RCRA/HSWA
Permit Renewal
Application

Volume 7

October 1, 2020
VOLUME 7

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EVAPORATOR FEED TANK NO. 2 (EF2)
ASSESSMENT

LONE MOUNTAIN FACILITY

WAYNOKA, OKLAHOMA

CleanHarbors
ENVIRONMENTAL SERVICES, INC.

APRIL 2016

CA1960
6-30-2016
015493
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1. TANK SYSTEM DESCRIPTION

Clean Harbors Environmental Services, Inc., retained ENVIROTECH ENGINEERING & CONSULTING, INC., to conduct the required 5-year assessment of Evaporator Feed Tank No. 2 (EF2), as outlined in the previous January 2011 assessment. A visual inspection of Tank EF2 was conducted by Envirotech on November 25, 2015. This report is a continuation of previous five-year assessments and references the original design data developed for this tank. Evaporator Feed Tank No. 2 (EF2) is a 60-ft.-dia. circular-steel aboveground open-top wastewater storage and treatment tank installed in July 1987. The 360,000-gal. (nominal) tank is utilized for storage and incidental treatment of pre-treated wastewater. Certain wastewater not requiring pretreatment may also be stored in the tank (i.e., contaminated rainwater, landfill leachates, etc.) After storage, the wastewater is transferred for final treatment and/or disposal. The tank (along with a similar Tank EF1 and a tank holding reagent-grade bleach) is located immediately east of the pretreatment area in a common-lined concrete secondary containment system. Tank volume calculations are included in Appendix A. An "As-Built" drawing depicting the tank details is included as Figure 1.

2. TANK SYSTEM ASSESSMENT

2.1 General Description of Evaporator Feed Tank No. 2 (EF2). Evaporator Feed Tank No. 2 (EF2) is a vertical circular carbon-steel tank with a nominal 60-ft.-dia. sitting on an 8-in. channel that rests upon a concrete ring wall foundation. A sand base and high-density polyethylene (HDPE) liner leak detection system is located directly under the primary tank floor with detector pipes extending through the ring wall and liner for positive leak identification.

2.2 Design Standard(s). The tank was constructed in 1987 and appears to be field-designed and constructed. Although the tank appears to be a modified design, for purposes of this assessment, structural calculations were prepared to compare the existing tank and supports to those applicable sections in the American Petroleum Institute Standard 653 - 1995 2ND Edition (API-653) and the American Institute of Steel Construction (AISC) Manual of Steel Construction - 6TH Edition. These calculations are included in Appendices B thru D. The actual steel specifications by which the tanks are constructed are not known, but have been assumed to be A36 (carbon steel).

2.3 Hazardous Characteristics of Managed Waste(s). The wastes managed in this tank are both characteristic and listed waste, as summarized in 40 CFR Part 261, Subparts C and D. This tank is a storage tank where aqueous-based waste materials that required oxidation, neutralization, filtration, or settling (among other physical/chemical treatment methods) were stored prior to evaporation or shipment off-site. Currently, the only material placed in the tank is treated wastewater. According to Clean Harbors, the waste managed in this tank has the following general characteristics:

- \[ 4 < \text{pH} < 13; \]
- \[ \text{N} > 1; \]
The tank is lined with coal tar that is resistant to most constituents-of-concern. The coal tar liner has survived well in this working environment.

With regards to the potential for corrosion, it was determined that the pH and normality levels of the waste are the primary areas-of-concern. This was to determine the applicability of a corrosion allowance for the tank material type and thickness.

2.4 **Existing Corrosion Protection.** The tank is isolated from soil and water by a ring wall, below which is a leak detection system. This system is comprised of an HDPE liner below a layer of sand on a concrete mat foundation. The HDPE liner and concrete mat foundation isolate the sand from the underlying soil. Water may be entrained in the sand when placed prior to construction of the tank bottom, but the secondary containment system is designed to drain entrained fluids to one of the leak detection drains that penetrate the ring wall. For further protection, a coal tar liner is employed on the bottom and sidewalls of the tank interior. In addition, the tank has an exterior epoxy paint layer.

2.5 **Documented Age of Tank.** Tank EF2 was erected and installed in July 1987 and is 28-years old as of this assessment conducted in November 2015.

2.6 **Results of Leak Test.** On November 25, 2015, a visual inspection of the tank system was conducted to satisfy the requirements of a leak test. No evidence of leakage from the welds, seams, flanged connections, valves and threaded connections was observed. The leak detector pipes that extend through the ring wall foundation showed no indication of tank bottom leakage.

2.7 **Existing Data Obtained.** The existing data associated with the referenced tank is summarized in Table 2.1.

2.8 **Calculation of Foundation Loading.** The total weight of the tank and its contents equals 1,968-ton. Detailed calculations reflecting the minimum required foundation thickness and steel reinforcement are included herein as Appendix G.

2.9 **Required Structural Calculation.** The calculated required wall thickness for this tank is 0.2363-in. This thickness includes 0.0625-in. added for corrosion allowance. This corrosion allowance is based on a "best-engineering" estimate, considering the materials being treated and a 20-yr. design life. Detailed calculations required for wall thickness and structural analysis of the tank support system are included herein as Appendices B thru D.
2.10 Comparison of Actual Structural to Theoretical Values. The comparison of actual structural to theoretical values is summarized in Table 2.2. Some minor variance of instrument readings can be attributed partially to the idiosyncrasies of the testing equipment such as density of "couplant" and roughness of tank surface at each test point.

