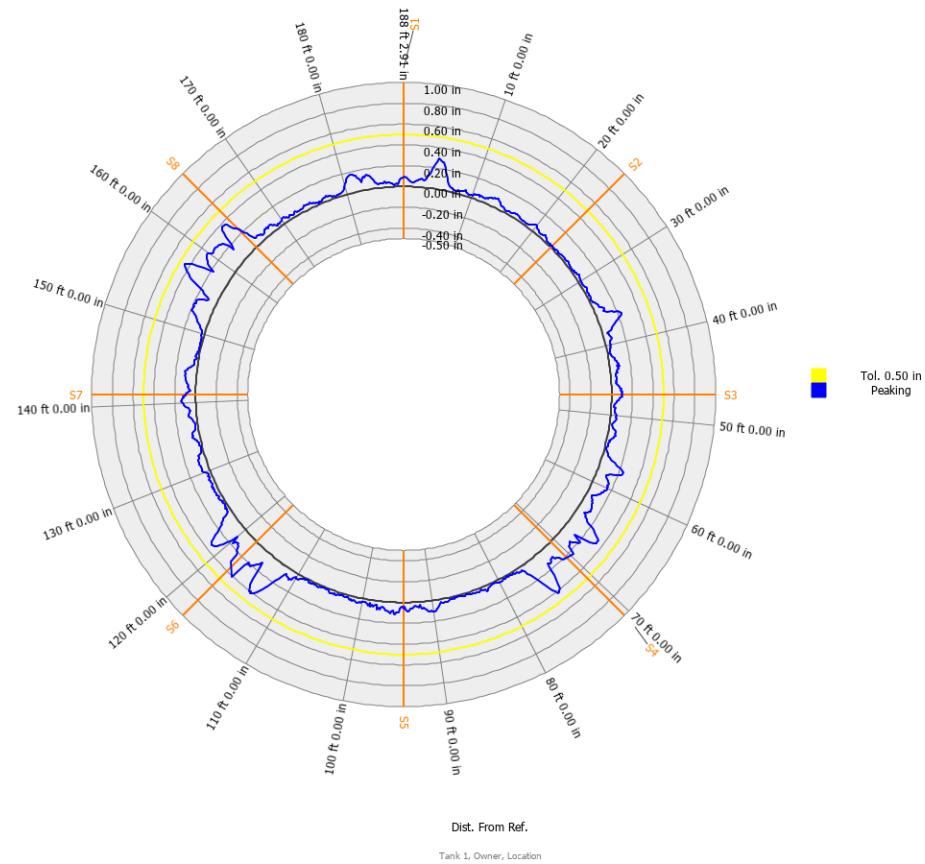


6 APPENDIX C: SHELL PEAKING CROSS-SECTIONS

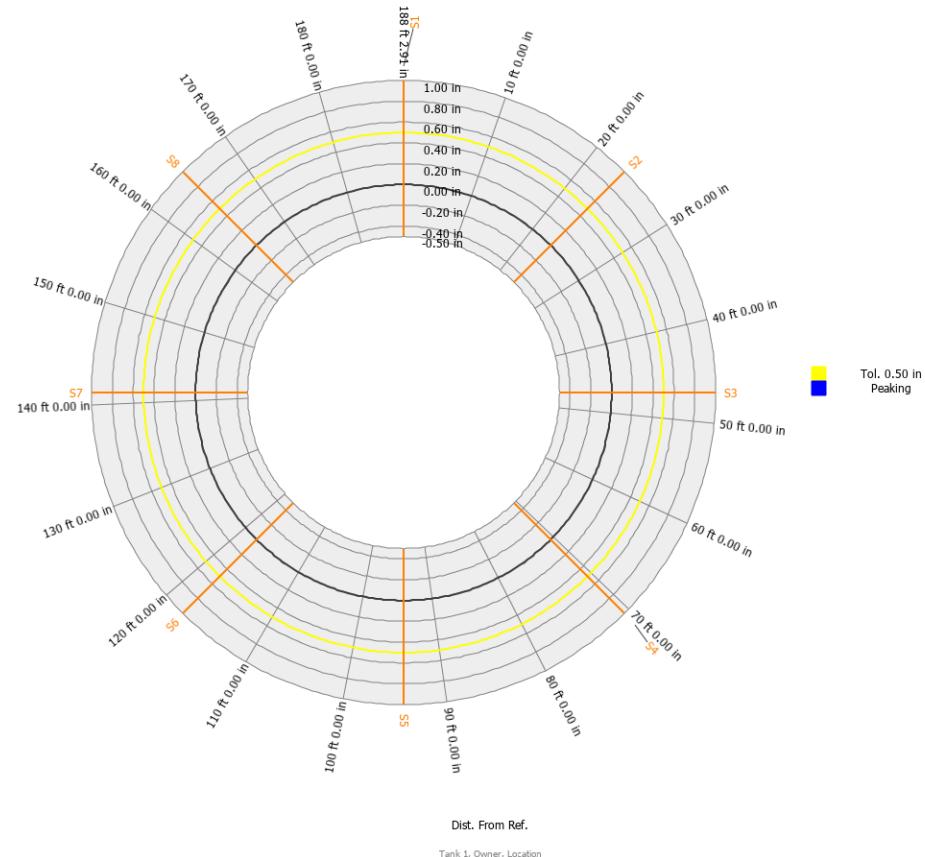
H. Peaking at 1 ft (R1 B+1ft)



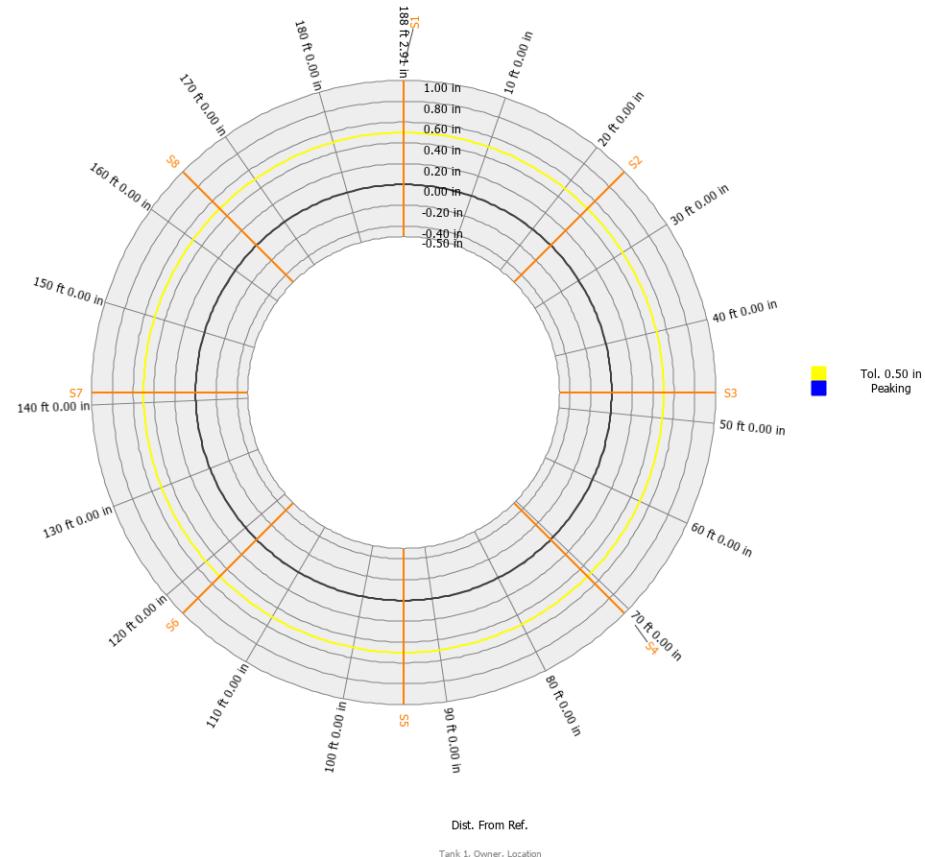
H. Peaking at 4 ft (R1 50%)



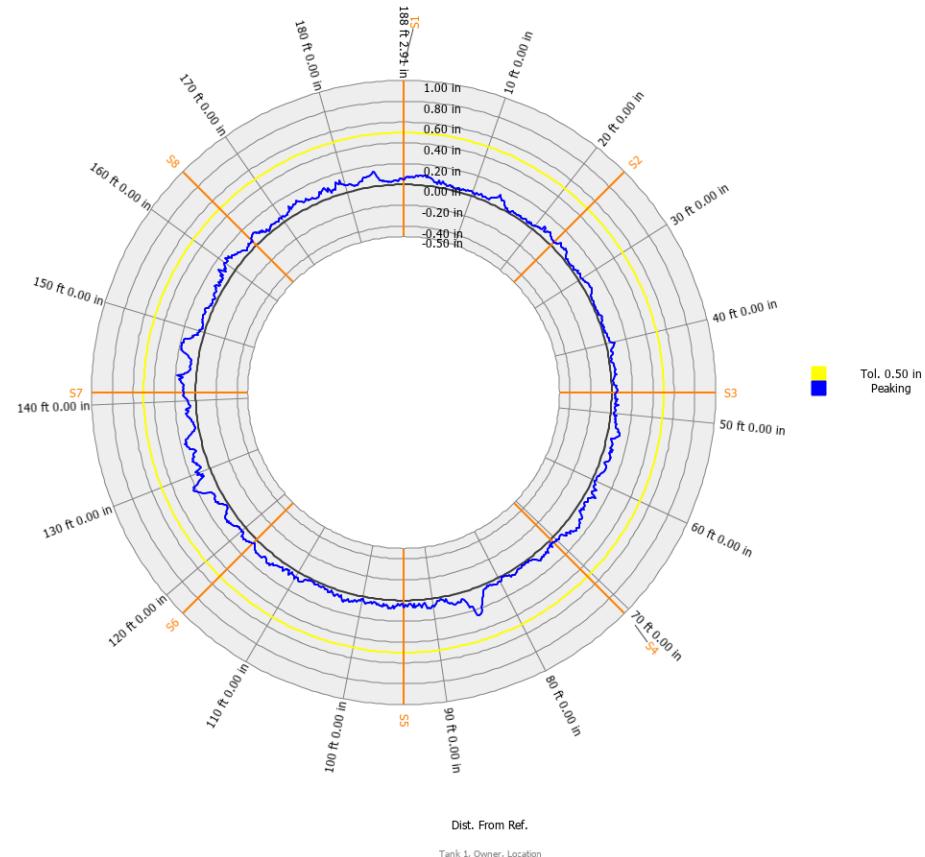
H. Peaking at 7 ft (R1 T-1ft)



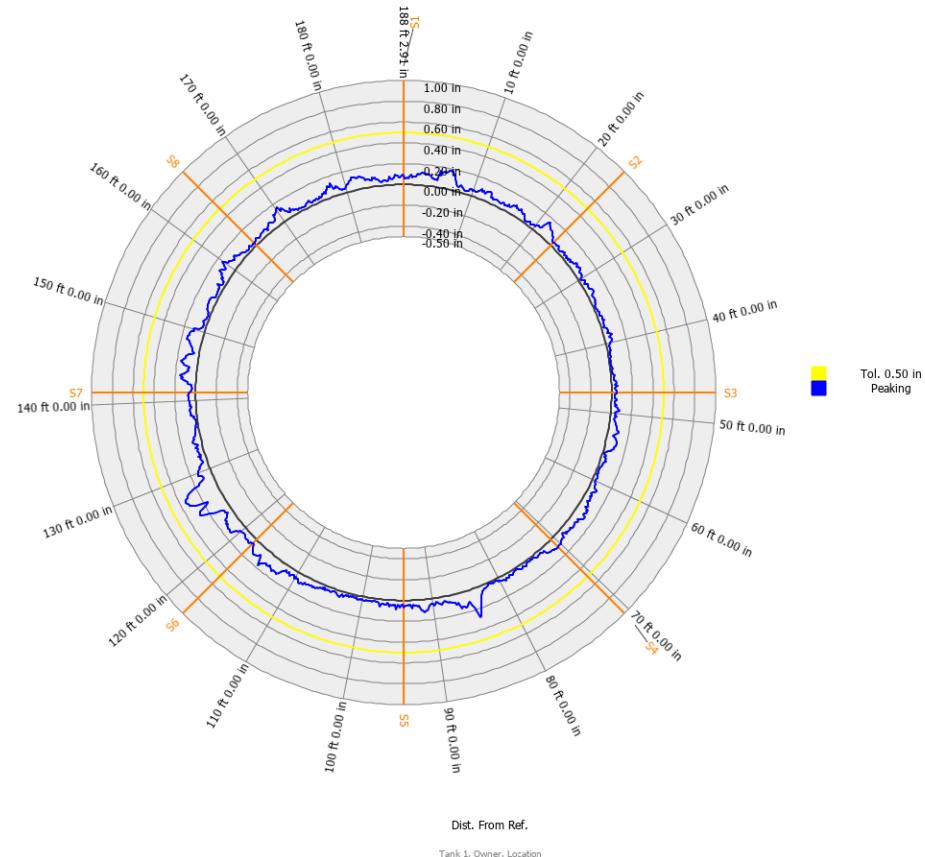
H. Peaking at 9 ft (R2 B+1ft)



