JONES EDMUNDS



December 19, 2008

Ms. Susan J. Pelz, P.E.
Florida Department of Environmental Protection
Southwest District
13051 North Telecom Parkway
Temple Terrace, Florida 33637-0926

RE: Effluent/Leachate Storage Tank Calculations and Drawings Submittal
Construction Permit No. 35435-015-SC/08,
Effluent/Leachate Storage Tank Construction
Southeast County Landfill, Hillsborough County, Florida
Jones Edmunds Project No.: 08449-030-02 Task 5200

Dear Ms. Pelz:

On behalf of the Hillsborough County Solid Waste Management Department (SWMD), Jones Edmunds has prepared this submittal as required in Permit No. 35435-015-SC/08, to satisfy Specific Condition No. Part B 4.b.3). This submittal provides signed and sealed calculations and drawings for the flat-bottom, self-supporting aluminum dome-roofed effluent/leachate storage tank, as provided by Tampa Tank, Inc.

Please call me at 813-258-0703 if you have any questions or require additional information.

Sincerely,

Jason Timmons, P.E.
Project Engineer

cc: Patricia Berry, SWMD
Larry Ruiz, SWMD
Megan Miller, SWMD

T:\08449 - Hillsborough\030-02 SCLF General Services\5000 - Leachate Storage Tank ERP\5200 - Effluent_Leachate Storage Tank Construction Services\3150 CORR\OUT\DEP\FDEP Tank Calcs Submittal_12_19_08.doc

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# Flat-Bottom, Self-Supporting Aluminum Dome-Roof Tank Calculations Designed in accordance with API STD 650

| | |
|---|---|
| Job Number: | 5350 |
| Tank Diameter: | 70 feet |
| Tank Height: | 20 feet |
| Service: | Effluent/Leachate Tank |
| Location: | Woodruff and Sons, Inc.<br>SE County Landfill<br>Lithia, Florida |
| **Revision: 1** | **(10 / 17 / 08 - For Record)** |



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## *Design Criteria* - *API STD 650, 11th Edition, with applicable Appendices*

The scope of API STD 650 is limited to tanks, whose bottoms are entirely and unifomly supported, designed to store liquids at approximately atmospheric pressure and at design temperatures not greater than 200°F. Appendix F provides rules for the design of tanks with internal pressures up to 2.5 psi. Appendix V provides rules for the design of tanks with external pressures up to 1.0 psi. Appendix M provides rules for the design of tanks at design temperatures not greater than 500°F. These calculations do not include any provisions for the design of tanks outside the scope of API STD 650. Tanks outside the scope of API STD 650,should be designed in accordance with a different design code.

## *Site Specific Data*

| | | |
|---|---|---|
| Site Location: | SE County Landfill<br>Lithia, Florida | |
| Seismic Site Data:<br>(From USGS website) | Peak Ground Acceleration: | $S_P := 3.1\%$ |
| | 0.2s Spectral Response Acceleration: | $S_S := 7.8\%$ |
| | 1.0s Spectral Response Acceleration: | $S_1 := 3.1\%$ |
| | Transition Period:<br>(for longer period ground motion) | $T_L := 8sec$ |
| | Seismic Site Class: | SiteClass := "D" |
| Wind Design Data: | Basic Wind Speed: | $V_{wind} := 120mph$ |
| | Exposure Category: | Exposure := "C" |
| Snow Load: | Ground Snow Load: | $S_{ground} := 0psf$ |
| Minimum One-Day Mean Temperature:<br>(From API STD 650, Figure 4-2) | | M1DT := 35°F |

## *Tank Specific Data*

**Product Stored:** Product := "Effluent/Leachate"  Design Specific Gravity: $G_P := 1.00$

**Design Internal Pressure:** $P_{int} := 0inH2O$  $P_{test} := 1.25 \cdot P_{int}$  $P_{test} = 0 \cdot inH2O$

**Design External Pressure:** $P_{ext} := 1inH2O$

**Maximum Design Temperature:** $T_{max} := 200°F$

**Minimum Design Metal Temperature:** MDMT := M1DT + 15°F  MDMT = 50·°F

**Seismic Tank Data:**

Seismic Use Group: SUG := 1

Seismic Importance Factor: $I_E := \begin{cases} 1.0 & \text{if } SUG = 1 \\ 1.25 & \text{if } SUG = 2 \\ 1.50 & \text{otherwise} \end{cases}$  $I_E = 1$

**Wind Design Data:**

Wind Importance Factor: $I_W := 1.15$

**Roof Loads:**

Roof Type: RoofType := "SELF-SUPPORTING ALUMINUM DOME"

Roof Live Load: $LL_{rf} := 20psf$

Roof Snow Load: $SL_{rf} := 0.84 \cdot (S_{ground})$  $SL_{rf} = 0 \cdot psf$

Superimposed Roof Dead Load: (from insulation, etc.) $SDL_{rf} := 0psf$

**Corrosion Allowance:** Unless noted otherwise the corrosion allowance will be applied to the interior surface of the bottom, shell plates and nozzles, and roof plates only.

$CA_{bt} := \frac{1}{16} in$

$CA_{sh} := \frac{1}{16} in$

$CA_{rf} := 0in$

**Assumed Anchorage Type:** (check status at end page)

Tank_Is_ASSUMED_to_be_Self_Anchored := "TRUE"

Tank_Is_Self_Anchored := Tank_Is_ASSUMED_to_be_Self_Anchored

*Tank Shell Design*

Nominal Shell Diameter: $D_{nom} := 70ft + 0in$

Shell_Plates_are := "Flush-Stacked Inside"

Nominal Shell Height: Height := 20ft

Select Rim Angle based on API STD 650, 5.1.5.9.e:

$$RimAngle := \begin{cases} \text{"L2x2x3/16"} & \text{if } D_{nom} \le 35ft \\ \text{"L2x2x1/4"} & \text{if } 35ft < D_{nom} \le 60ft \\ \text{"L3x3x3/8"} & \text{otherwise} \end{cases}$$

USE ==>> RimAngle := "None" <<== USE

Height of Rim Angle: $h_{rim} = 0 \cdot in$

Rim Angle Section Properties: $A_{rim} = 0 \cdot in^2$ $x_{rim} = 0 \cdot in$

$t_{rim} = 0 \cdot in$ $y_{rim} = 0 \cdot in$

Rim Angle Diameter:

$$D_{rim} := \begin{cases} D_{nom} + 2 \cdot x_{rim} & \text{if Shell\_Plates\_are = "Flush-Stacked Inside"} \\ D_{nom} + 2 \cdot x_{rim} - t_{rim} & \text{if Shell\_Plates\_are = "Centerline-Stacked"} \\ D_{nom} + 2 \cdot (x_{rim} - t_{rim}) & \text{if Shell\_Plates\_are = "Flush-Stacked Outside"} \end{cases}$$

$D_{rim} = 70 \cdot ft$

Rim Angle Weight: $DL_{rim} := \pi \cdot D_{rim} \cdot A_{rim} \cdot \gamma_s$ $DL_{rim} = 0 \cdot lbf$

Shell Courses: Number of Shell Courses: $n_{sh} := 2$

Thicknesses Overrides
(0 in. indicates no override)

Top Shell Course: $h_1 := 120in$ $t_1 := 0in$

Bottom Shell Course $h_2 := 120in$ $t_2 := 0in$

Shell Height:
(including Rim Angle)

$$H_{sh} := \sum_{i=1}^{n_{sh}} h_i + h_{rim}$$

$H_{sh} = 20 \cdot ft$

$H_{sh} = 240 \cdot in$

Minimum Shell Plate Thickness:
(per 5.6.1.1)

$$t_{min} := \begin{cases} 0.1875in & \text{if } D_{nom} < 50ft \\ 0.25in & \text{if } 50ft \le D_{nom} < 120ft \\ 0.3125in & \text{if } 120ft \le D_{nom} \le 200ft \\ 0.375in & \text{if } 200ft < D_{nom} \end{cases}$$

$t_{min} = 0.25 \cdot in$

## *Tank Bottom Design*

Minimum Thickness per 5.4.1: $t_{bt.min} := \frac{1}{4} in + CA_{bt}$

Bottom Plate Thickness: $t_{bt} := t_{bt.min}$ $t_{bt} = 0.313 \cdot in$

Bottom Plate Yield Strength: $Fy_{bt} := 36000psi$

Is there an Annular Plate?: Tank_Has_Annular_Plate := "FALSE"

Annular Plate Thickness: $t_{annpl} := \frac{5}{16} in$

Annular Plate Yield Strength: $Fy_{annpl} := 36000psi$

Bottom Configuration: Bottom_Is := "Cone Down"

Bottom Slope:

$$Slope_{bt} := \begin{cases} \frac{1in}{10ft} & \text{if Bottom\_Is = "Crown Up"} \\ 0 & \text{if Bottom\_Is = "Flat"} \\ \frac{-1in}{10ft} & \text{if Bottom\_Is = "Cone Down"} \end{cases}$$

$Slope_{bt} = -1 \cdot \frac{in}{10ft}$

Height of Bottom Slope: $H_{bt.slope} := \frac{D_{nom}}{2} \cdot Slope_{bt}$ $H_{bt.slope} = -3.5 \cdot in$

*Self-Supporting Aluminum Dome Roof Design per Appendix G*   $D_{rf} := D_{nom}$   $D_{rf} = 70 \cdot ft$

Roof Gravity Loads:

$$LL_{design} := \max\left[\left(\max\left(LL_{rf}, SL_{rf}\right) + 0.4 \cdot P_{ext}\right), \left(P_{ext} + 0.4 \cdot \max\left(LL_{rf}, SL_{rf}\right)\right)\right]$$   $LL_{design} = 22.08 \cdot psf$

Roof Design:   Roof_Design_is := "by Dome Roof Manufacturer"

## *Tank Nominal Capacity*

Product Height:

Freeboard Height: $H_{frbd} := 1.375in$

Overfill Protection Height: $H_{ofp} := 6in$

Minimum Fill Level: $H_{min} := 6in$

Design Product Height: $H_P := H_{sh} - H_{frbd}$ $\quad H_P = 19.885 \cdot ft$

Maximum Capacity:

Capacity at Design Liquid Level: $V_{max} := \left(\frac{\pi}{4}\right) \cdot D_{nom}^{2} \cdot \left(H_P - \frac{H_{bt.slope}}{3}\right)$

$V_{max} = 76.902 \times 10^{3} \cdot ft^{3}$ $\quad V_{max} = 575.268 \times 10^{3} \cdot gal$

Minimum Operating Volume:

$$V_{min} := \begin{cases} \left(\frac{\pi}{4}\right) \cdot D_{nom}^{2} \cdot \left(H_{min} - \frac{H_{bt.slope}}{3}\right) & \text{if } H_{min} \ge H_{bt.slope} \\ \left(\frac{\pi}{4}\right) \cdot D_{nom}^{2} \cdot \left(H_{min} - \frac{H_{bt.slope}}{3}\right) - \frac{\pi}{6} \cdot \frac{\left(H_{bt.slope} - H_{min}\right)^{3}}{Slope_{bt}^{2}} & \text{otherwise} \end{cases}$$

$V_{min} = 2.298 \times 10^{3} \cdot ft^{3}$ $\quad V_{min} = 17.193 \times 10^{3} \cdot gal$

Overfill Protection Volume:

$V_{ofp} := \left(\frac{\pi}{4}\right) \cdot D_{nom}^{2} \cdot H_{ofp}$

$V_{ofp} = 1.924 \times 10^{3} \cdot ft^{3}$ $\quad V_{ofp} = 14.394 \times 10^{3} \cdot gal$

Net Working Capacity:

$V_{net} := V_{max} - V_{ofp} - V_{min}$

$V_{net} = 72.680 \times 10^{3} \cdot ft^{3}$ $\quad V_{net} = 543.681 \times 10^{3} \cdot gal$

Nominal Weight of Product:

$W_P := V_{max} \cdot G_P \cdot \gamma_w$ $\quad W_P = 4.799 \times 10^{6} \cdot lbf$

*Tank Shell Plate Design (Top Shell Course)* $i := 1$

Material Specification: (ASTM - UON) $PL\_spec_i :=$ "Appendix A (E=0.70)"

Mechanical Properties:

Specified Yield Strength: $Fy_i := FY(PL\_spec_i)$ $Fy_i = 31500 \cdot psi$

Design Yield Strength: $Fy_{dsn_i} := FY_{Mod}(PL\_spec_i)$ $Fy_{dsn_i} = 31500 \cdot psi$

Specified Tensile Strength: $Fu_i := FU(PL\_spec_i)$ $Fu_i = 55000 \cdot psi$

Allowable Tensile Stress:

Specified Allowable Stress: (per Table 5-2) $Sd(PL\_spec_i) = 21000 \cdot psi$

Design Allowable Stress: (per Appendix M) $S_{d_i} := \min\left(\frac{2}{3} \cdot Fy_{dsn_i}, Sd(PL\_spec_i)\right)$ $S_{d_i} = 21000 \cdot psi$

Testing Allowable Stress: (per Table 5-2) $S_{t_i} := St(PL\_spec_i)$ $S_{t_i} = 21000 \cdot psi$

Joint Efficiency: $JE_i := 0.70$

Liquid Height:

$$h_{p_i} := H_P - \sum_{j=i+1}^{n_{sh}} h_j \qquad h_{p_i} = 9.885 \cdot ft$$

Design Required Thickness: (incl. corrosion allowance)

$$t_{d_i} := \frac{2.6\left(\frac{h_{p_i} + \frac{P_{int}}{\gamma_w \cdot G_P}}{ft} - 1\right) \cdot \left(\frac{D_{nom}}{ft}\right) \cdot G_P}{\left(\frac{S_{d_i}}{psi}\right) \cdot JE_i} \cdot in + CA_{sh} \qquad t_{d_i} = 0.173 \cdot in$$

Testing Required Thickness:

$$t_{t_i} := \frac{2.6\left(\frac{h_{p_i} + \frac{P_{test}}{\gamma_w}}{ft} - 1\right) \cdot \left(\frac{D_{nom}}{ft}\right)}{\left(\frac{S_{t_i}}{psi}\right) \cdot JE_i} \cdot in \qquad t_{t_i} = 0.11 \cdot in$$

Nominal Thickness Used:

$$t_i := \frac{ceil\left(\max\left(\frac{t_{d_i}}{in}, \frac{t_{t_i}}{in}, \frac{t_{min}}{in}, \frac{t_i}{in}\right) \cdot 16\right)}{16} in \qquad t_i = 0.25 \cdot in$$

Check maximum thickness for material specified: $t_{max}(PL\_spec_i) = 0.5 \cdot in$

$(t_i \le t_{max}(PL\_spec_i)) = 1$ 1 = TRUE, ==>> OK

*<u>Tank Shell Plate Design</u> (Bottom Shell Course)* $i := n_{sh}$ $i = 2$

Material Specification: (ASTM - UON) $PL\_spec_i :=$ "Appendix A (E=0.70)"

**Mechanical Properties:**

| | | | |
|---|---|---|---|
| Specified Yield Strength: | $Fy_i := FY(PL\_spec_i)$ | $Fy_i = 31500 \cdot psi$ |
| Design Yield Strength: | $Fy_{dsn_i} := FY_{Mod}(PL\_spec_i)$ | $Fy_{dsn_i} = 31500 \cdot psi$ |
| Specified Tensile Strength: | $Fu_i := FU(PL\_spec_i)$ | $Fu_i = 55000 \cdot psi$ |

**Allowable Tensile Stress:**

| | | |
|---|---|---|
| Specified Allowable Stress: (per Table 5-2) | $Sd(PL\_spec_i) = 21000 \cdot psi$ | |
| Design Allowable Stress: (per Appendix M) | $S_{d_i} := \min\left(\frac{2}{3} \cdot Fy_{dsn_i}, Sd(PL\_spec_i)\right)$ | $S_{d_i} = 21000 \cdot psi$ |
| Testing Allowable Stress: (per Table 5-2) | $S_{t_i} := St(PL\_spec_i)$ | $S_{t_i} = 21000 \cdot psi$ |
| Joint Efficiency: | $JE_i := 0.70$ | |

Liquid Height: $h_{p_i} := H_P$ $h_{p_i} = 19.885 \cdot ft$

Design Required Thickness: (incl. corrosion allowance)

$$t_{d_i} := \frac{2.6\left(\frac{h_{p_i} + \frac{P_{int}}{\gamma_w \cdot G_P}}{ft} - 1\right) \cdot \left(\frac{D_{nom}}{ft}\right) \cdot G_P}{\left(\frac{S_{d_i}}{psi}\right) \cdot JE_i} \cdot in + CA_{sh} \qquad t_{d_i} = 0.296 \cdot in$$

Testing Required Thickness:

$$t_{t_i} := \frac{2.6\left(\frac{h_{p_i} + \frac{P_{test}}{\gamma_w}}{ft} - 1\right) \cdot \left(\frac{D_{nom}}{ft}\right)}{\left(\frac{S_{t_i}}{psi}\right) \cdot JE_i} \cdot in \qquad t_{t_i} = 0.234 \cdot in$$

Nominal Thickness Used:

$$t_i := \frac{ceil\left(\max\left(\frac{t_{d_i}}{in}, \frac{t_{t_i}}{in}, \frac{t_{min}}{in}, \frac{t_i}{in}\right) \cdot 16\right)}{16} in \qquad t_i = 0.3125 \cdot in$$

Check maximum thickness for material specified: $t_{max}(PL\_spec_i) = 0.5 \cdot in$

$(t_i \le t_{max}(PL\_spec_i)) = 1$ 1 = TRUE, ==>> OK

*Tank Shell Plate Recap*

Number of Shell Course: $n_{sh} = 2$

Widths and Thicknesses of Shell Plates: $t = \begin{pmatrix} 0.25 \\ 0.313 \end{pmatrix} \cdot in$ $h = \begin{pmatrix} 120 \\ 120 \end{pmatrix} \cdot in$ $PL\_spec = \begin{pmatrix} \text{"Appendix A (E=0.70)"} \\ \text{"Appendix A (E=0.70)"} \end{pmatrix}$

Weights of Shell Plate:

Centerline Diameters:

$$d := \begin{cases} D_{nom} + t & \text{if Shell\_Plates\_are = "Flush-Stacked Inside"} \\ D_{nom} + 0 \cdot t & \text{if Shell\_Plates\_are = "Centerline-Stacked"} \\ D_{nom} - t & \text{if Shell\_Plates\_are = "Flush-Stacked Outside"} \end{cases}$$

$$d = \begin{pmatrix} 840.25 \\ 840.313 \end{pmatrix} \cdot in$$

Weight of each Course:

```
wt := | for i ∈ 1 .. n_sh
      |   shwt_i ← π·d_i·h_i·t_i·γ_s
      | return shwt
```

$$wt = \begin{pmatrix} 22.438 \times 10^3 \\ 28.049 \times 10^3 \end{pmatrix} \cdot lbf$$