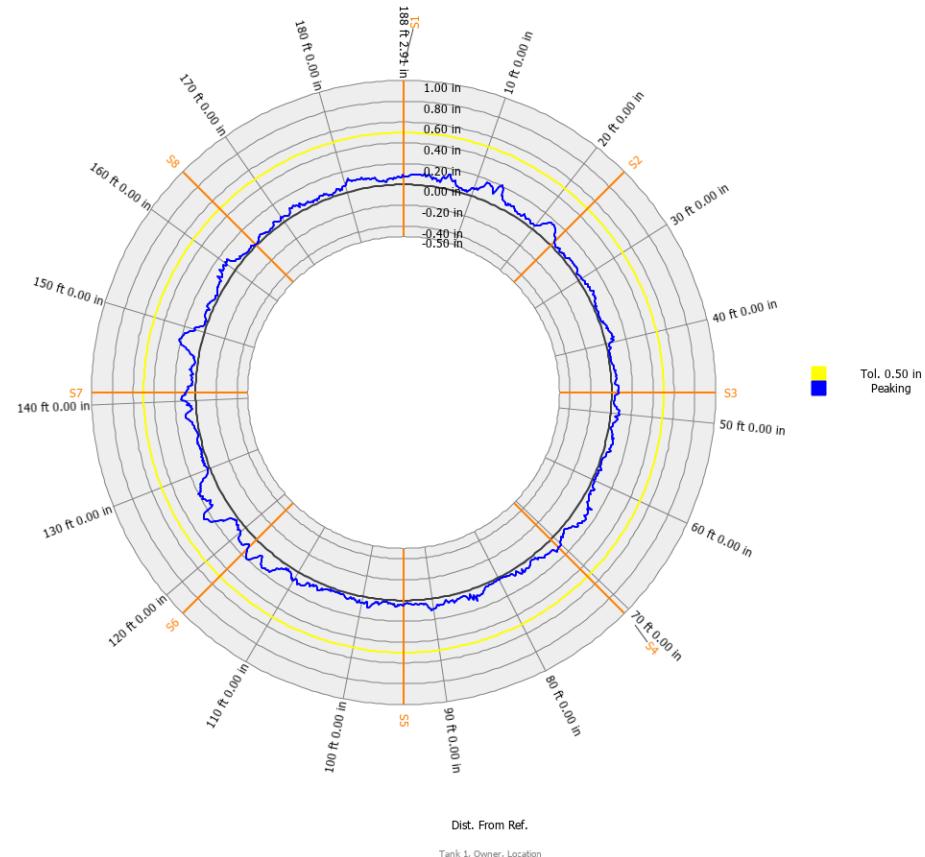
H. Peaking at 12 ft (R2 50%)



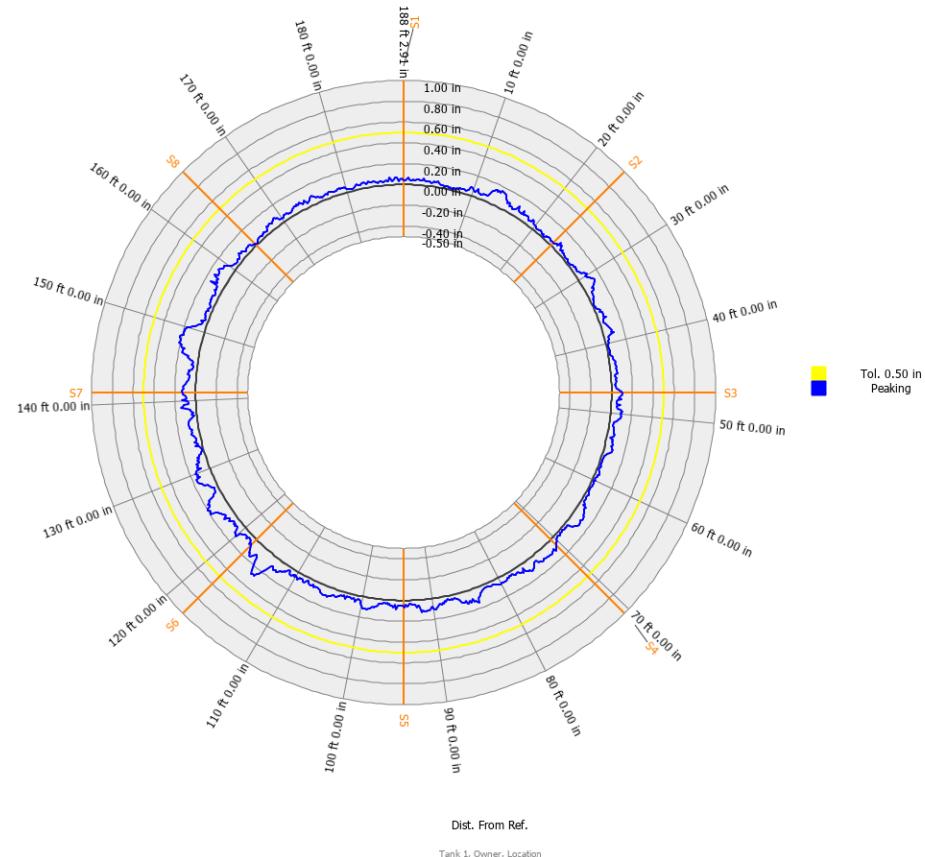
H. Peaking at 15 ft (R2 T-1ft)



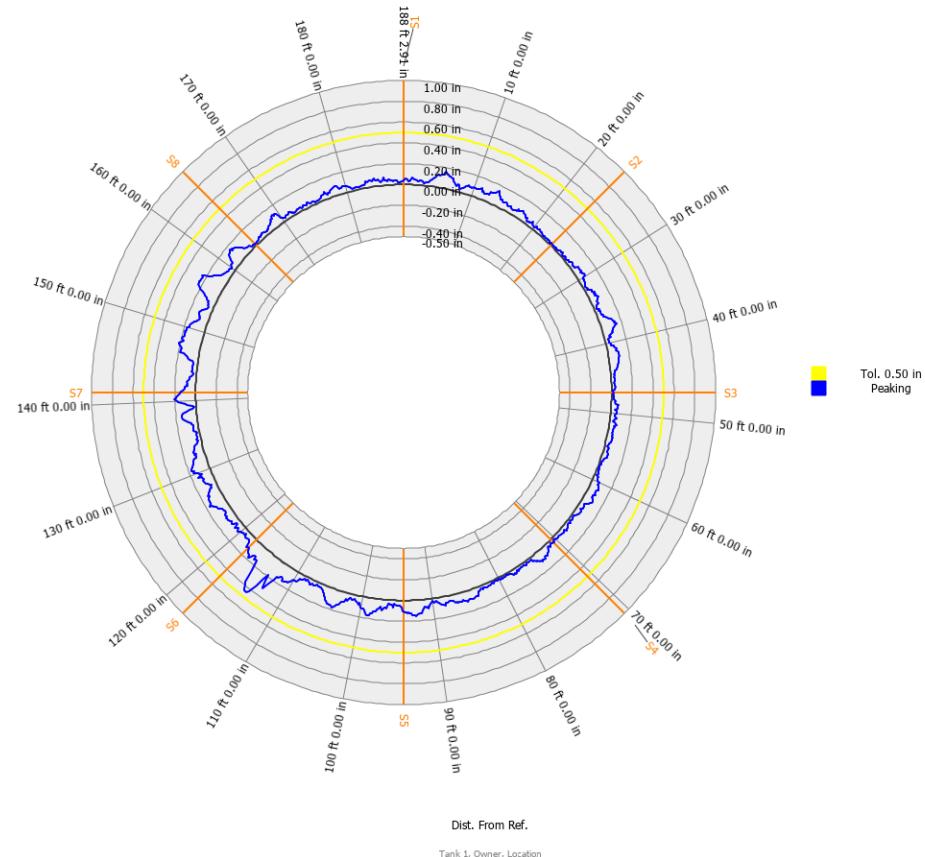
H. Peaking at 17 ft (R3 B+1ft)



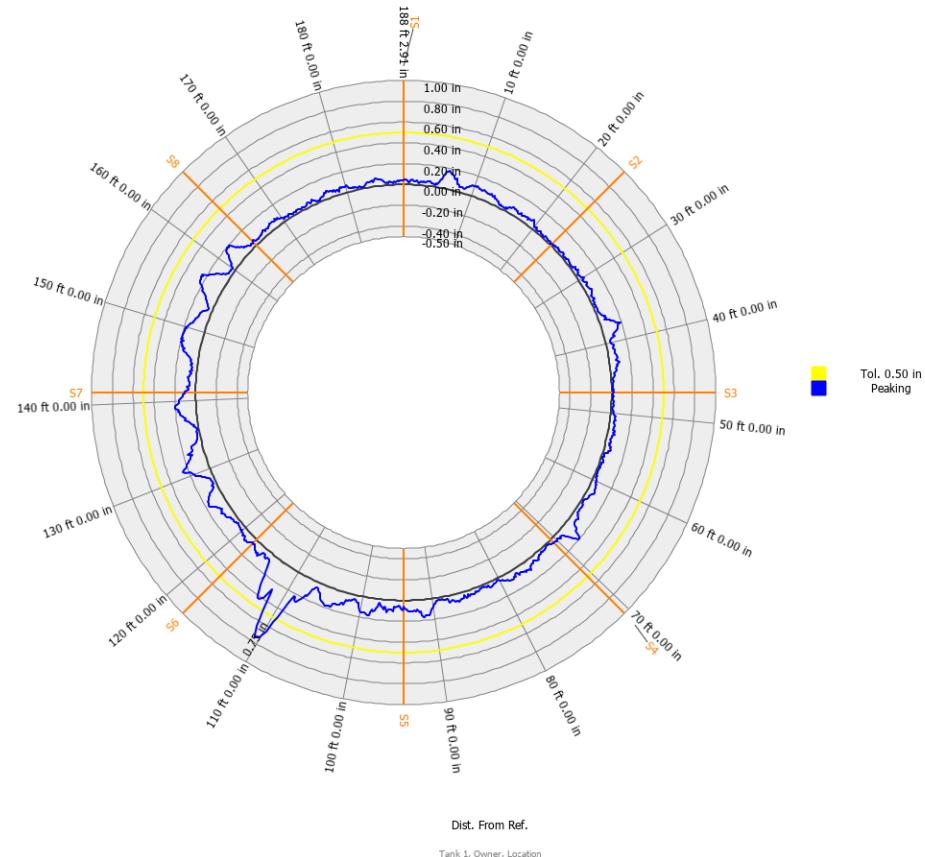
H. Peaking at 20 ft (R3 50%)



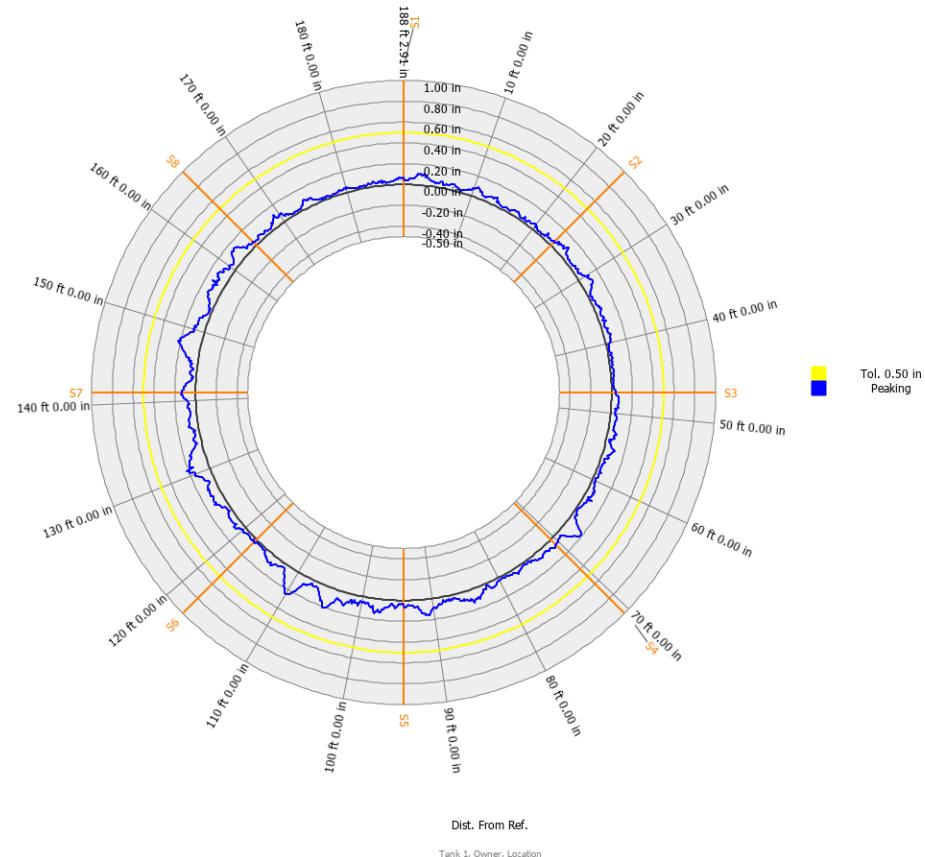
H. Peaking at 23 ft (R3 T-1ft)



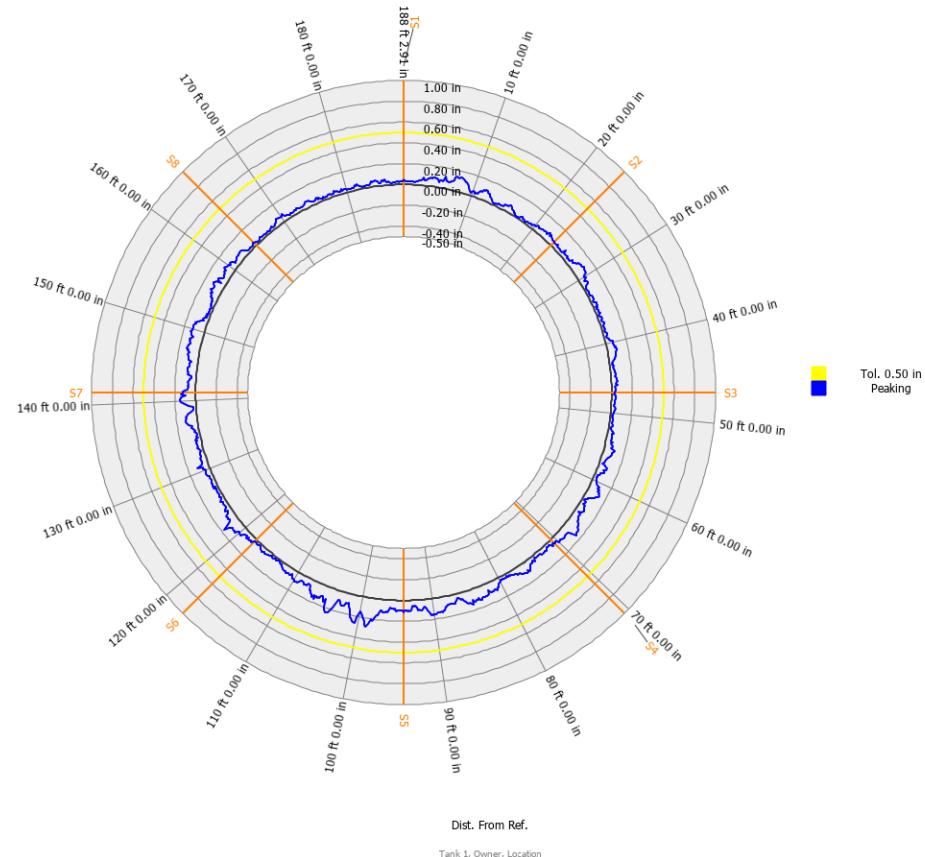
H. Peaking at 25 ft (R4 B+1ft)