New and Uncorroded Shell Weight:
(including Rim Angle)

$$DL_{sh} := \sum_{i=1}^{n_{sh}} wt_i + DL_{rim}$$

$$DL_{sh} = 50.487 \times 10^3 \cdot lbf$$

Corroded Shell Weight:

$$CDL_{sh} := DL_{sh} - \pi \cdot D_{nom} \cdot H_{sh} \cdot CA_{sh} \cdot \gamma_s$$

$$CDL_{sh} = 39.271 \times 10^3 \cdot lbf$$

## *Tank Shell Moments and Centroids*

Shell Plate Centroids: Centroid of each Course:

$$y := \begin{array}{|l} \text{for } i \in 1..n_{sh} \\ \quad cg_i \leftarrow \sum_{j=i}^{n_{sh}} h_j - \frac{h_i}{2} \\ \text{return } cg \end{array} \qquad y = \begin{pmatrix} 180 \\ 60 \end{pmatrix} \cdot in$$

Moments:

$$my := \begin{array}{|l} \text{for } i \in 1..n_{sh} \\ \quad shmy_i \leftarrow wt_i \cdot y_i \\ \text{return } shmy \end{array} \qquad my = \begin{pmatrix} 336.565 \times 10^3 \\ 140.246 \times 10^3 \end{pmatrix} \cdot lbf \cdot ft$$

Rim Angle: Rim Angle Moment: $my_{rim} := DL_{rim} \cdot (H_{sh} - y_{rim})$ $\qquad my_{rim} = 0.000 \times 10^0 \cdot lbf \cdot ft$

Tank Shell Centroid:

$$y_{sh} := \frac{\sum_{i=1}^{n_{sh}} my_i + my_{rim}}{DL_{sh}} \qquad y_{sh} = 9.444 \cdot ft$$

## *Tank Bottom Weight*

Bottom Outside Diameter: $D_{bt} := d_{n_{sh}} + t_{n_{sh}} + 4in$ $\qquad D_{bt} = 70.385 \cdot ft$

Plate Lap: $PLap := 1.5in$

Factor to account for plate laps: $LapFactor := \frac{96in}{96in - PLap} \cdot \frac{240in}{240in - PLap}$ $\qquad LapFactor = 1.022$

New and Uncorroded: $DL_{bt} := \left(\frac{\pi}{4}\right) \cdot D_{bt}^{\,2} \cdot t_{bt} \cdot \gamma_s \cdot LapFactor$ $\qquad DL_{bt} = 50714.0 \cdot lbf$

Corroded Bottom Weight: $CDL_{bt} := DL_{bt} \cdot \frac{t_{bt} - CA_{bt}}{t_{bt}}$ $\qquad CDL_{bt} = 40571.2 \cdot lbf$

## *Tank Roof Weight*

Roof Gravity Loads:
(DL- new - uncorroded)

$DL_{rfPL} := 10000lbf$ $\qquad DL_{rfPL} = 10.000 \times 10^{3} \cdot lbf$

$DL_{rfstr} := 0lbf$ $\qquad DL_{rfstr} = 0.000 \times 10^{0} \cdot lbf$

$DL_{rfstrsh} := 0lbf$ $\qquad DL_{rfstrsh} = 0.000 \times 10^{0} \cdot lbf$

$DL_{rfsh} := DL_{rfPL}$ $\qquad DL_{rfsh} = 10.000 \times 10^{3} \cdot lbf$

$DL_{rfPLsh} := DL_{rfsh} - DL_{rfstrsh}$ $\qquad DL_{rfPLsh} = 10.000 \times 10^{3} \cdot lbf$

Roof Gravity Loads:
(DL - corroded)

$CDL_{rfPL} := 10000lbf$ $\qquad CDL_{rfPL} = 10.000 \times 10^{3} \cdot lbf$

$CDL_{rfstr} := 0lbf$ $\qquad CDL_{rfstr} = 0.000 \times 10^{0} \cdot lbf$

$CDL_{rfstrsh} := 0lbf$ $\qquad CDL_{rfstrsh} = 0.000 \times 10^{0} \cdot lbf$

$CDL_{rfsh} := CDL_{rfPL}$ $\qquad CDL_{rfsh} = 10.000 \times 10^{3} \cdot lbf$

$CDL_{rfPLsh} := CDL_{rfsh} - CDL_{rfstrsh}$ $\qquad CDL_{rfPLsh} = 10.000 \times 10^{3} \cdot lbf$

Roof Gravity Loads:
(Live Load)

$LL_{design} = 22.08 \cdot psf$

$LL_{rfPL} := \frac{\pi}{4} \cdot D_{rf}^{2} \cdot LL_{design}$ $\qquad LL_{rfPL} = 84.974 \times 10^{3} \cdot lbf$

$LL_{rfsh} := LL_{rfPL}$ $\qquad LL_{rfsh} = 84.974 \times 10^{3} \cdot lbf$

## *Wind Loads per 5.2.1.j*

$V_{wind} = 120 \cdot mph$ Exposure = "C"

Importance Factor: $I_W = 1.15$

Design Pressure on Cylindrical Surfaces: $q_{sh} := 18 \frac{lbf}{ft^2} \cdot \left(\frac{V_{wind}}{120mph}\right)^2 \cdot I_W$ $q_{sh} = 20.70 \cdot psf$

Design Uplift Pressure on Roof Surfaces: $q_{rf} := 30 \frac{lbf}{ft^2} \cdot \left(\frac{V_{wind}}{120mph}\right)^2 \cdot I_W$ $q_{rf} = 34.50 \cdot psf$

Wind on Shell:

$F_{sh} := D_{nom} \cdot H_{sh} \cdot q_{sh}$ $F_{sh} = 28.980 \times 10^3 \cdot lbf$

$M_{sh} := F_{sh} \cdot \frac{H_{sh}}{2}$ $M_{sh} = 289.800 \times 10^3 \cdot lbf \cdot ft$

Wind Uplift on Roof:

$F_{uplift} := \frac{\pi}{4} \cdot D_{rf}^2 \cdot q_{rf}$ $F_{uplift} = 132.772 \times 10^3 \cdot lbf$

$M_{uplift} := F_{uplift} \cdot \frac{D_{nom}}{2}$ $M_{uplift} = 4.647 \times 10^6 \cdot lbf \cdot ft$

Total Wind:

$F_W := F_{sh}$ $F_W = 28.980 \times 10^3 \cdot lbf$

$M_W := M_{sh} + M_{uplift}$ $M_W = 4.937 \times 10^6 \cdot lbf \cdot ft$

## *Internal Pressure Loads*

Uplift Force: $F_{Pi} := \frac{\pi}{4} \cdot D_{rf}^2 \cdot P_{int}$ $F_{Pi} = 0.000 \times 10^0 \cdot lbf$

Uplift Moment: $M_{Pi} := \frac{\pi}{8} \cdot D_{rf}^3 \cdot P_{int}$ $M_{Pi} = 0.000 \times 10^0 \cdot lbf \cdot ft$

## *Moments Resisting Overturning per 3.11*

Total Corroded DL Resisting Uplift: $CDL_{up} := CDL_{sh} + CDL_{rfstrsh} + CDL_{rfPLsh}$ $CDL_{up} = 49.271 \times 10^3 \cdot lbf$

Dead Load Overturning Resistance: $M_{DL} := CDL_{up} \cdot \frac{D_{nom}}{2}$ $M_{DL} = 1.724 \times 10^6 \cdot lbf \cdot ft$

Fluid Load Overturning Resistance: $M_F := \left(4.67 \cdot \frac{lbf}{ft}\right) \cdot \left(\frac{t_{bt} - CA_{bt}}{in}\right) \cdot \left(\sqrt{\frac{Fy_{bt}}{psi} \cdot \frac{H_P}{ft}}\right) \cdot \frac{\pi \cdot D_{nom}^2}{2}$

$M_F = 7.603 \times 10^6 \cdot lbf \cdot ft$

## *Check Overturning Stability per 5.11.2*

$$\text{Wind\_Anchors} := \begin{cases} \text{"ARE REQUIRED"} & \text{if } \left(0.6 \cdot M_w + M_{Pi}\right) \ge \dfrac{M_{DL}}{1.5} \\ \text{"ARE NOT REQUIRED"} & \text{otherwise} \end{cases}$$

$$\text{Wind\_Anchors} := \begin{cases} \text{"ARE REQUIRED"} & \text{if } \left[\left(M_w + 0.4 \cdot M_{Pi}\right) \ge \left(\dfrac{M_{DL} + M_F}{2.0}\right)\right] \vee (\text{Wind\_Anchors} = \text{"ARE REQUIRED"}) \\ \text{"ARE NOT REQUIRED"} & \text{otherwise} \end{cases}$$

Factor of Safety for Overturning: $FS_{ovr} := \min\left(\dfrac{M_{DL}}{0.6 \cdot M_w + M_{Pi}}, \dfrac{M_{DL} + M_F}{M_w + 0.4 \cdot M_{Pi}}\right)$ $FS_{ovr} = 0.582$

## *Check Sliding per 5.11.4*

Maximum Allowable Sliding Friction: (per 5.11.4) $F_r := \left(CDL_{sh} + CDL_{bt} + CDL_{rfPL} + CDL_{rfstr}\right) \cdot 0.4$ $F_r = 35.937 \times 10^3 \cdot lbf$