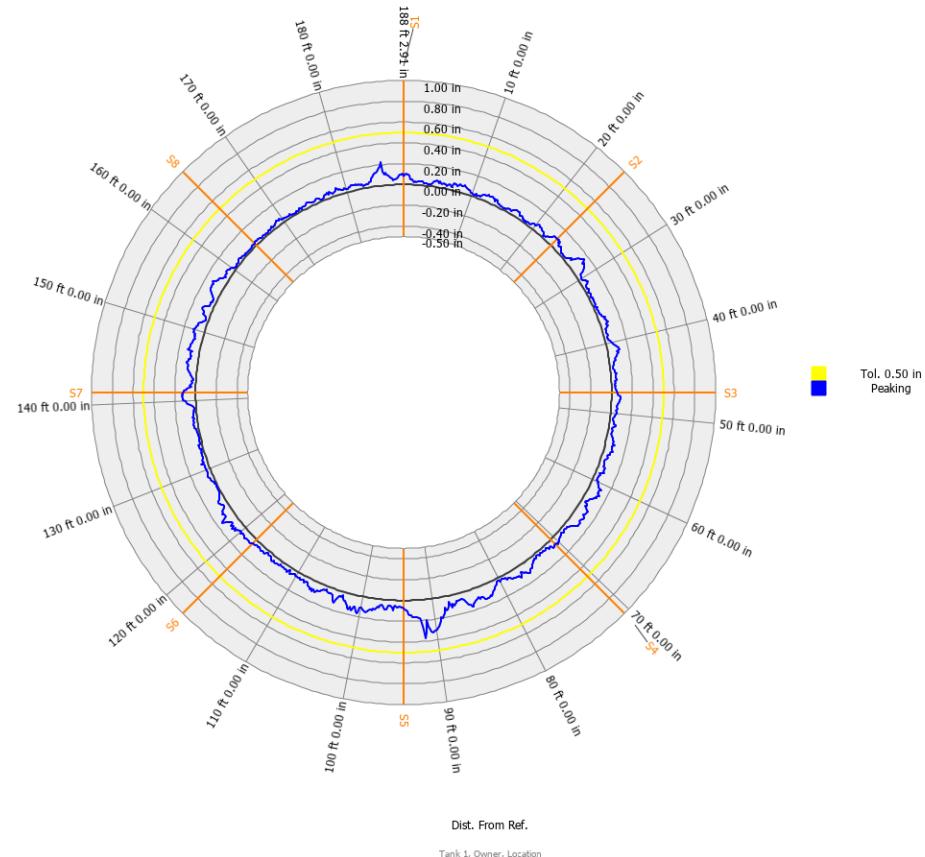
H. Peaking at 28 ft (R4 50%)



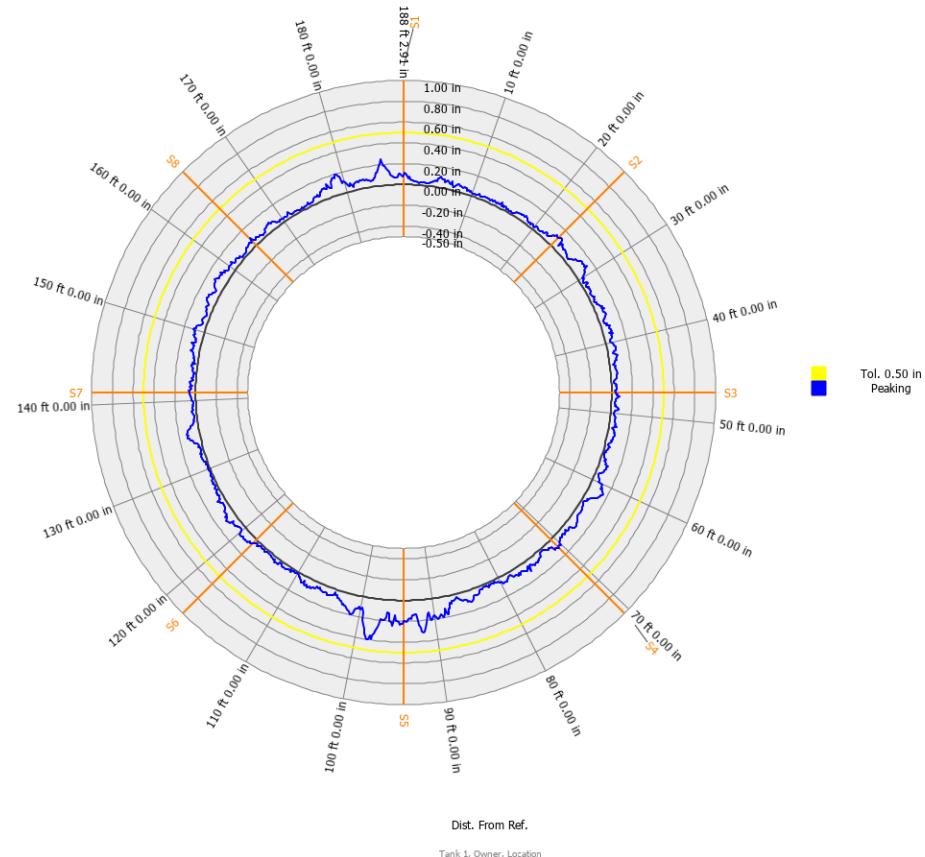
H. Peaking at 31 ft (R4 T-1ft)



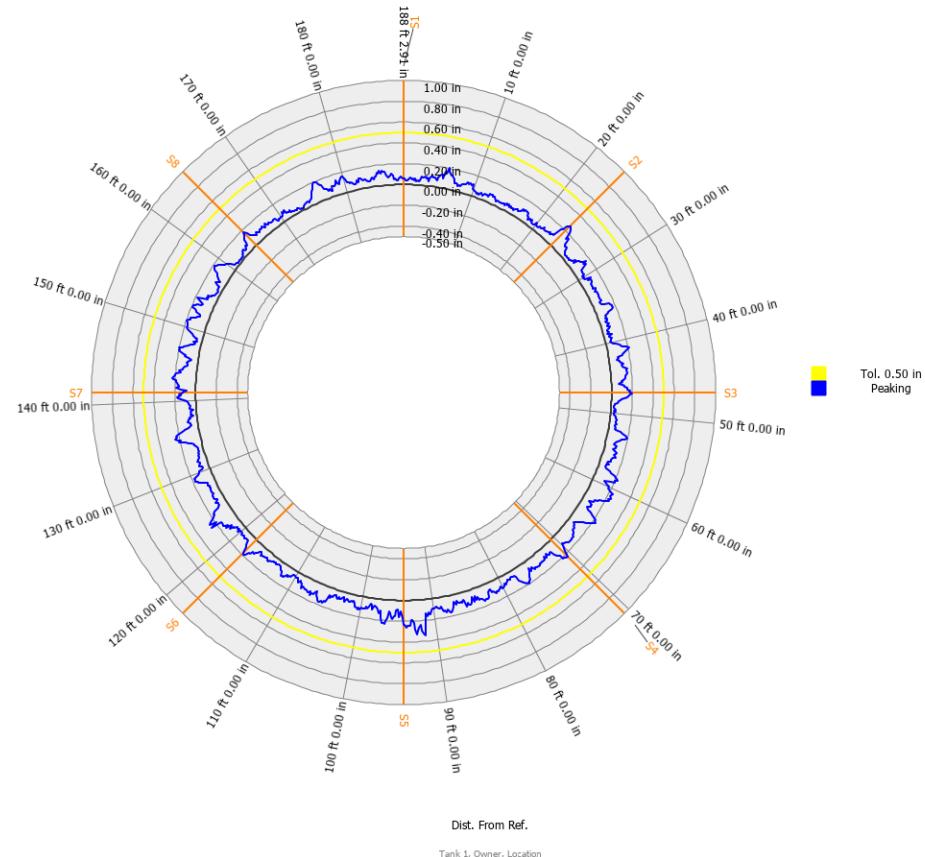
H. Peaking at 33 ft (R5 B+1ft)



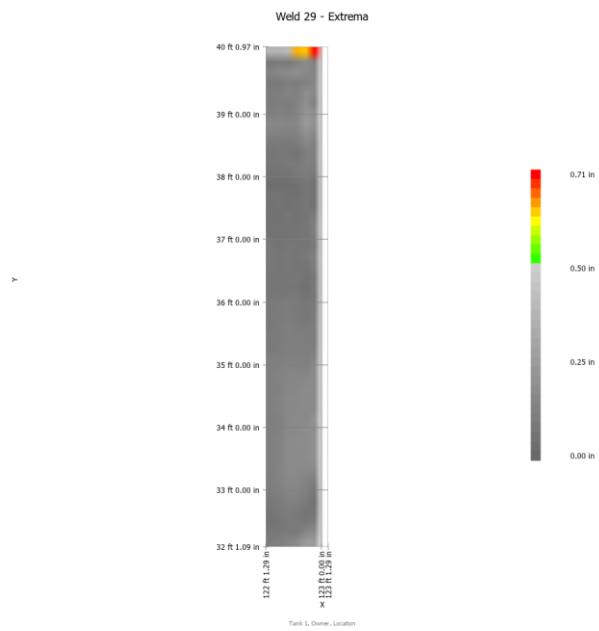
H. Peaking at 36 ft (R5 50%)



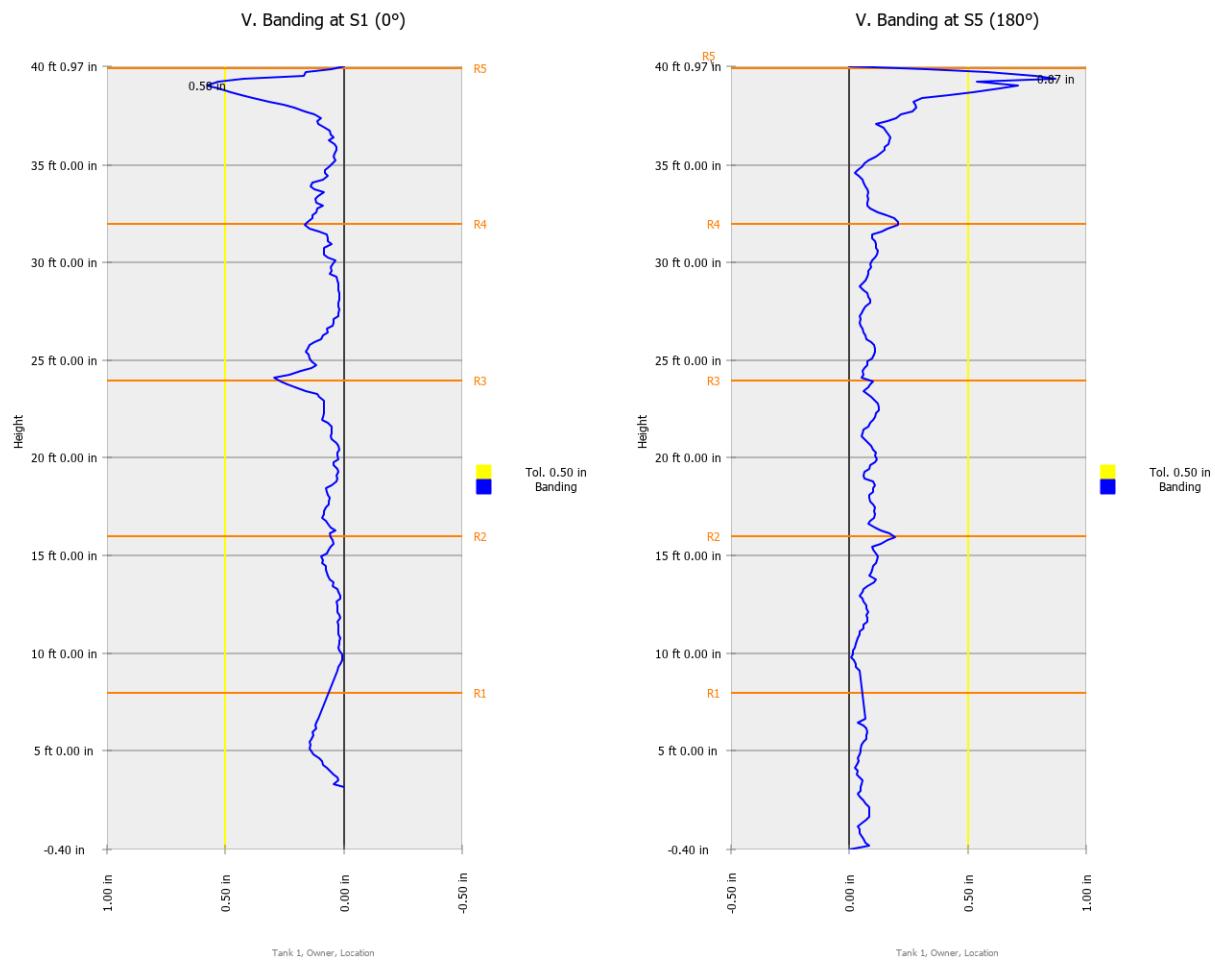
H. Peaking at 39 ft (R5 T-1ft)