$F_w = 28.980 \times 10^3 \cdot lbf$

$$\text{Wind\_Anchors} := \begin{cases} \text{"ARE REQUIRED"} & \text{if } \left(F_w \ge F_r\right) \vee (\text{Wind\_Anchors} = \text{"ARE REQUIRED"}) \\ \text{"ARE NOT REQUIRED"} & \text{otherwise} \end{cases}$$

## *Check Anchor Status*

Wind_Anchors = "ARE REQUIRED"

$$\text{Tank\_Is\_Self\_Anchored} := \begin{cases} \text{"FALSE"} & \text{if Wind\_Anchors} = \text{"ARE REQUIRED"} \\ \text{Tank\_Is\_Self\_Anchored} & \text{otherwise} \end{cases}$$

Tank_Is_Self_Anchored = "FALSE"

*Check for Intermediate Wind Girder per 5.9.7*

Maximum Height of Unstiffened Shell:

$$h_{max} := 600000 \cdot \left(\frac{t_1}{in}\right) \cdot \left(\frac{\frac{t_1}{in}}{\frac{D_{nom}}{ft}}\right)^{\frac{3}{2}} \cdot \left(\frac{120mph}{V_{wind}}\right)^2 \cdot \left(\frac{1}{I_W}\right) \cdot ft$$

$$h_{max} = 27.839 \cdot ft$$

Transposed Shell Height:

$$h_T := \sum_{i=1}^{n_{sh}} \left[h_i \left(\frac{t_1}{t_i}\right)^{2.5}\right] \qquad h_T = 15.724 \cdot ft$$

Check Status:

$$\text{Intermediate\_Windgirder} := \begin{cases} \text{"is NOT REQUIRED"} & \text{if } h_T \le h_{max} \\ \text{"ONE REQUIRED"} & \text{if } h_T > h_{max} \\ \text{"TWO REQUIRED"} & \text{if } \frac{h_T}{2} > h_{max} \\ \text{"THREE REQUIRED"} & \text{if } \frac{h_T}{3} > h_{max} \\ \text{"MODIFY THE SHELL DESIGN"} & \text{if } \frac{h_T}{4} > h_{max} \end{cases}$$

$$\text{Intermediate\_Windgirder} = \text{"is NOT REQUIRED"}$$

Required Section Modulus:
(if windgirder is required)

$$h_{wg} := \begin{cases} 0ft & \text{if } h_T \le h_{max} \\ \frac{h_T}{2} & \text{if } h_T > h_{max} \\ \frac{h_T}{3} & \text{if } \frac{h_T}{2} > h_{max} \\ \frac{h_T}{4} & \text{if } \frac{h_T}{3} > h_{max} \end{cases} \qquad h_{wg} = 0 \cdot ft$$

$$S_{iwg} := 0.0001 \cdot \frac{h_{wg}}{ft} \cdot \left(\frac{D_{nom}}{ft}\right)^2 \cdot \left(\frac{V_{wind}}{120mph}\right)^2 \cdot in^3 \qquad S_{iwg} = 0 \cdot in^3$$

*Top Wind Girder Design* *(for aluminum dome - designed as an open-top tank)*

Minimum Required Section Modulus: $S_{twg} := 0.0001 \cdot \frac{H_{sh}}{ft} \cdot \left(\frac{D_{nom}}{ft}\right)^2 \cdot \left(\frac{V_{wind}}{120mph}\right)^2 \cdot (I_W) \cdot in^3$ $S_{twg} = 11.27 \cdot in^3$

Use L6x4x1/2 (LLH) rolled toe-in and welded to the shell PL.

## *Seismic Design per Appendix E*

Check if Seismic Design is Required (see exception in E.1):

$$\text{Seismic\_Design\_Is} := \begin{cases} \text{"NOT REQUIRED"} & \text{if } \left[\left(S_1 \le 4\cdot\%\right) \wedge \left(S_S \le 15\cdot\%\right)\right] \vee \left(S_P \le 5\%\right) \\ \text{"REQUIRED"} & \text{otherwise} \end{cases}$$

Seismic_Design_Is = "NOT REQUIRED"

## *Anchor Design per 5.12*

Tank_Is_Self_Anchored = "FALSE"

Minimum Number of Anchors Required:

$$n_{ab} := \max\left(4, \frac{\pi \cdot D_{nom}}{10ft}\right)$$

$n_{ab} = 21.991$

Number of Anchors Used:

$$n_{ab} := 24$$

Anchor Uplift Forces per 5.12 (Table 5-21b)

Anchor Uplift for Wind Forces:

$$P_W := \frac{\max\left[0, \left[\frac{4 \cdot M_w}{D_{nom}} - \left(CDL_{sh} + CDL_{rfsh}\right)\right]\right]}{n_{ab}}$$

$P_W = 9.701 \times 10^3 \cdot lbf$

Anchor Uplift for Seismic Forces:

$$P_S := \frac{\max\left[0, \left[\frac{4 \cdot M_{rw}}{D_{nom}} - \left(CDL_{sh} + CDL_{rfsh}\right)\right]\right]}{n_{ab}}$$

$P_S = 0.000 \times 10^0 \cdot lbf$

Anchor Uplift for Design Pressure + Wind:

$$P_{PW} := \frac{\max\left[0, \left[\left(\frac{4 \cdot M_w}{D_{nom}}\right) + \left[\left(\frac{\pi}{4} \cdot D_{nom}^{\ 2}\right) \cdot P_{int} - CDL_{rfPL}\right] - \left(CDL_{sh} + CDL_{rfstrsh}\right)\right]\right]}{n_{ab}}$$

$P_{PW} = 9.701 \times 10^3 \cdot lbf$

Anchor Uplift for Design Pressure + Seismic:

$$P_{PS} := \frac{\max\left[0, \left[\left(\frac{4 \cdot M_{rw}}{D_{nom}}\right) + \left[\left(\frac{\pi}{4} \cdot D_{nom}^{\ 2}\right) \cdot P_{int} - CDL_{rfPL}\right] - \left(CDL_{sh} + CDL_{rfstrsh}\right)\right]\right]}{n_{ab}}$$

$P_{PS} = 0.000 \times 10^0 \cdot lbf$

Anchor Material Specification:

Anch_Matl := "ASTM A193, Gr. B8M"   $Fy_{ab} := 30000psi$

Anchor Diameter:

$d_{ab} := 1in$

$A_{ab} = 0.537 \cdot in^2$

$$A_{ab} := \begin{cases} 0.537in^2 & \text{if } d_{ab} = 1in \\ 0.740in^2 & \text{if } d_{ab} = 1.125in \\ 0.942in^2 & \text{if } d_{ab} = 1.25in \\ 1.12in^2 & \text{if } d_{ab} = 1.375in \\ 1.37in^2 & \text{if } d_{ab} = 1.5in \\ 0in^2 & \text{otherwise} \end{cases}$$

Anchor Stresses:

Wind Load

$\sigma_W := \frac{P_W}{A_{ab}}$   $\sigma_W = 18065.8 \cdot psi$

Wind Load & Design Pressure

$\sigma_{PW} := \frac{P_{PW}}{A_{ab}}$   $\sigma_{PW} = 18065.8 \cdot psi$

Seismic Load

$\sigma_S := \frac{P_S}{A_{ab}}$   $\sigma_S = 0.0 \cdot psi$

Seismic Load & Design Pressure

$\sigma_{PS} := \frac{P_{PS}}{A_{ab}}$   $\sigma_{PS} = 0.0 \cdot psi$

$$\text{Anchor\_Design\_is} := \begin{cases} \text{"NO GOOD"} & \text{if } \sigma_W > 0.8 \cdot Fy_{ab} \\ \text{"NO GOOD"} & \text{if } \sigma_S > 0.8 \cdot Fy_{ab} \\ \text{"NO GOOD"} & \text{if } \sigma_{PW} > 20000psi \\ \text{"NO GOOD"} & \text{if } \sigma_{PS} > 0.8 \cdot Fy_{ab} \\ \text{"Acceptable"} & \text{otherwise} \end{cases}$$

Anchor_Design_is = "Acceptable"

## Foundation Loads

### Area Loads:

Uniform Pressure on Bottom:
(for operating condition)

$q_{bot} := H_P \cdot G_P \cdot \gamma_w + t_{bt} \cdot \gamma_s + P_{int}$ $\qquad q_{bot} = 1253.6 \cdot psf$

Uniform Pressure on Bottom:
(for hydrostatic testing)

$q_{bt} := H_{sh} \cdot \gamma_w + t_{bt} \cdot \gamma_s + P_{test}$ $\qquad q_{bt} = 1260.75 \cdot psf$

### Shell Loads:
(per foot of circumference)

Dead Load at Base of Shell:
(New and Uncorroded)

$$DL := \frac{DL_{sh} + DL_{rfsh}}{\pi \cdot D_{nom}} \qquad DL = 275.1 \cdot \frac{lbf}{ft}$$

Dead Load at Base of Shell:
(Fully Corroded)

$$CDL := \frac{CDL_{sh} + CDL_{rfsh}}{\pi \cdot D_{nom}} \qquad CDL = 224.1 \cdot \frac{lbf}{ft}$$

Live Load at Base of Shell:

$$LL := \frac{LL_{rfsh}}{\pi \cdot D_{nom}} \qquad LL = 386.4 \cdot \frac{lbf}{ft}$$

### Wind Loads: (at Base of Shell)

$V_{wind} = 120 \cdot mph$

Wind Base Shear: $F_w = 28.980 \times 10^3 \cdot lbf$

Wind Moment: $M_w = 4.937 \times 10^6 \cdot ft \cdot lbf$

### Seismic Loads: (at Base of Shell)

Seismic Base Shear: $V_E = 0.000 \times 10^0 \cdot lbf$

Seismic Shell Moment:
(for Shell and Ringwall Design) $M_{rw} = 0.000 \times 10^0 \cdot ft \cdot lbf$