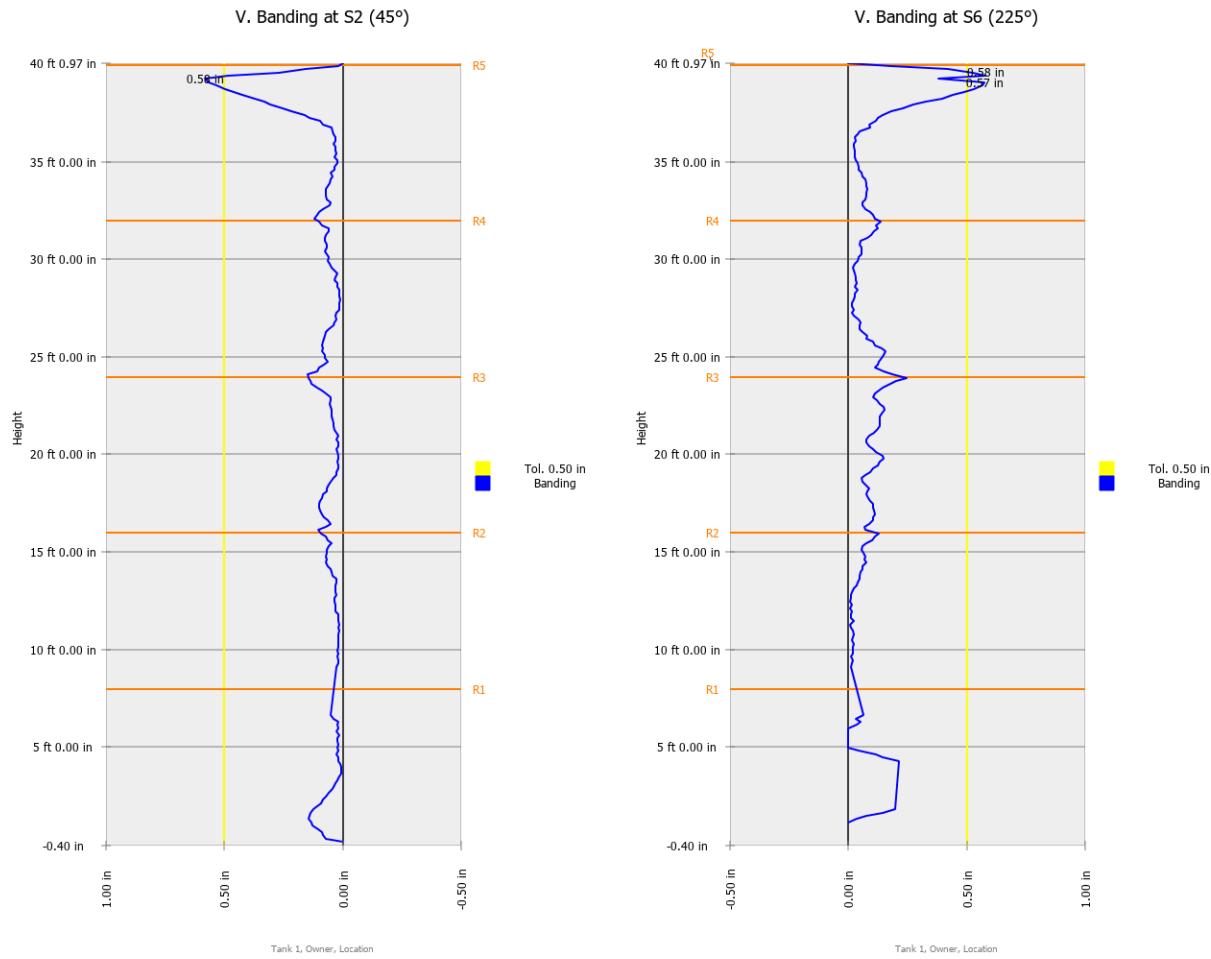


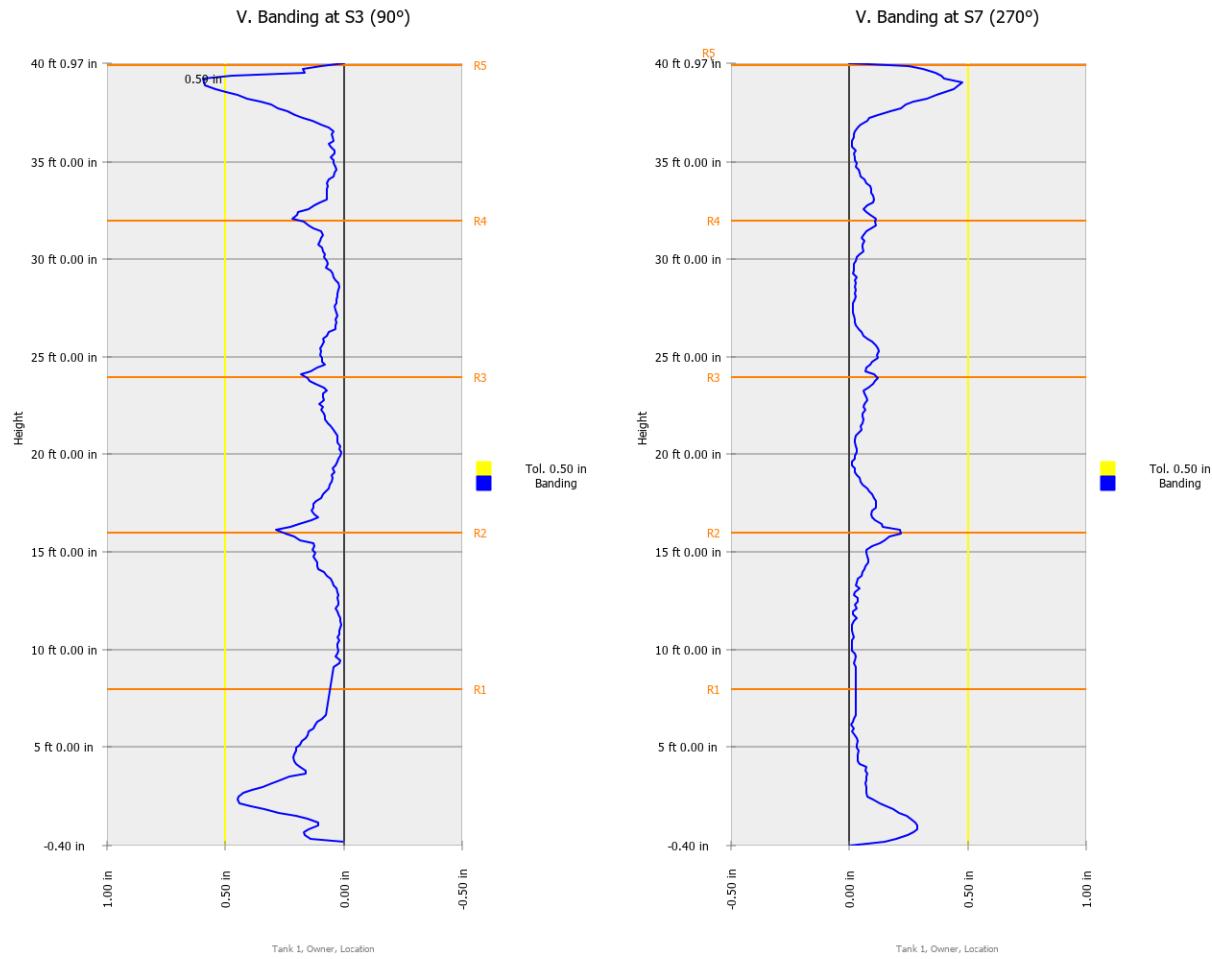
7 APPENDIX D: SHELL PEAKING AT WELDS

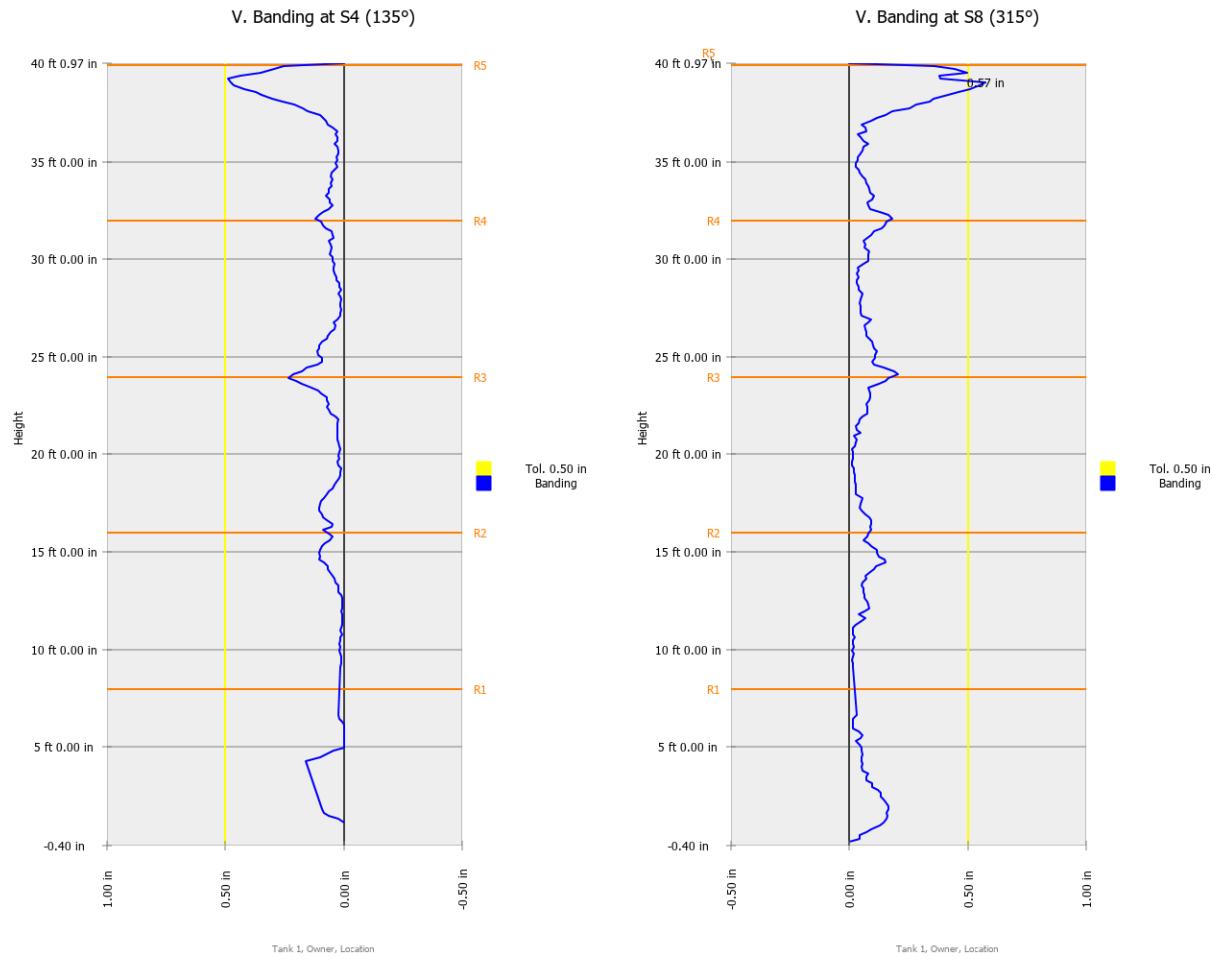


8 APPENDIX E: SHELL BANDING CROSS-SECTIONS

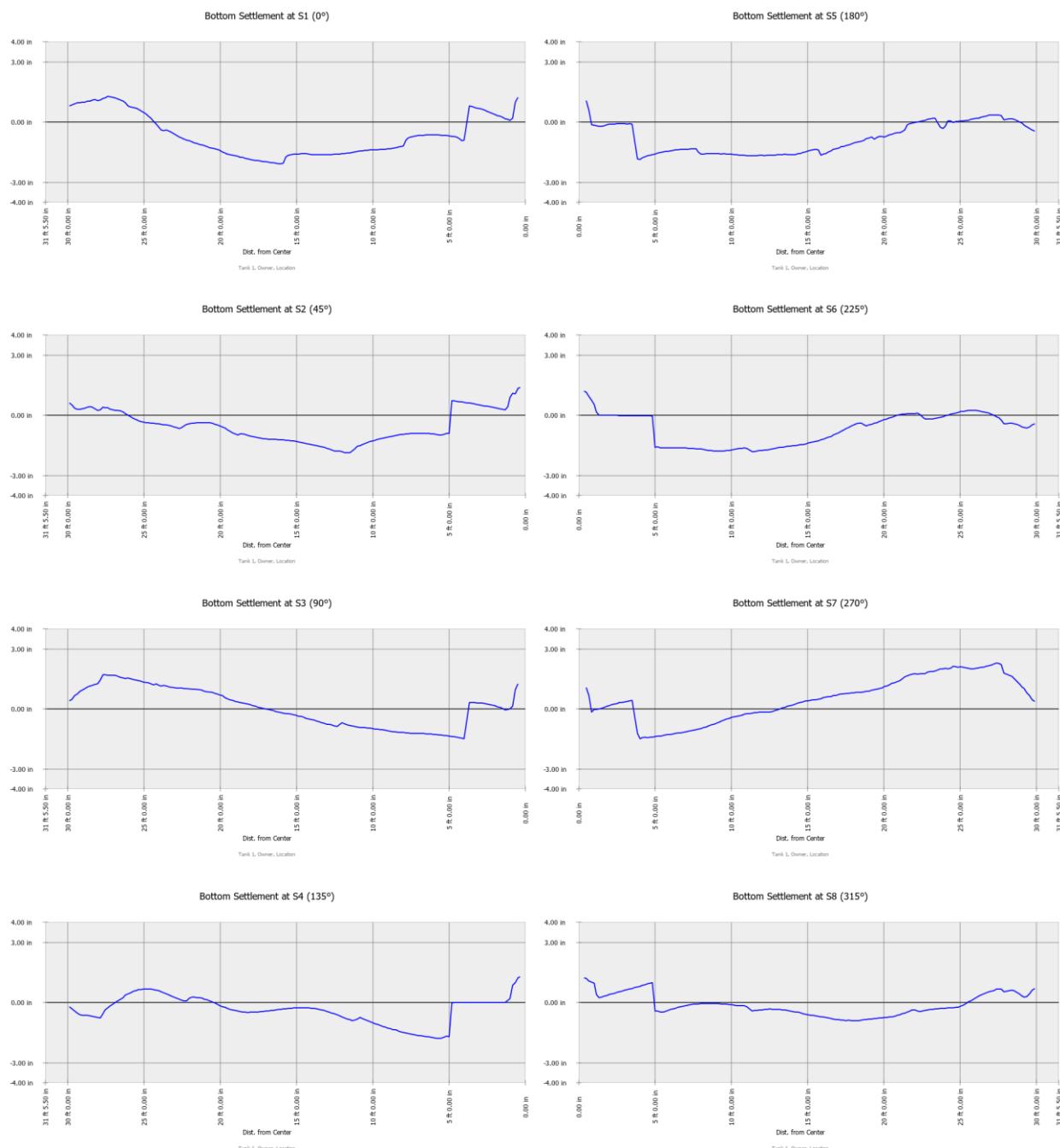




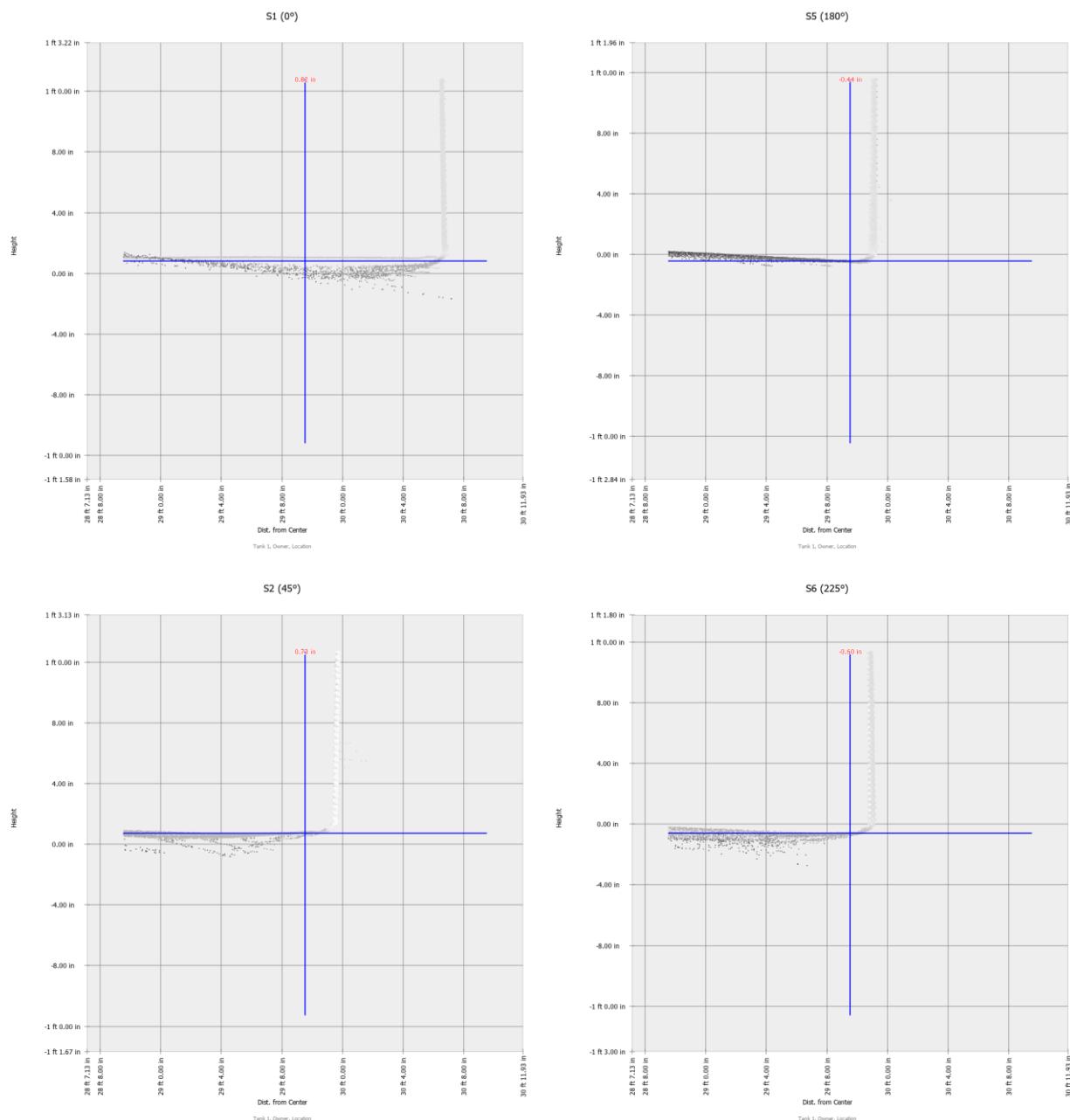


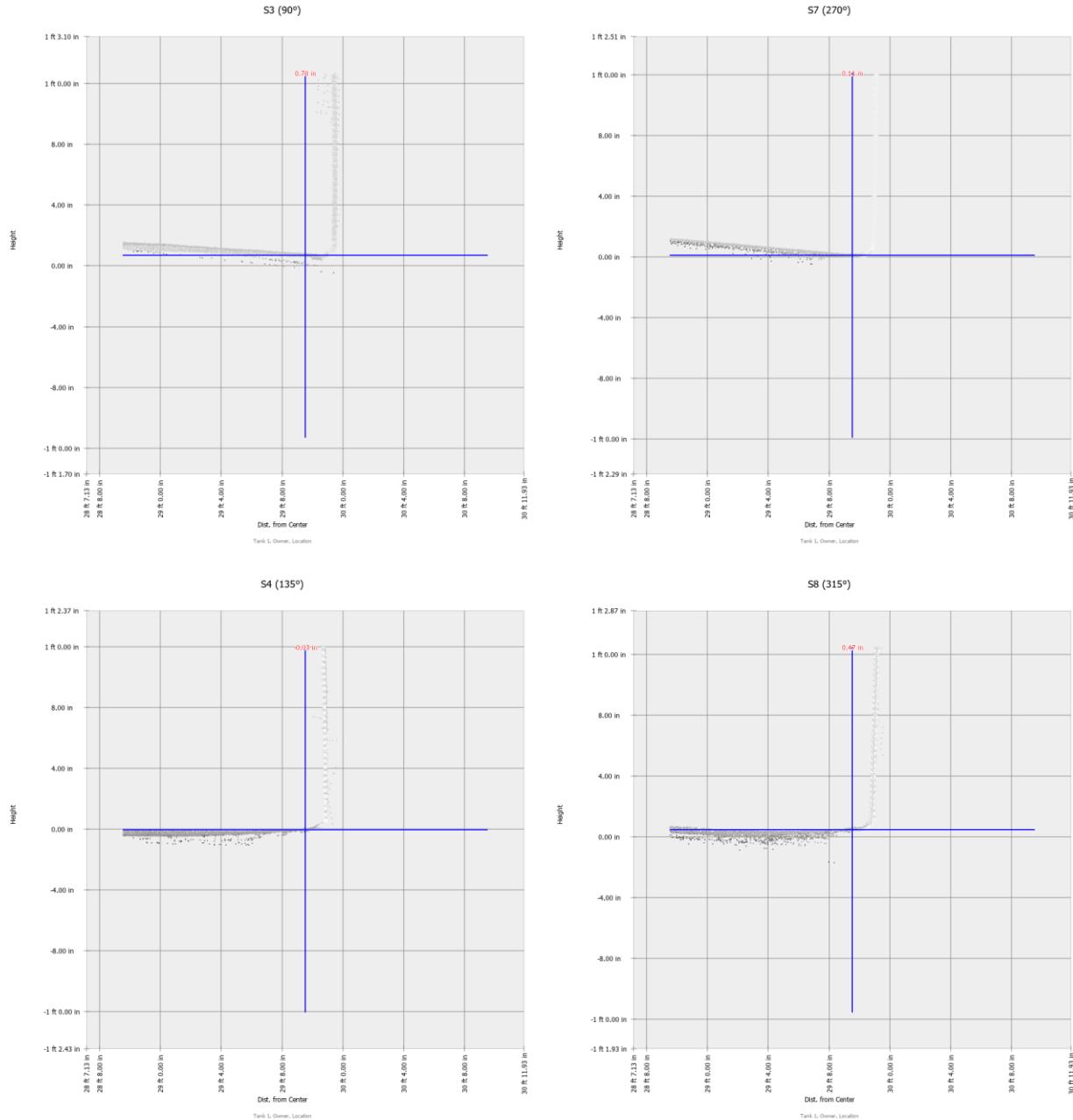


9 APPENDIX F: BOTTOM SETTLEMENT CROSS-SECTIONS

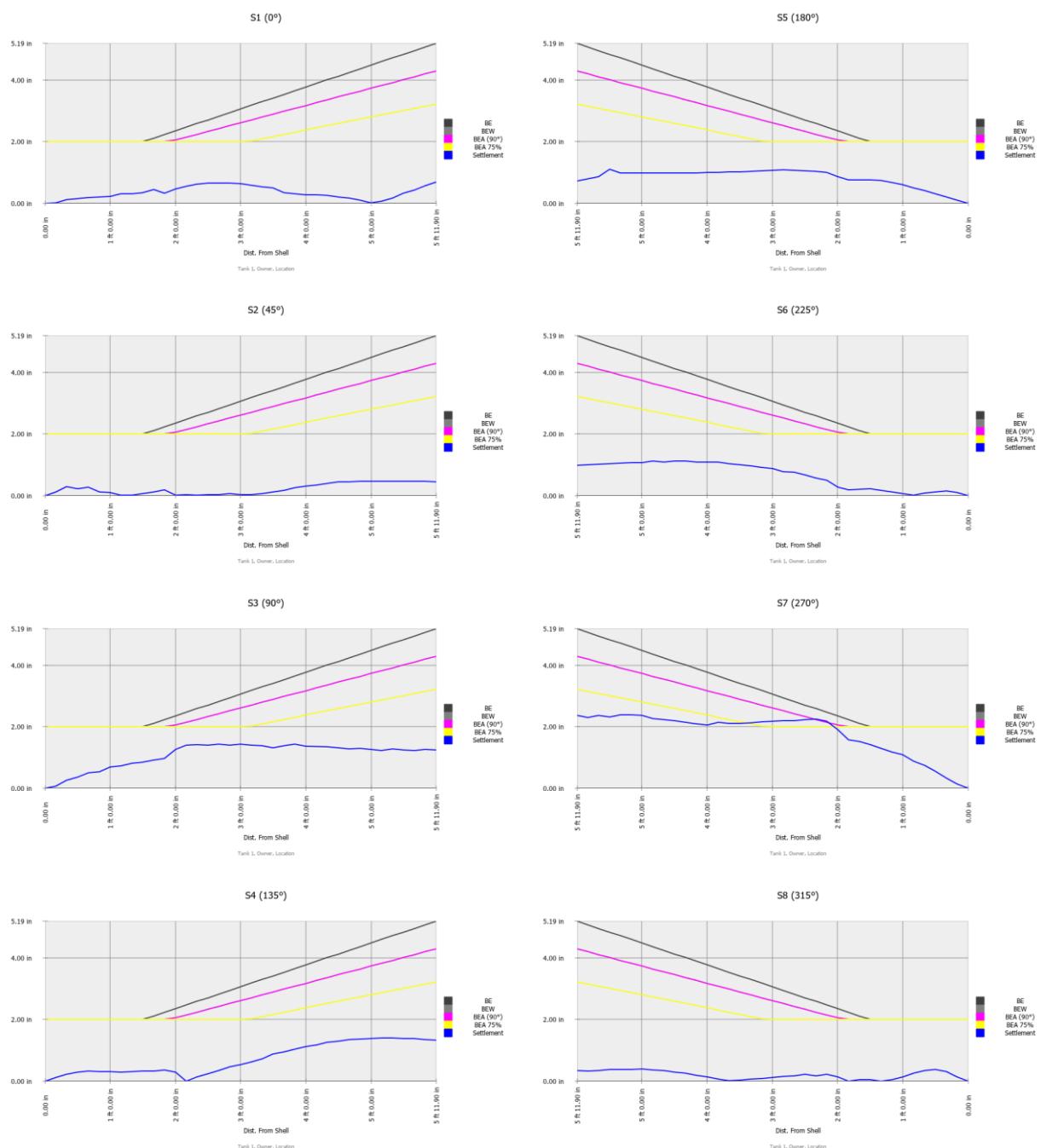


10 APPENDIX G: SHELL SETTLEMENT CROSS-SECTIONS

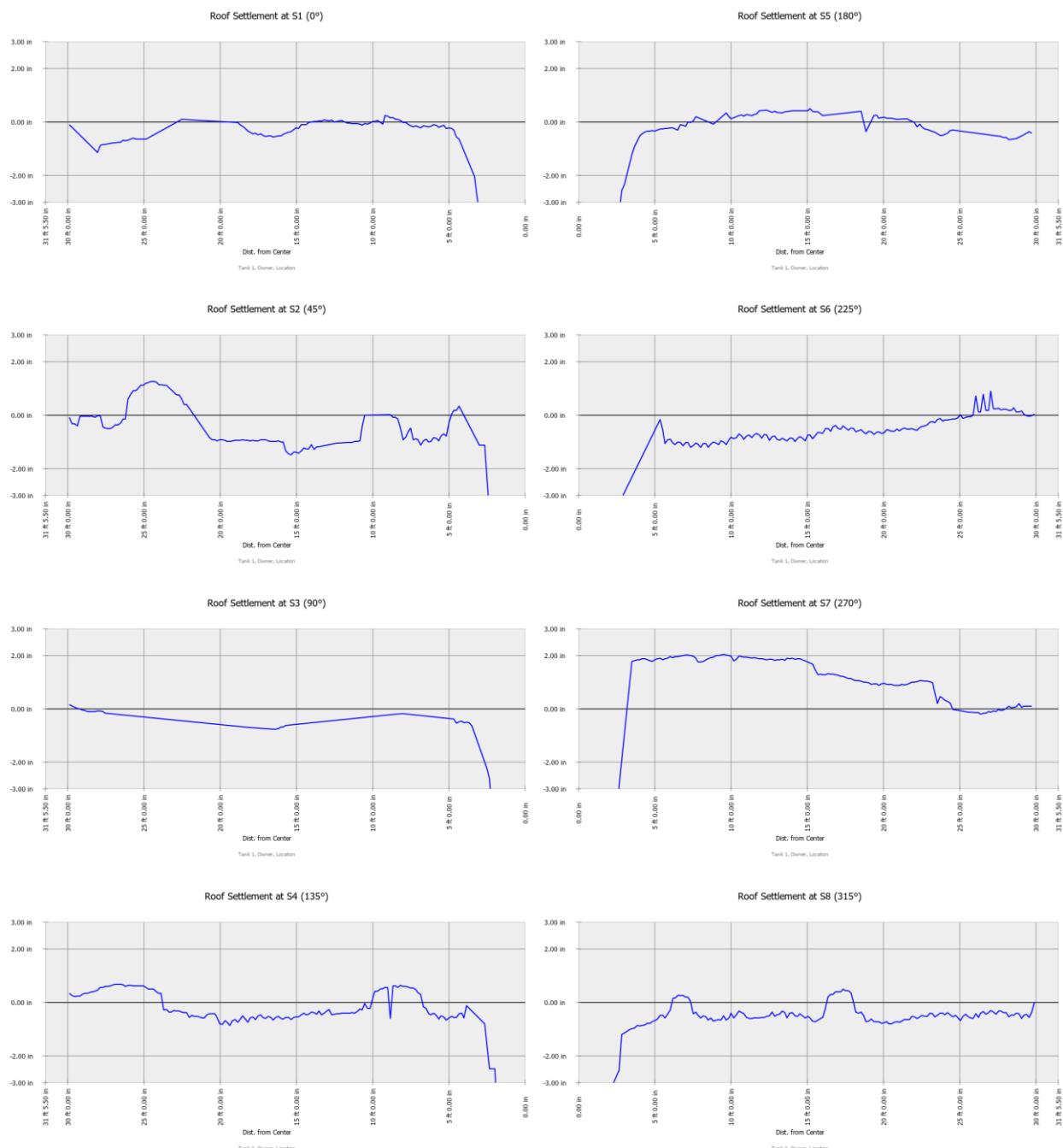




11 APPENDIX H: EDGE SETTLEMENT STATIONS

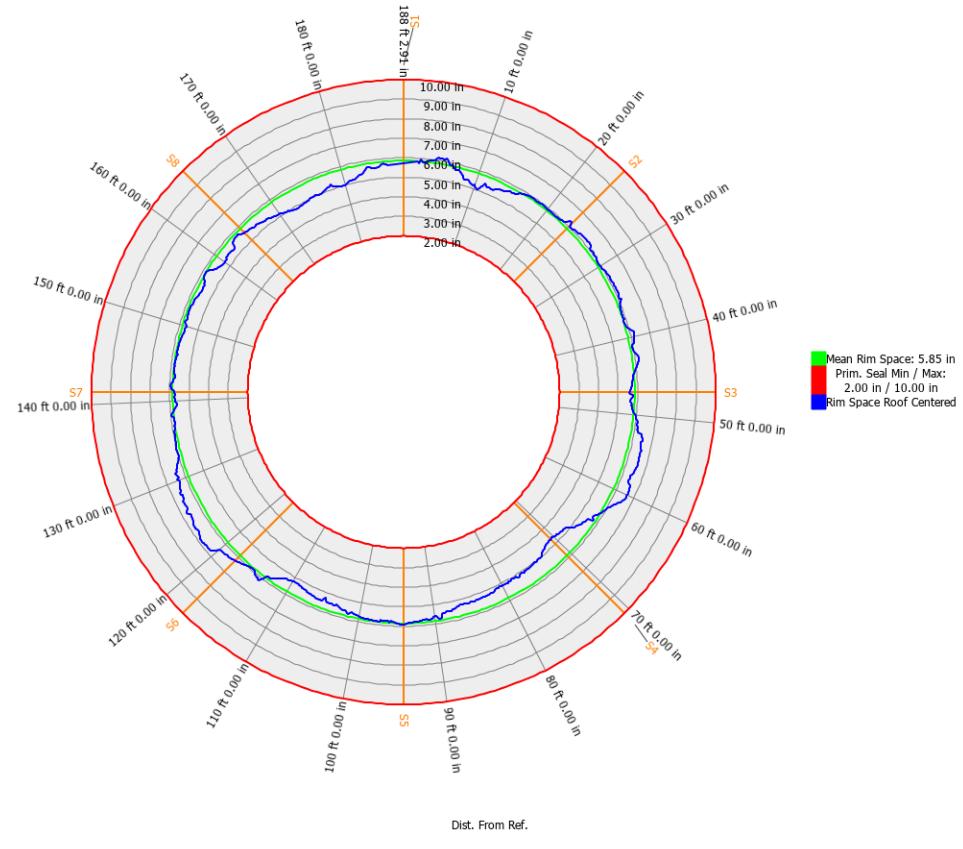


12 APPENDIX I: ROOF SETTLEMENT CROSS-SECTIONS

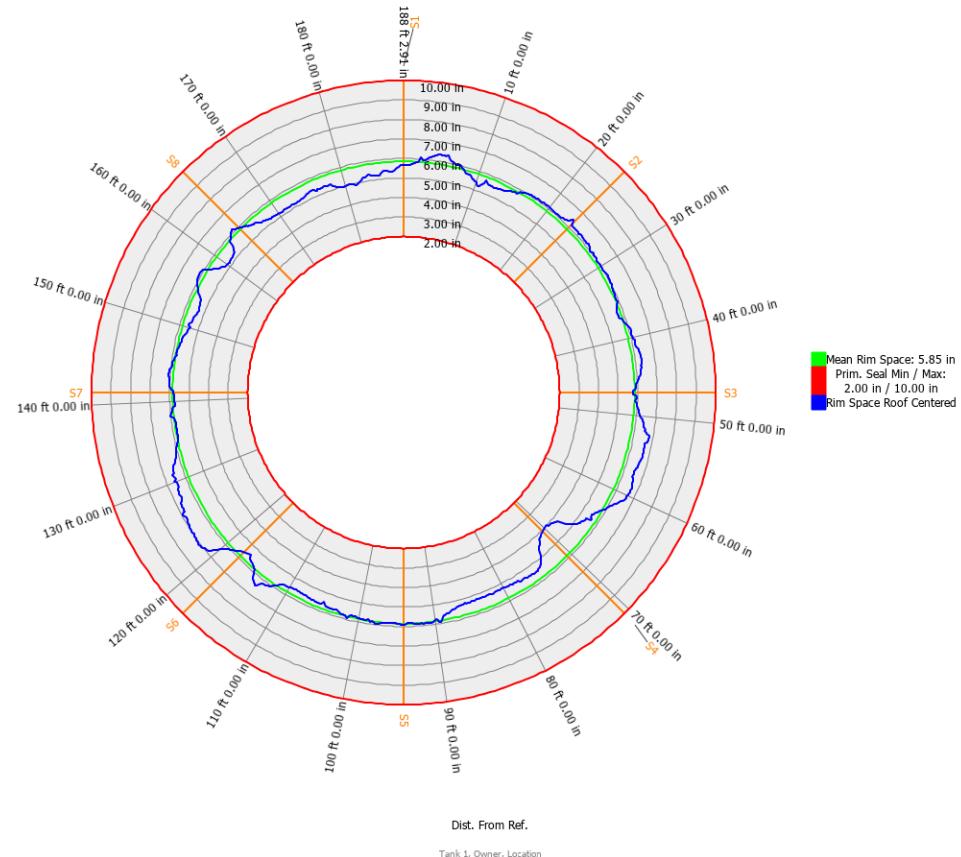