Seismic Base Moment:
(for Slab and Pile Foundations) $M_s = 0.000 \times 10^0 \cdot ft \cdot lbf$

Tank_Is_Self_Anchored = "FALSE"

## *Design Recap Sheet*

## *Roof Design*

RoofType = "SELF-SUPPORTING ALUMINUM DOME"

Roof_Design_is = "by Dome Roof Manufacturer"

RimAngle = "None"

## *Shell Design*

Number of Shell Course: $n_{sh} = 2$ Intermediate_Windgirder = "is NOT REQUIRED"

Widths and Thicknesses of Shell Plates:

$h = \begin{pmatrix} 120 \\ 120 \end{pmatrix} \cdot in$ PL_spec = $\begin{pmatrix} \text{"Appendix A (E=0.70)"} \\ \text{"Appendix A (E=0.70)"} \end{pmatrix}$ $t = \begin{pmatrix} 0.2500 \\ 0.3125 \end{pmatrix} \cdot in$ $t_d = \begin{pmatrix} 0.173 \\ 0.296 \end{pmatrix} \cdot in$ $t_t = \begin{pmatrix} 0.110 \\ 0.234 \end{pmatrix} \cdot in$

## *Bottom Design*

Bottom_Is = "Cone Down" $Slope_{bt} = -1 \cdot \frac{in}{10ft}$

Tank_Has_Annular_Plate = "FALSE" $w_{annpl}$ = " N / A " ·in $t_{annpl}$ = " N / A " ·in

Bottom Plate Thickness: $t_{bt} = 0.313 \cdot in$

## *Anchor Design*

Tank_Is_Self_Anchored = "FALSE"

Number of Anchors: $n_{ab} = 24$ Anch_Matl = "ASTM A193. Gr. B8M"

Anchor Diameter: $d_{ab} = 1 \cdot in$ $A_{ab} = 0.537 \cdot in^2$

Maximum Anchor Force: $T_{ab} = 9701 \cdot lbf$ Anchor_Design_is = "Acceptable"

| St | Input | Name | Output | Unit | Comment |
|---|---|---|---|---|---|
| | | | | | Ringwall Analysis |
| | | u_wt_conc | 150 | pcf | Unit weight of concrete ( default = 150 pcf ) |
| | | u_wt_soil | 120 | pcf | Unit weight of soil ( default = 120 pcf ) |
| | | phi_soil | 19.47122 | deg | Soil friction angle ( default = 19.47122 deg ) |
| | | Ka | .5 | | Coefficient of Rankine's active earth pressure |
| | 70 | D_ring | | ft | Diameter of ringwall at centerline |
| | 2 | b_ring | | ft | Width of ringwall |
| | 3 | d_ring | | ft | Depth of ringwall |
| | 1 | G | | | Product specific gravity |
| | 20 | H | | ft | Product height |
| | .3125 | t_bot | | in | Thickness of bottom plate |
| | | q_prod | 1260.75 | psf | Bearing pressure due to product + bottom plate |
| | | q_soil | 1620.75 | psf | Soil bearing pressure under tank product at elevation of bottom of ri |
| | 70 | D_shell | | ft | Diameter of shell |
| | 48071 | W_shell | | lbf | Total weight of shell and shell supported items |
| | | w_shell | 218.5925 | plf | Weight of shell and supported items per foot |
| | | e_shell | 0 | ft | Eccentricity of shell ( + toward center ) |
| | | b_prod | 1 | ft | Width of ring wall loaded by product |
| | | e_prod | .5 | ft | Eccentricity of product ( + toward center ) |
| | | q_brg_normal | 1189.671 | psf | Soil bearing under ringwall from normal operation |
| | 24 | N_anch | | | Number of anchor bolts |
| | 70.5 | D_anch | | ft | Diameter of anchor bolt circle |
| | 9701 | P_anch | | lbf | Tension in one anchor bolt |
| | | e_anch | -.25 | ft | Eccentricity of anchor bolts ( + toward center ) |
| | 289800 | M_wind | | ft*lbf | Wind moment at base of shell |
| | 28980 | V_wind | | lbf | Wind shear at base of shell |
| | | q_brg_wind | 1238.618 | psf | |
| | | w_wind | 97.89393 | lbf / ft | |
| | 0 | M_seismic | | ft*lbf | Seismic moment at base of shell |
| | 0 | V_seismic | | lbf | Seismic shear at base of shell |
| | | q_brg_seismic | 1189.671 | psf | |
| | | w_seismic | 0 | lbf / ft | |
| | 2000 | q_allow_norm | | psf | Allowable soil bearing with FS = 2.5 |
| | 2666.667 | q_allow_wind | | psf | Allowable soil bearing with FS = 1.875 ( 3/4 of 2.5 ) |
| | | P_hoop | 73478.25 | lbf | Hoop Forces in ringwall |
| | | T_ecc | 895.0542 | ft*lbf / ft | Torque due to eccentricities |
| | | | | | Job No. 5350 - Woodruff & Sons, Inc. |
| | | | | | 70' Dia. x 20' FB Alum Dome Roof Leachate Storage Tank |
| | | | | | Lithia, Florida |
| | | | | | September 8, 2008 - TFM |
| | | | | | Sheet _____ of _____ |

| St | Input | Name | Output | Unit | Comment |
|---|---|---|---|---|---|
| | | | | | Ringwall Design |
| | 73478 | P_hoop | | lbf | Hoop force in ringwall (from ringwall analysis) |
| | 895.05 | T_ecc | | ft*lbf / ft | Torque due to eccentricities (from ringwall analysis) |
| | 1.6 | L_Factor | | | Load factor for concrete design |
| | | phi | .9 | | Resistance factor for concrete design |
| | 70 | D_ring | | ft | Diameter of ringwall at centerline |
| | 2 | b_ring | | ft | Width of ringwall |
| | 3 | d_ring | | ft | Depth of ringwall |
| | | A_g | 864 | in^2 | Gross area of concrete |
| | | A_s_min | 2.16 | in^2 | Minimum area of reinforcing steel per ACI 318, 14.3.3 |
| | 4000 | fc | | psi | Compressive strength of concrete |
| | | Fy | 60000 | psi | Yield strength of reinforcing steel |
| | 10 | N_bars | | | Quantity of reinforcing bars used for hoop reinforcing |
| | #6 | BarSize | | | Reinforcing bar size used for hoop reinforcing |
| | | d_b | .75 | in | Bar diameter |
| | | A_b | .441786467 | in | Cross-sectional area of a single bar |
| | | A_s | 4.41786467 | in^2 | Area of reinforcing steel provided |
| | | I_s | 608.961227 | in^4 | "Moment of Inertia" of steel WRT horizontal neutral axis |
| | 14.625 | c | | in | Vertical distance from horizontal neutral axis to bottom steel |
| | | P_bar | 7347.825 | lbf | Hoop force in each reinforcing bar |
| | | P_ecc | 3988.57052 | lbf | Hoop force increase ( in extreme bar ) due to eccentricity |
| | | Pu_bar | 18138.2328 | lbf | Required strength ( factored force ) in extreme bar |
| | | phi_Pn_bar | 23856.4692 | lbf | Design strength of each reinforcing bar |
| | 2.5 | cc | | in | Smallest value of clear cover over, side cover, or 1/2 c/c spacing |
| | | alpha | 1.3 | | Reinforcement location factor ( = 1.3 for "top" bars ) |
| | | beta | 1 | | Coating factor ( = 1.0 for uncoated bars ) |
| | | gamma | .8 | | Bar size factor ( = 0.8 for #6 and smaller, = 1.0 for others ) |
| | | lambda | 1 | | Lightweight aggregate factor ( = 1.0 for normalweight concrete ) |
| | | L_d | 22.1991892 | in | Basic development length for hoop steel per ACI 318-99, 12.2 |
| | | LapLength | 29 | in | Minimum length of Class B splice per ACI 318-99, 12.15.1 |
| | | A_s_vert_min | .3456 | in^2 / ft | Minimum area of vertical steel required by ACI 318-99, 14.3.2 |
| | #4 | Vert_BarSize | | | Reinforcing bar size for vertical reinforcing |
| | 2 | N_faces | | | Number of vertical bars per spacing |
| | 13.5 | s | | in | Spacing of vertical bars ( each face ) |
| | | A_s_vert | .34906585 | in^2 / ft | Calculated area of vertical reinforcing supplied |
| | | | | | Job No. 5350 - Woodruff & Sons, Inc. |
| | | | | | 70' Dia. x 20' FB Alum Dome Roof Leachate Storage Tank |
| | | | | | Lithia, Florida |
| | | | | | September 8, 2008 - TFM |
| | | | | | Sheet _____ of _____ |

## DESIGN SHELL THICKNESSES

| RING No. | API MAT'L GROUP | DESIGN FOR PRODUCT: ALLOWABLE STRESS (PSI) | DESIGN FOR PRODUCT: CALCULATION THK. (IN) | DESIGN FOR TEST: ALLOWABLE STRESS (PSI) | DESIGN FOR TEST: CALCULATION THK. (IN) | CORROSION ALLOWANCE | ACTUAL THK. (IN) |
|---|---|---|---|---|---|---|---|
| 1 | I | 21000 | 0.285" | 21000 | 0.223" | 1/16" | 0.3125" |
| 2 | I | 21000 | 0.162" | 21000 | 0.099" | 1/16" | 0.25" |