13 APPENDIX J: RIM SPACE ROOF CENTERED CROSS-SECTIONS

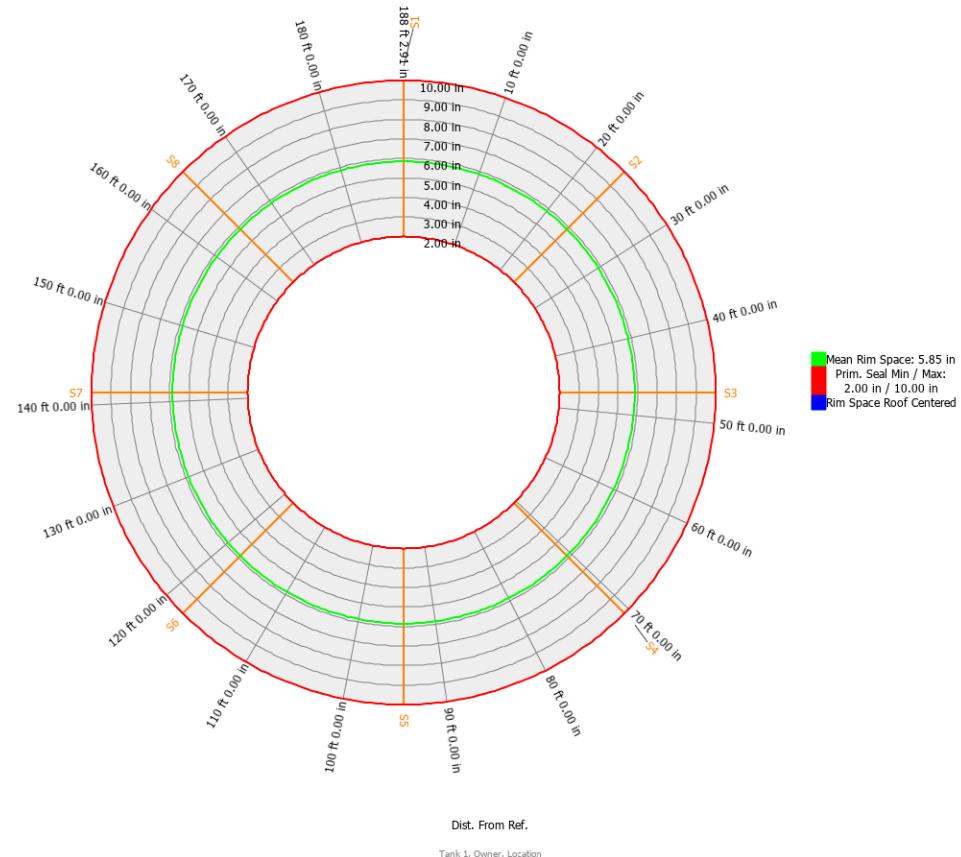
H. Rim Space Roof Centered at 1 ft (R1 B+1ft)



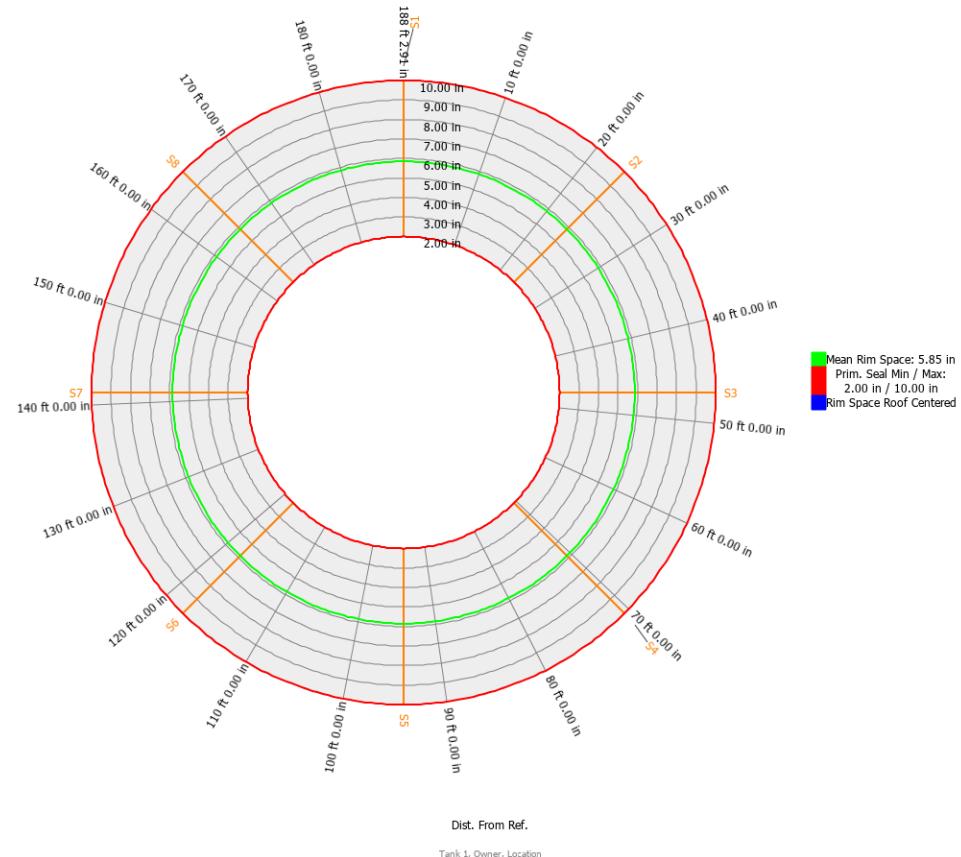
H. Rim Space Roof Centered at 4 ft (R1 50%)



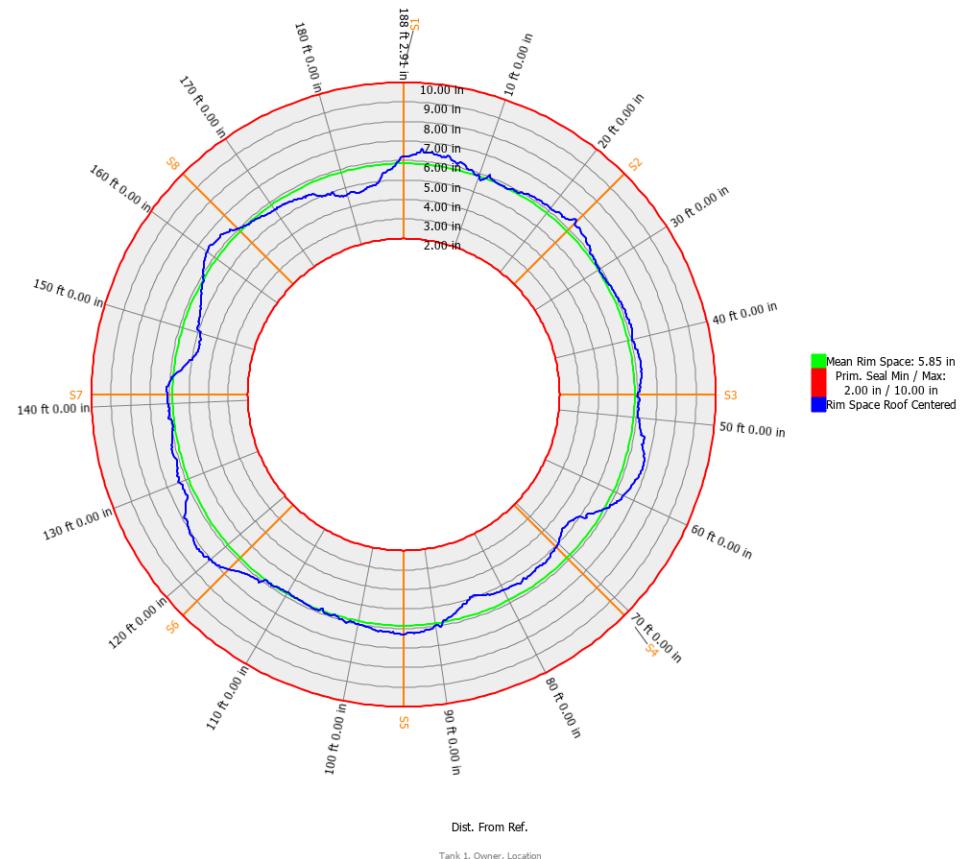
H. Rim Space Roof Centered at 7 ft (R1 T-1ft)



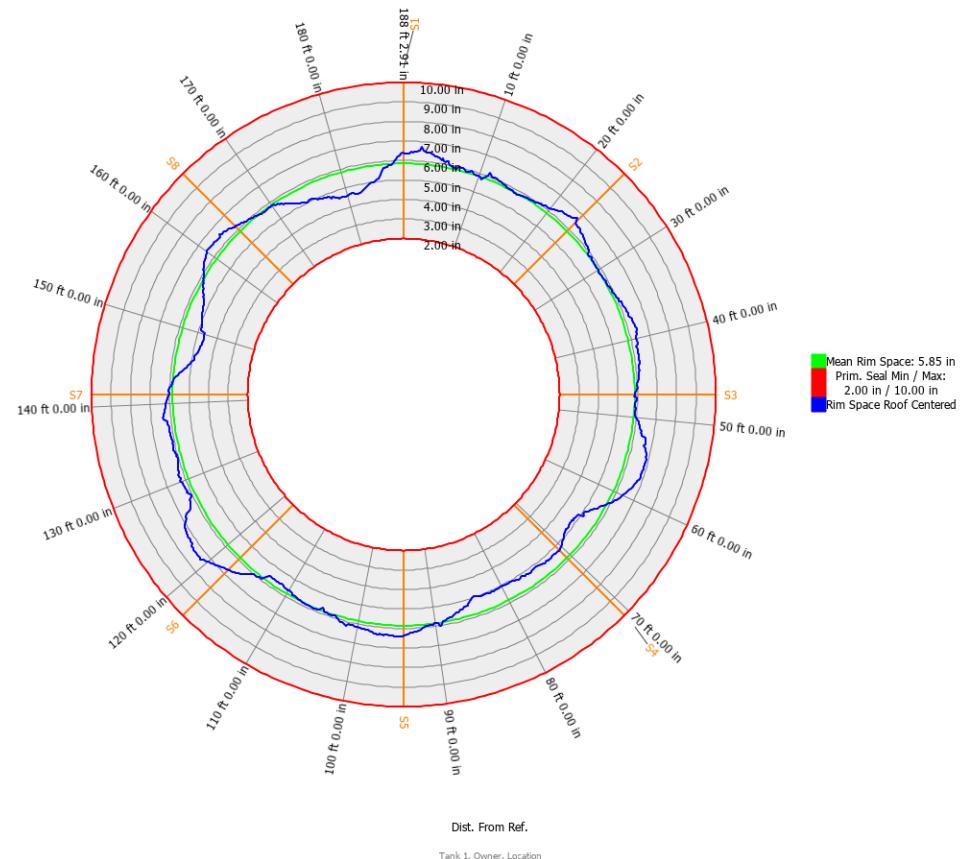
H. Rim Space Roof Centered at 9 ft (R2 B+1ft)



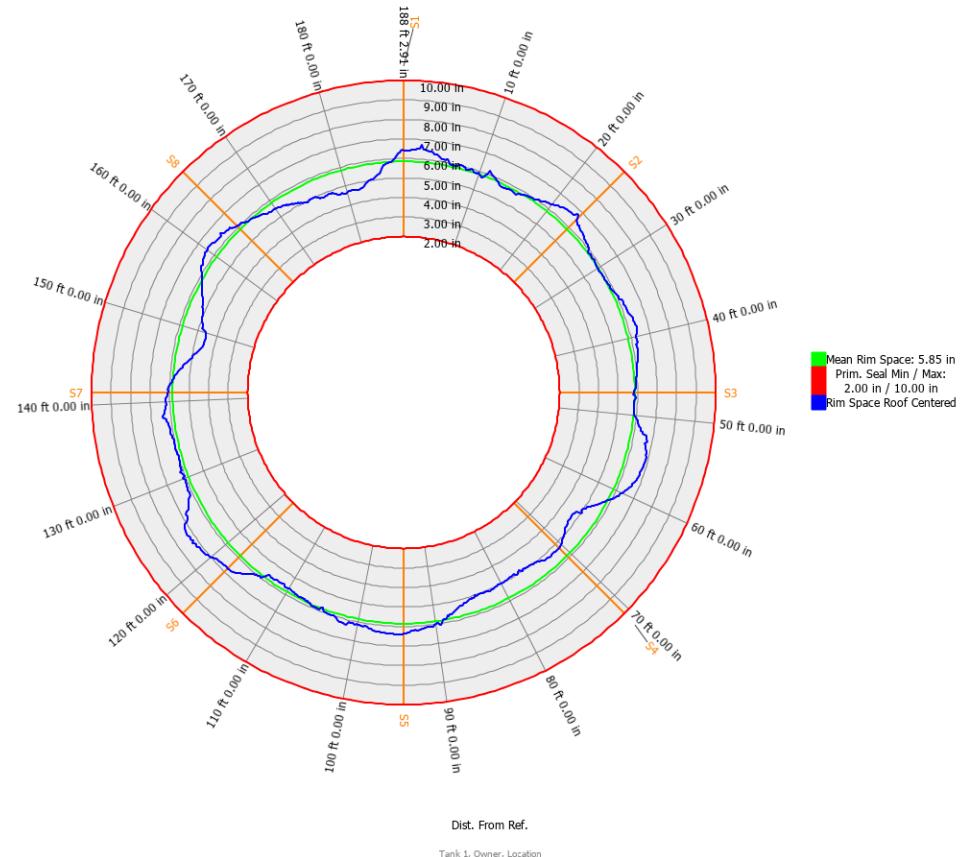
H. Rim Space Roof Centered at 12 ft (R2 50%)



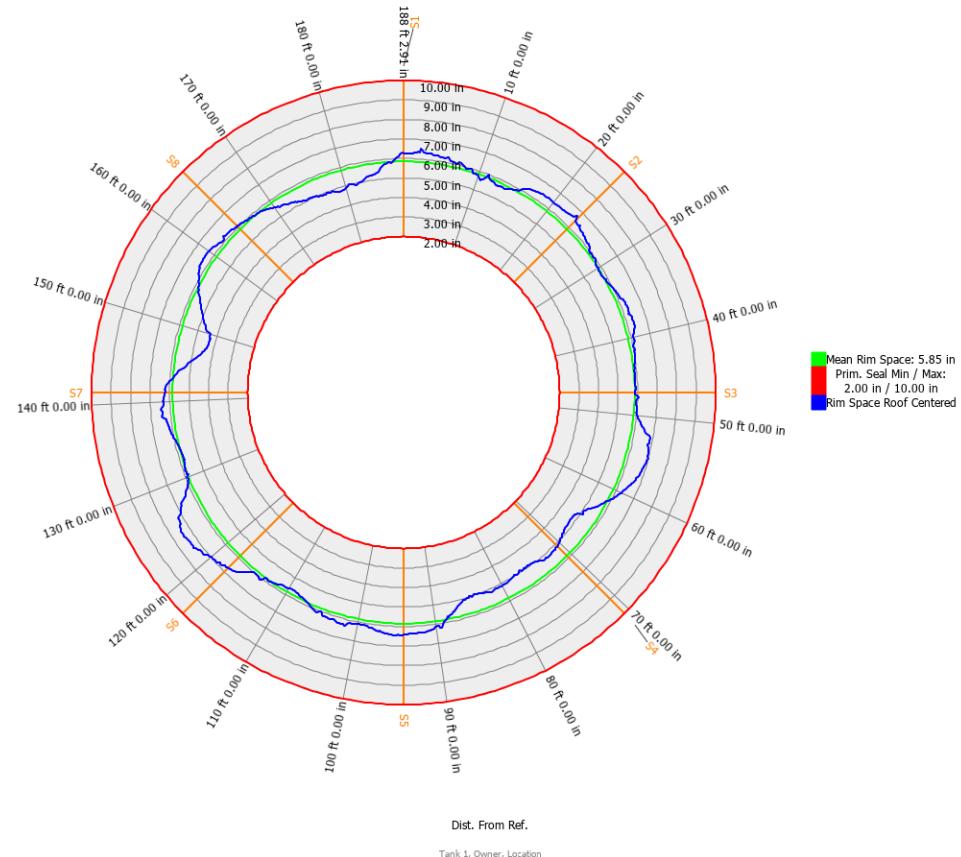
H. Rim Space Roof Centered at 15 ft (R2 T-1ft)



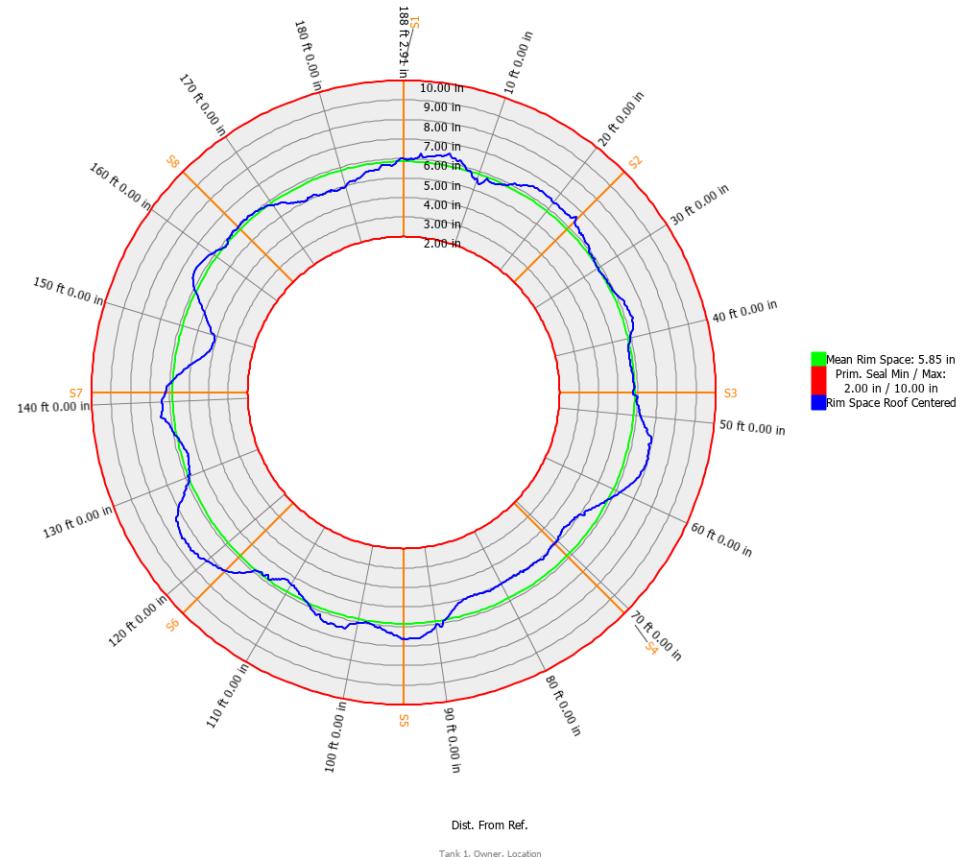
H. Rim Space Roof Centered at 17 ft (R3 B+1ft)



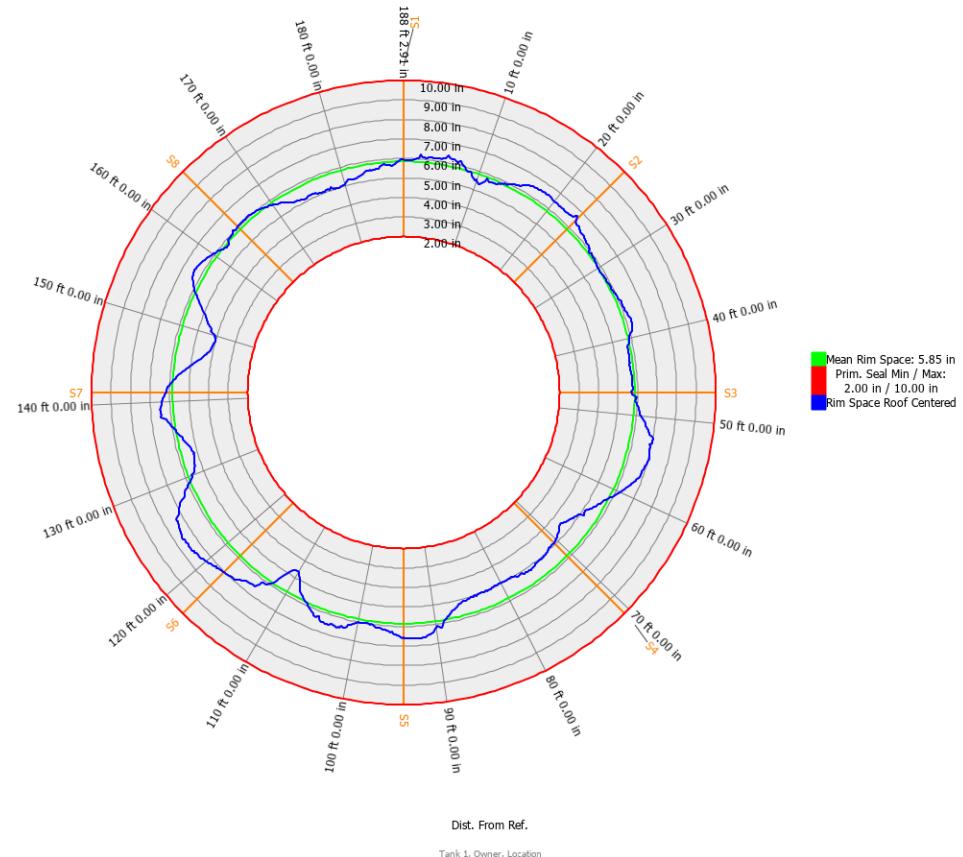
H. Rim Space Roof Centered at 20 ft (R3 50%)