## CHORD ON INSIDE SHELL PLATES

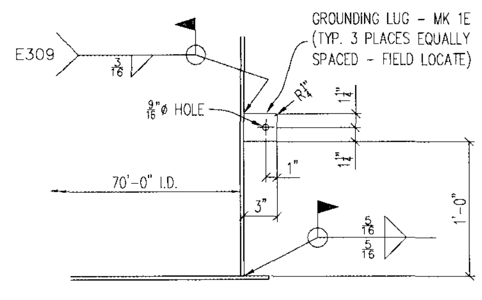
| MARK | CHORD | M. O. |
|---|---|---|
| 1A, 1B | 30'-5 1/4" | 3'-5 13/16" |
| 1AA | 29'-11 3/4" | 3'-4 1/2" |
| 1BA | 29'-11 5/8" | 3'-4 7/16" |

## TANK DATA

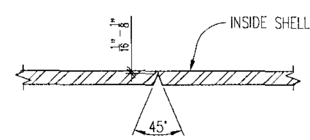
| | | | |
|---|---|---|---|
| DESIGNED AND FABRICATED PER: | API STD 650 ELEVENTH EDITION WITH APPLICABLE APPENDICES | | |
| NUMBER OF TANKS REQ'D.: | ONE | TANK CONTENTS: | EFFLUENT/LEACHATE |
| NOMINAL CAPACITY : | 550,000 GAL | DESIGN SPECIFIC GRAVITY: | 1 |
| DESIGN INTERNAL PRESSURE: | ATMOSPHERIC | OPERATING PRESSURE: | ATMOSPHERIC |
| DESIGN EXTERNAL PRESSURE: | 1 IN H20 | OPERATING TEMPERATURE: | AMBIENT |
| DESIGN TEMPERATURE: | 200° F | MIN. DESIGN METAL TEMPERATURE (MDMT): | 50° F |
| SEISMIC DESIGN PARAMETERS: | | CORROSION ALLOWANCE: | 1/16" BOTTOM & SHELL |
| $S_S$ : 7.8% $S_1$: 3.1% $T_L$ : 8 Sec. | | JOINT EFFICIENCY FACTOR: | 70% (NO XRAY) |
| SITE CLASS: | D | ROOF LIVE LOAD: | 20 PSF |
| BASIC WIND SPEED: | 120 MPH | | |
| IMPORTANCE FACTOR: | 1.15 | EMPTY WEIGHT: | 114,600 LBS |
| EXPOSURE CATEGORY: | C | FLOODED W/WATER WEIGHT: | 4,900,000 LBS |
| RADIOGRAPHY: | NONE | OPERATING WEIGHT: | 4,700,600 LBS |

## BILL OF MATERIAL

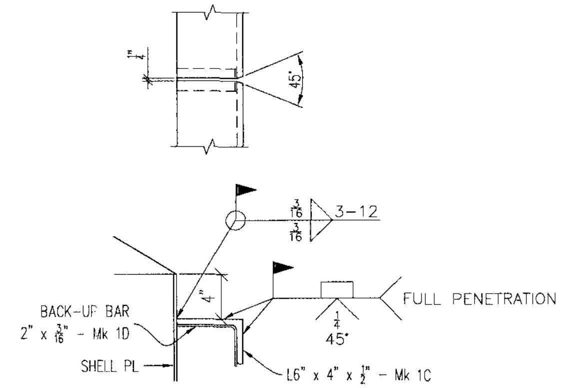
| PART | QTY | DESCRIPTION | MATERIAL | WT EA. | TOTAL |
|---|---|---|---|---|---|
| 1A | 6 | PL 5/16" x 120" x 31'-6" LG | A36 | 4058 | 24344 |
| | | ROLL TO 70'-0" I.D. | | | |
| 1AA | 1 | PL 5/16" x 120" x 30'-11 15/16"± LG | A36 | | 3993 |
| | | ROLL TO 70'-0" I.D. | | | |
| | | | | | |
| 1B | 6 | PL 1/4" x 120" x 31'-6" LG | A36 | 3245 | 19467 |
| | | ROLL TO 70'-0" I.D. | | | |
| 1BA | 1 | PL 1/4" x 120" x 30'-11 3/4"± LG | A36 | | 3193 |
| | | ROLL TO 70'-0" I.D. | | | |
| | | | | | |
| 1C | 13 | WIND GIRDER SECTIONS | | | |
| | | L6" x 4" x 1/2" x 17'-6" (LLH) | A36 | 291 | 3775 |
| | | ROLL TO 71'-0 1/2" I. D. (LONG LEG TOE IN) | | | |
| | | FIELD TRIM LAST PIECE AT TIME OF ASSEMBLY | | | |
| | | | | | |
| 1D | 13 | WIND GIRDER BACK-UP PL | | | |
| | | BAR 2" x 3/16" x 0'-8 13/16" LG | A36 | 1 | 12 |
| | | BENT 5 5/16" + 3 1/2" | | | |
| | | | | | |
| 1E | 3 | GROUNDING LUG | | | |
| | | PL 1/4" x 2 1/2" x 0'-3" LG | 304 S/S | 0.5 | 2 |
| | | | | | |
| | | | | | 54786 |




SHELL PLATE TO BOTTOM PLATE CONNECTION



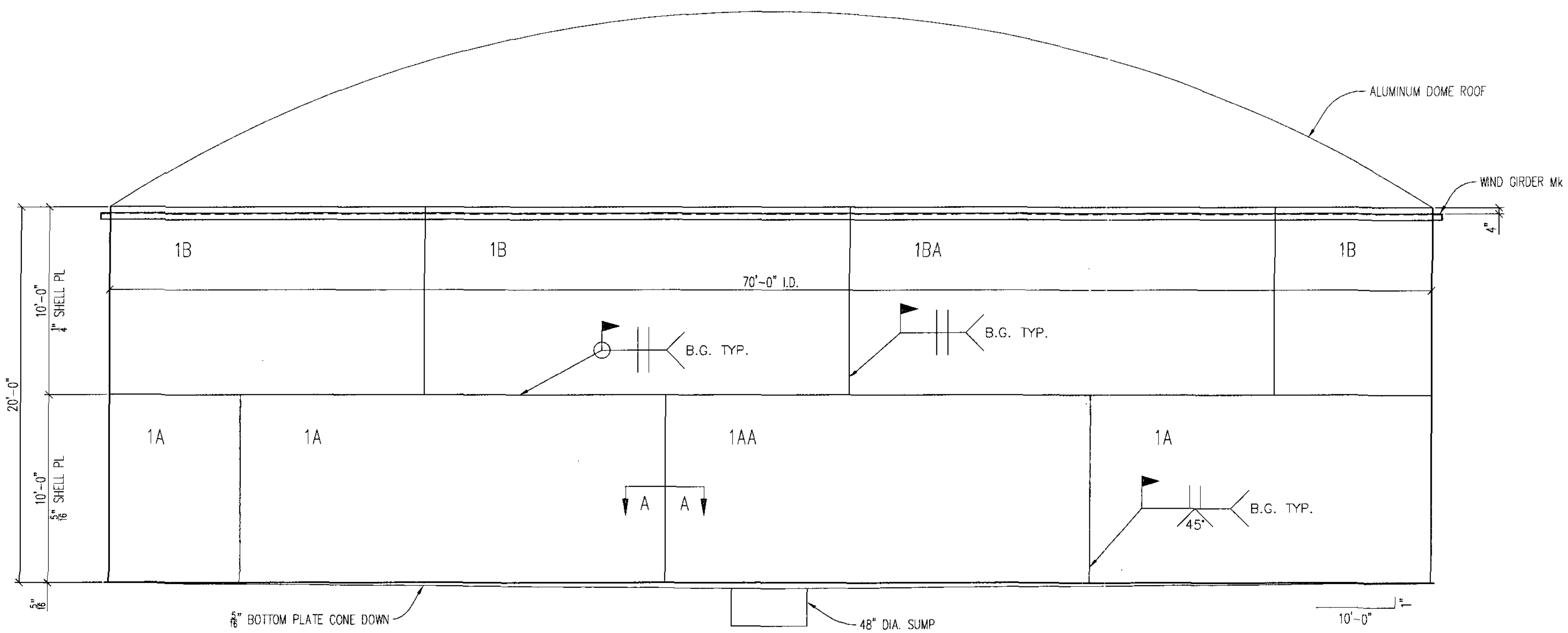

SECTION "A-A"




WINDGIRDER WELD DETAIL
(13 PLACES)

NOTES:

1. TANK IS DESIGNED IN ACCORDANCE WITH API STANDARD 650 APPENDIX "A", FLORIDA BUILDING CODE 2004 (AS APPLICABLE), AND THE ORDINANCES OF HILLSBOROUGH COUNTY.
2. SHELL NOZZLE FLANGE BOLTS TO STRADDLE VERTICAL TANK CENTERLINES.
3. TANK TO BE INSPECTED PER API STD. 650. TANK BOTTOM WELDS TO BE VACUUM BOX TESTED.
4. T.T.I. TO FURNISH & INSTALL NOZZLE BLANK OFFS W/ GASKETS AND PERFORM THE HYDROTEST. PIPING, PUMPING TRANSFER AND/OR DISPOSAL OF THE HYDROTEST WATER IS BY OTHERS. HYDROTEST WATER SHALL BE FILLED TO A POINT NOT LESS THAN 6" FROM TOP OF SHELL FOR 48 HOURS.
5. FOR NAMEPLATE SEE DWG. NO. B-5350-01