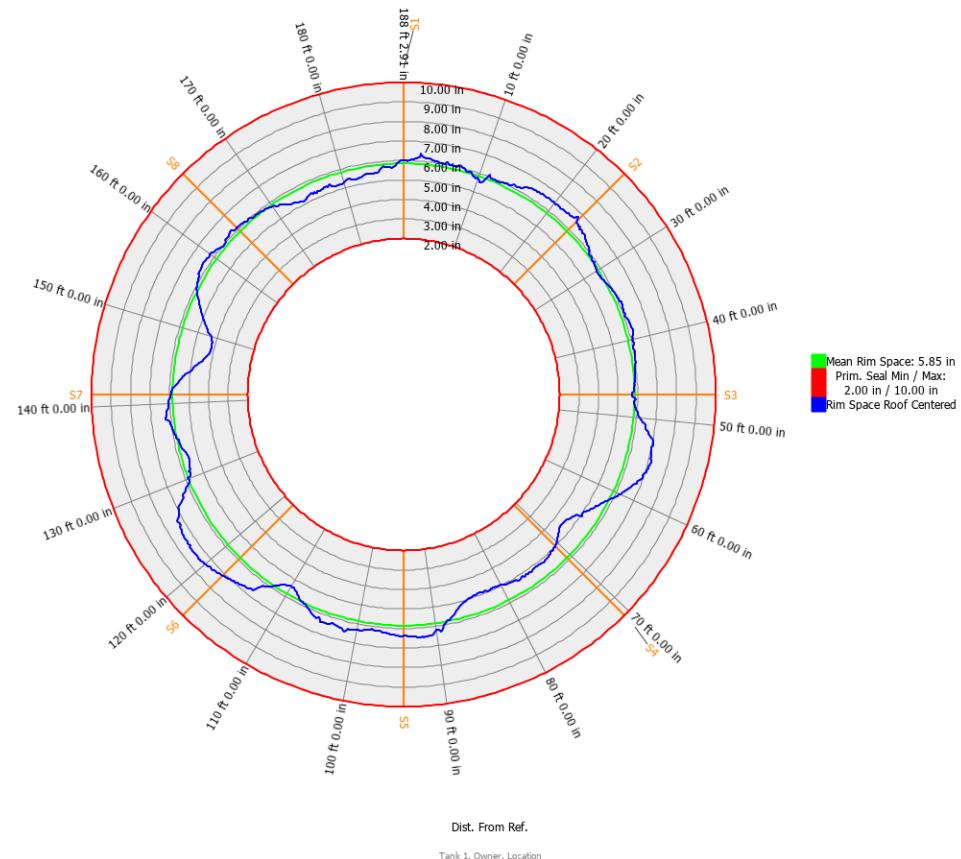
H. Rim Space Roof Centered at 23 ft (R3 T-1ft)



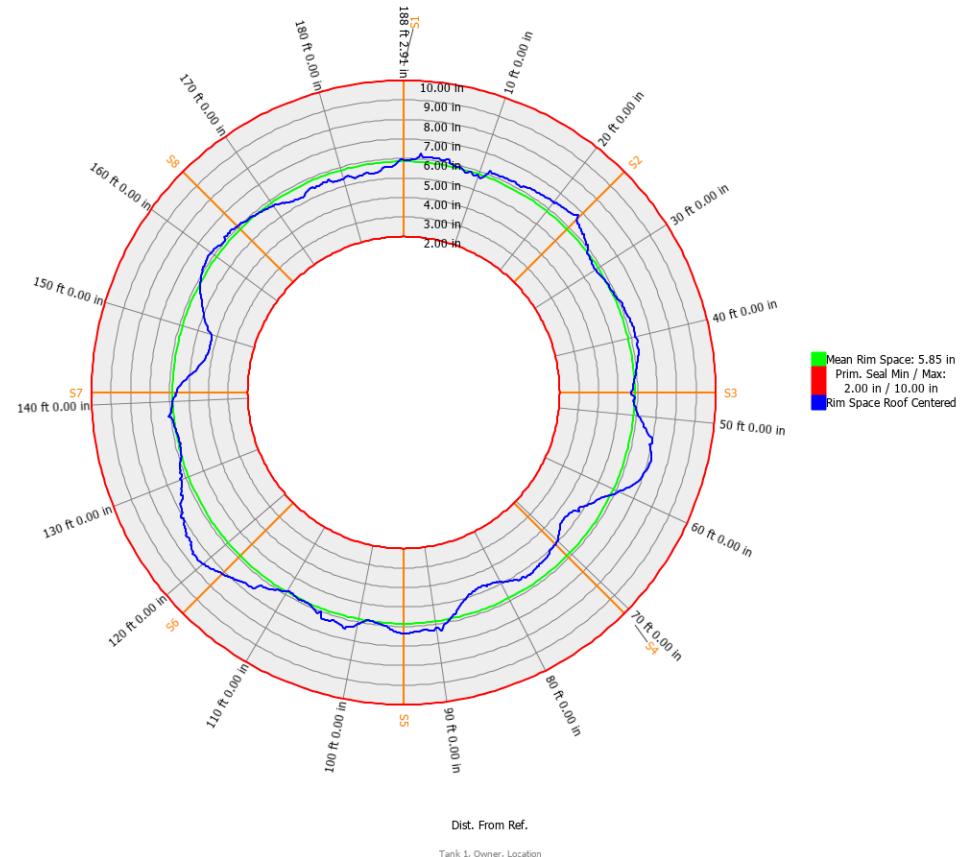
H. Rim Space Roof Centered at 25 ft (R4 B+1ft)



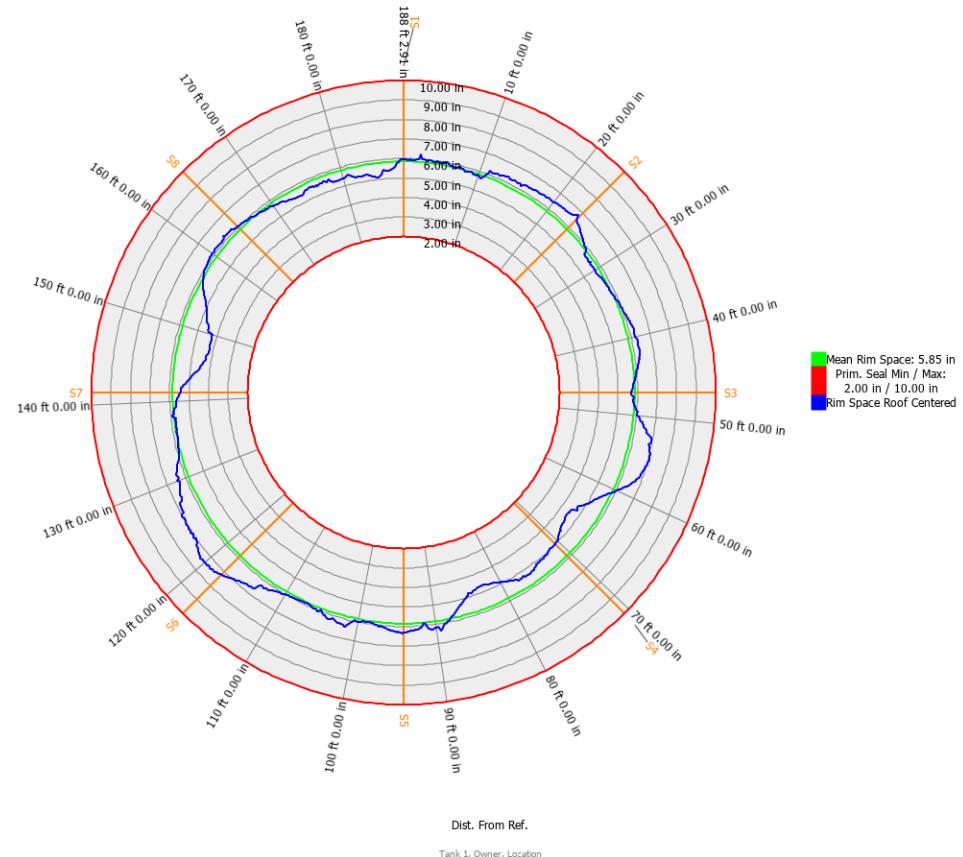
H. Rim Space Roof Centered at 28 ft (R4 50%)



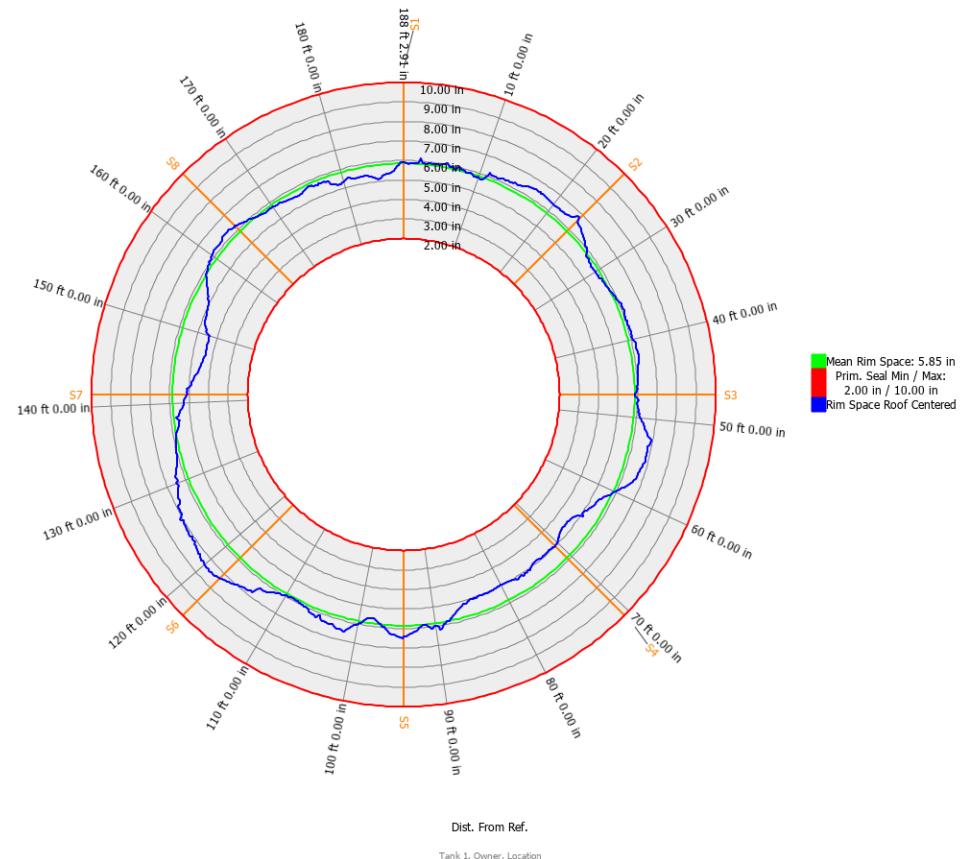
H. Rim Space Roof Centered at 31 ft (R4 T-1ft)



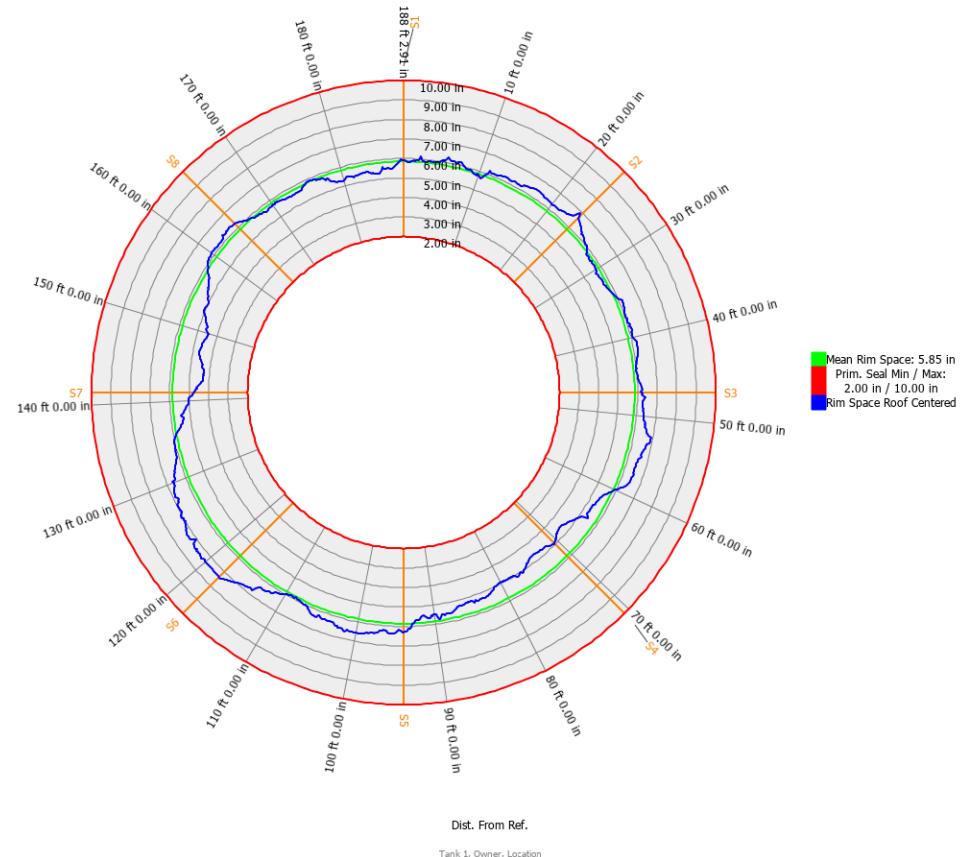
H. Rim Space Roof Centered at 33 ft (R5 B+1ft)



H. Rim Space Roof Centered at 36 ft (R5 50%)



H. Rim Space Roof Centered at 39 ft (R5 T-1ft)



14 APPENDIX K: COLUMNS

COLUMN-01 (Tol. 2.41 in)