ELEVATION
SEE PLAN VIEW SHT 2 FOR TRUE NOZZLE ORIENTATION

Timothy F. Mulligan, PE
2710 5th Avenue
Tampa, Florida 33605

Florida PE Registration No. 54736
Florida Cert. of Auth. No. 27234

| DATE: | CUST: | SHOP: | FIELD: | REV: |
|---|---|---|---|---|
| 9-12-08 | - | - | - | 0 |
| 9-24-08 | - | - | - | 1 |

| MATERIAL OF CONSTRUCTION (UNLESS OTHERWISE NOTED) | |
|---|---|
| PLATE: | A36 |
| SHAPES: | A36 |
| PIPE: | A106, GR. B 2" & BELOW ABOVE 2" A53, GR. B |
| FLANGES: | A105 |
| GASKETS: | EPDM |
| NUTS: | A194 8M |
| BOLTS: | A193 B8M |

INTERIOR FINISH:
PS-5350-01

EXTERIOR FINISH:
PS-5350-01

| STATUS | BY | DATE |
|---|---|---|
| RELEASED TO FIELD | | |
| RELEASED FOR FABRICATION | RSU | 9-24-08 |
| APPROVAL RECEIVED | | |
| ISSUED FOR APPROVAL | | |
| CHECKED | RSU | 9-05-08 |
| DRAWING | JRN | 8-12-08 |

| REV. | DESCRIPTION | BY / CHK | DATE |
|---|---|---|---|
| 2 | ADDED GASKET MATERIAL | RSU / RSU | 10-18-08 |
| 1 | RELEASE FOR FABRICATION | MM / RSU | 9-24-08 |
| 0 | FOR APPROVAL | MM / RSU | - |

**TAMPA TANK, INC.**
TAMPA , FLORIDA

ELEVATION AND DETAILS FOR
70'-0" DIA. x 20'-0" SHELL TANK

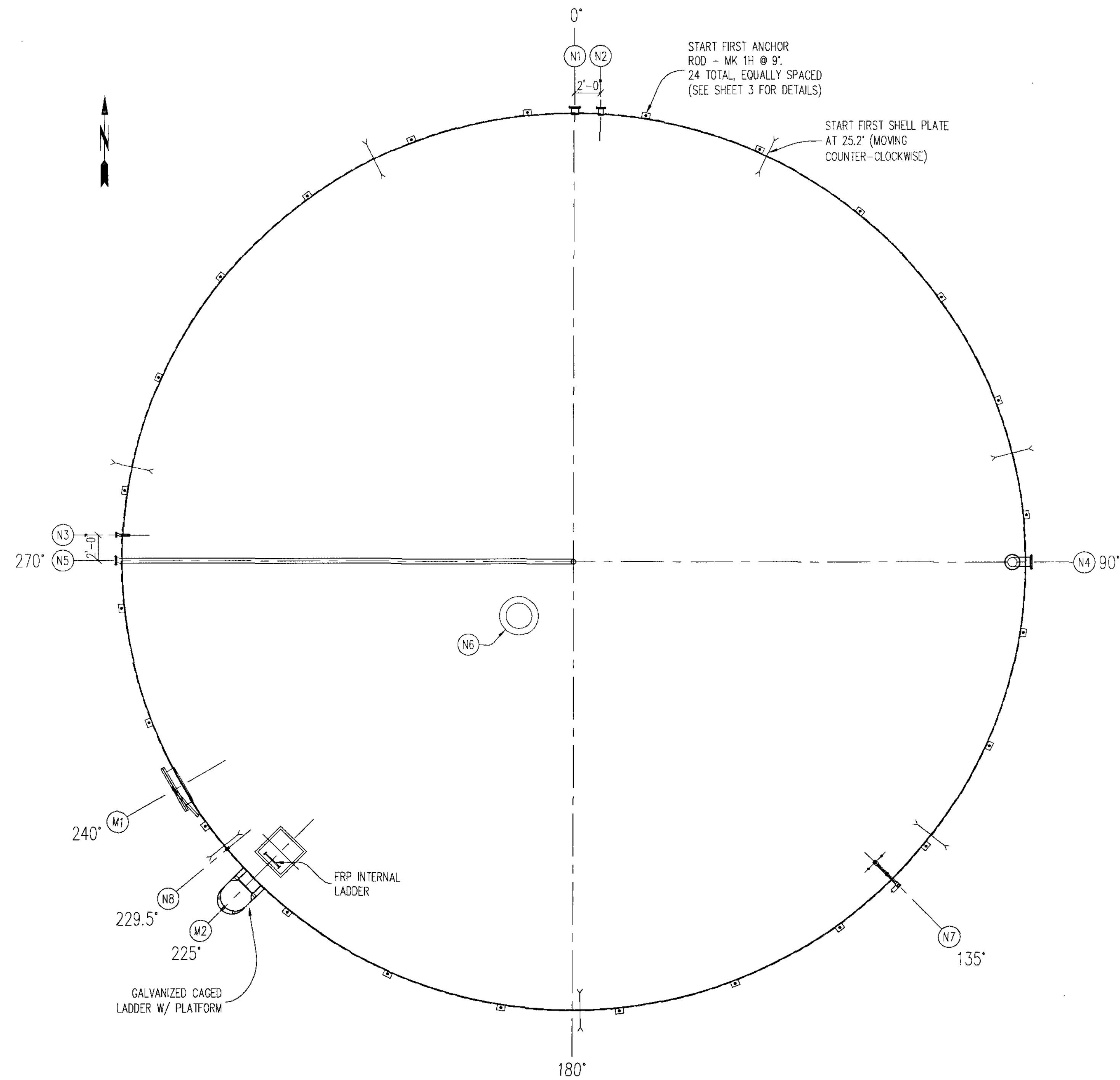
CUSTOMER: WOODRUFF & SONS, INC.
6450 31st STREET EAST
BRADENTON, FL, 3403

JOB SITE: HILLSBOROUGH COUNTY S.E. LANDFILL
LITHIA, FL.

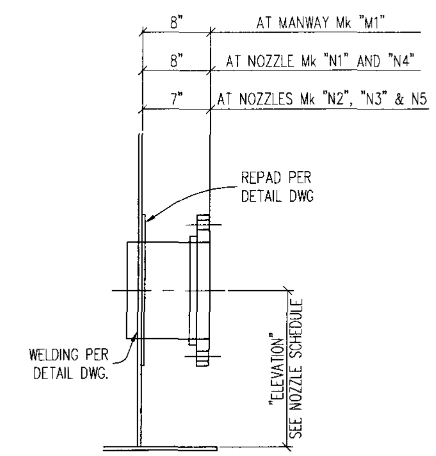
CUSTOMER'S P.O. No.: 2517
FIELD WORK No.: 5350F
CONTRACT No.: TTI-5350S
SHEET No.: 1 OF 3
DRAWING No.: D-5350-01
REV.: 2

File: Z:\Jobs\2008 - 5300\5350 Woodruff\EDL\Detailing\D-5350-01.dwg Sht (1) Plotted By: tmulligan Date: Nov 26, 2008 - 11:00am

| (TOP OF BOTTOM PLATE.) ELEVATION | NOZZLE SCHEDULE MARK | QTY. | PIPE SIZE & SCHEDULE | FLANGE & FACING | REPAD MARK | COMMENTS |
|---|---|---|---|---|---|---|
| 18'-6" | N1 | ONE | 6" EXTRA HEAVY | 6" 150# RFSO | | LEACHATE INLET |
| 18'-6" | N2 | ONE | 4" EXTRA HEAVY | 4" 150# RFSO | | EFFLUENT INLET |
| 19'-0" | N3 | ONE | 1 1/2" EXTRA HEAVY | 1 1/2" 150# RFSO | | FILL AND DIP PIPE |
| 17'-9" | N4 | ONE | 8" EXTRA HEAVY | 8" 150# RFSO | | OVERFLOW |
| 1'-2" | N5 | ONE | 4" EXTRA HEAVY | 4" 150# RFSO | 4N5A | EFFLUENT OUTLET (TO SUMP) |
| 3'-6" | M1 | ONE | 36" SCH. 40 | 36" AWWA C207 | 4M1A | 36" SHELL MANWAY W/ DAVIT |
| (2) 19'-2" | N8 | ONE | 3/4" 3000# CPL'G THREADED | – | | CATHODIC PROTECTION |
| ALUMA DOME COVER ROOF FITTINGS | | | | | | |
| (2) – | M2 | ONE | 30" SQ. | | | ROOF MANWAY (ALUMN.) |
| – | N6 | ONE | 24" ROOF VENT | | | GRAVITY VENT (ALUMN.) |
| – | N7 | ONE | 1 1/2" | | | LEVEL GAUGE |
| | | | | | | |




PLAN




ELEVATION AT SHELL NOZZLES

SEE NOZZLE SCHEDULE


| TABLE OF ARCS ON OUTSIDE OF SHELL PLATE | |
|---|---|
| DEGREE | FT–IN |
| 1° | 0'-7 5/16" |
| 2° | 1'-2 11/16" |
| 5° | 3'-0 11/16" |
| 10° | 6'-1 3/8" |
| 20° | 12'-2 11/16" |
| 30° | 18'-4 1/16" |
| 35° | 21'-4 3/4" |
| 45° | 27'-6 1/8" |

| STATUS | BY | DATE | REV. | DESCRIPTION | BY / CHK | DATE |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| RELEASED TO FIELD | | | | | | |
| RELEASED FOR FABRICATION | RSU | 9-24-08 | | | | |
| APPROVAL RECEIVED | | | | | | |
| ISSUED FOR APPROVAL | | | 2 | ROOF MANWAY WAS 36" SQ., ADDED "N8" | RSU / RSU | 9-27-08 |
| CHECKED | RSU | 9-17-08 | 1 | RELEASE FOR FABRICATION | MM / RSU | 9-24-08 |
| DRAWING | JRN | 8-12-08 | 0 | FOR APPROVAL | MM / RSU | – |


Timothy F. Mulligan, PE
2710 5th Avenue
Tampa, Florida 33605

Florida PE Registration No. 54736
Florida Cert. of Auth. No. 27234


# TAMPA TANK, INC.
TAMPA , FLORIDA

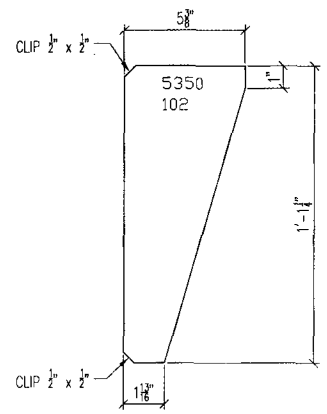
## ASSEMBLY PLAN AND DETAILS FOR 70'-0" DIA. x 20'-0" SHELL TANK

CUSTOMER: WOODRUFF & SONS, INC.
6450 31st STREET EAST
BRADENTON, FL, 3403

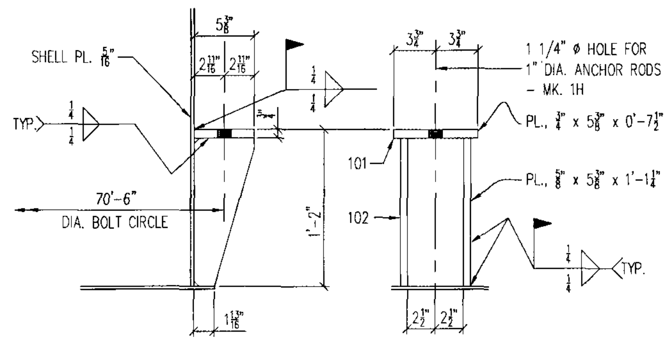
JOB SITE: HILLSBOROUGH COUNTY S.E. LANDFILL
LITHIA, FL.

CUSTOMER'S P.O. No.: 2517
FIELD WORK No.: 5350F
CONTRACT No.: TTI-5350S
SHEET No.: 2 OF 3
DRAWING No.: D-5350-01
REV.: 2

| DATE: | 9-12-08 | 9-24-08 |
|---|---|---|
| CUST: | 1 | – |
| SHOP: | – | – |
| FIELD: | – | – |
| REV: | 0 | 1 |



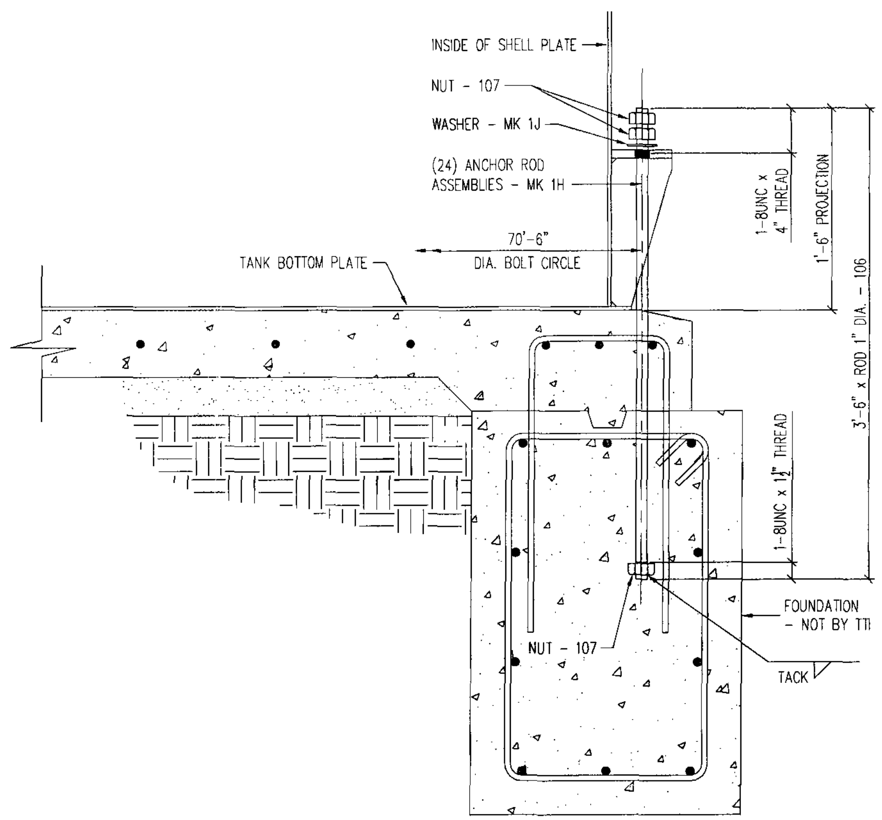

48 REQ'D - PART 102




24 ANCHOR CHAIRS REQUIRED - MK 1F
(SEE PLAN FOR LOCATION)

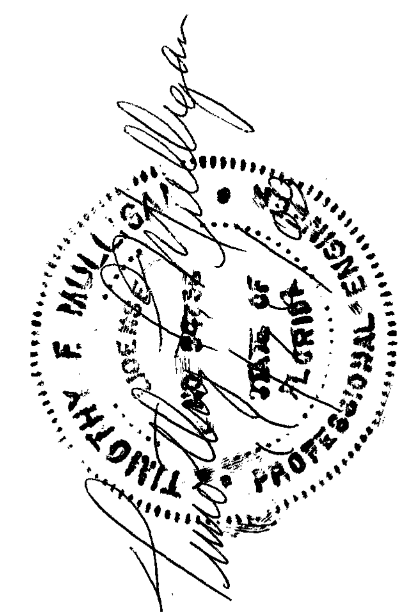
| | | | | | |
|---|---|---|---|---|---|
| | | BILL OF MATERIAL | | | |
| PART | QTY | DESCRIPTION | MATERIAL | WT EA. | TOTAL |
| 1F | 24 | ANCHOR CHAIR ASSEMBLIES | | | |
| 101 | 24 | PL., 3/4" x 5 3/8" x 0'-7 1/2" | A36 | 9 | 206 |
| 102 | 48 | PL., 5/8" x 5 3/8" x 1'-1 1/4" | A36 | 9 | 418 |
| | | | | | |
| 1H | 24 | ANCHOR ROD ASSEMBLIES | | | |
| 106 | 24 | ROD, 1" DIA. x 3'-6" | A193 Gr. B8M | 10.2 | 247 |
| | | (1-8UNC x 4" LONG ONE END AND | | | |
| | | 1-8UNC x 1 1/2" LONG ONE END.) | | | |
| 107 | 72 | 1-8UNC HEAVY HEX. NUTS | A194 Gr. 8M | 0.4 | 31 |
| | | | | | |
| 1J | 24 | PLATE WASHER | | | |
| | 24 | PL 3/8" x 2 5/8" O.D. x 1 1/16" I.D. | 316 S/S | .5 | 12 |
| | | | | | |
| | | | | | 914 |

RELEASE FOR FABRICATION
9-20-08




ELEVATION VIEW

24-ANCHOR ROD - MK 1H
(SEE PLAN VIEW FOR ANCHOR LOCATIONS
PER DWG D-5350-01, SHT. NO. 2)



Timothy F. Mulligan, PE
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Tampa, Florida 33605

Florida PE Registration No. 54736
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| | | | | |
|---|---|---|---|---|
| DATE: | 9-12-08 | 9-20-08 | 9-24-08 | |
| CUST: | - | - | - | |
| SHOP: | - | 1 | 1 | |
| FIELD: | - | - | - | |
| REV.: | 0 | 1 | 2 | |

| STATUS | BY | DATE |
|---|---|---|
| | | |
| | | |
| RELEASED TO FIELD | | |
| RELEASED FOR FABRICATION | RSU | 9-20-08 |
| APPROVAL RECEIVED | | |
| ISSUED FOR APPROVAL | | |
| CHECKED | RSU | 9-12-08 |
| DRAWING | MM | 9-12-08 |

| REV. | DESCRIPTION | BY / CHK | DATE |
|---|---|---|---|
| 2 | RELEASE REMAINDER ITEM FOR FABRICATION | MM / RSU | 9-24-08 |
| 1 | RELEASE ANCHOR ROD ASSEMBLY FOR FABRICATION | RSU / RSU | 9-20-08 |
| 0 | FOR APPROVAL | MM / RSU | - |

**TAMPA TANK, INC.**
TAMPA , FLORIDA

ANCHOR CHAIR & ANCHOR ROD DETAILS

CUSTOMER: WOODRUFF & SONS, INC.
6450 31st STREET EAST
BRADENTON, FL, 3403

JOB SITE: HILLSBOROUGH COUNTY S.E. LANDFILL
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CUSTOMER'S P.O. No.: 2517
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CONTRACT No.: TTI-5350S
SHEET No.: 3 OF 3
DRAWING No.: D-5350-01
REV.: 2

File: Z:\Jobs\2008 - 5300\5350 Woodruff\EDL\Detailing\D-5350-01.dwg Sht (3) Plotted By: tmulligan Date: Nov 26, 2008 - 11:01am