<table>
<thead>
<tr>
<th>TABLE 2.1</th>
<th>EF2 TANK DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank Diameter</td>
<td>60-ft.</td>
</tr>
<tr>
<td>Tank Height</td>
<td>16.9-ft.</td>
</tr>
<tr>
<td>Maximum Operating Level</td>
<td>15.9-ft.</td>
</tr>
<tr>
<td>Material</td>
<td>A36 (Assumed)</td>
</tr>
<tr>
<td>Wall Thickness (See Appendix B)</td>
<td>0.25-in.</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.3</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>Ambient</td>
</tr>
<tr>
<td>Maximum Volume</td>
<td>47,785-ft³</td>
</tr>
<tr>
<td>Seismic Zone</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 2.2</th>
<th>COMPARISON OF ACTUAL STRUCTURAL TO THEORETICAL VALUES FOR THE EF2 TANK</th>
</tr>
</thead>
<tbody>
<tr>
<td>WALL THICKNESS COMPARISON</td>
<td></td>
</tr>
<tr>
<td>Calculated Required Wall Thickness</td>
<td>0.2363-in.</td>
</tr>
<tr>
<td>Minimum Required Wall Thickness by API 653 (2.3.3.1)</td>
<td>0.1738-in.</td>
</tr>
<tr>
<td>Original Plate Thickness</td>
<td>0.25-in.</td>
</tr>
<tr>
<td>Measured Wall Thickness w/Coating (minimum)</td>
<td>0.279-in.</td>
</tr>
<tr>
<td>BOTTOM THICKNESS COMPARISON</td>
<td></td>
</tr>
<tr>
<td>Minimum Required Bottom Thickness by API 653</td>
<td>0.10-in.</td>
</tr>
<tr>
<td>Original Plate Thickness</td>
<td>0.24-in.</td>
</tr>
<tr>
<td>Measured Bottom Thickness w/Coating (minimum)</td>
<td>0.243-in.</td>
</tr>
</tbody>
</table>

2.10.1 Wall Thickness Comparison. During the November 2015 assessment, a visual inspection and an ultrasonic thickness corrosion survey were conducted on the tank walls. Wall thickness measurements of the interior protective surface ranging from
0.270-in. to 0.314-in. exceeded the minimum required wall thickness of 0.2363-in. and 0.1738-in., as graphically depicted on Figure 1a. The interior wall coating appeared sound and intact, with no pitting or corrosion. Separate readings indicating that the coating thickness varies are most likely the result of normal wear and tear. Furthermore, the difference in values does not indicate a reduction that would adversely impact the minimum thickness requirement.

2.10.2 Bottom Thickness Comparison. During the November 2015 assessment, a visual inspection was conducted on the tank bottom. Floor thickness measurements of the interior protective surface, ranging from 0.270- to 0.391-in., exceeded the minimum required floor thickness of 0.10-in., as graphically depicted on Figure 1a. The floor coating appeared sound and intact, with no pitting or corrosion. Separate readings indicating that the coating thickness varies are most likely the result of normal use. Furthermore, the difference in values does not indicate a reduction that would adversely impact the minimum thickness requirement.

2.10.3 Foundation Integrity. Evaporator Feed Tank No. 2 (EF2) is situated on a concrete ring foundation with a sand base. The sand base rests on a concrete slab that is tied to the foundation ring. Indications of insignificant minor cracks in the foundation ring have been coated with an impermeable coating. On the top of the foundation ring is a steel channel to which the tank is attached.

In September 1993, USPCI (former facility owner) retained Law Engineering to conduct an investigation that would yield site-specific subsurface data in the vicinity of Tank EF2. Law drilled four (4) geotechnical borings as part of this investigation. In general, the soil profile consisted of 1- to 2-ft. of gravel followed by 15- to 20-ft. of soft-to-hard, reddish-brown silty clay. A review of the data within the Law report, including the boring logs, indicates the soil strengths should be adequate to support the tank and associated ring foundation. The applicable portion of the Law report is included herein as Appendix F. In addition, a foundation design analysis is included in Appendix G.

To quantify foundation settlement since October 2001, Jviden Surveying shot nine (9) points around the perimeter of the tank on several occasions, as indicated in the monitoring documents included in Appendix E. The survey points are graphically depicted on the drawing included herein as Figure 2. These existing foundation elevations were compared with previous surveys of the same points. A graphic representation of the historical foundation data is included herein as Figure 3. The most recent survey data indicates that minor foundation movement continues to occur at a reasonably uniform rate excepting point No. 89 which demonstrated an 0.11 ft. difference in 2014 but returned to its normal level in 2015. It was determined this was due to a measurement recording error. Foundation movement appears uniform without generating a concern for structural or containment failure. Generally, the tank in its entirety has demonstrated a minor cyclical rise and fall in
Note:
1. Wall and floor thickness measured with ultrasonic test device equipment (owned by Envirotech) on Nov 25, 2015.
2. Wall thickness measured at height of 3' above floor around perimeter.
3. Thickness shown in 0.000" measured inside the tank.

NOTE:
THICKNESS IS IN INCHES AND AT DECIMAL POINT ON UPPER NUMBER
.272 TOP IS METAL THICKNESS
.008 BOTTOM IS COATING THICKNESS
Figure 3.
3. SECONDARY CONTAINMENT SYSTEM

3.1 General Description of Secondary Containment. The secondary containment system is designed and operated to prevent migration of wastes or liquids out of the system. Evaporator Feed Tank Nos. 1 and 2 are located in a reinforced-concrete-base floor area with vertical concrete sidewalls. This area is inspected on a daily basis.

A previously-reported visual inspection prior to October 2001 showed apparent stress cracks or other conditions that would indicate an insufficiency in the foundation design. The previously-referenced geotechnical investigation has addressed these issues. It was determined that this apparent failure in the concrete was due to the lack of proper steel reinforcement and/or differential settlement (consolidation) in the subgrade. The subgrade appeared to be comprised of fill material. The possibility that the subgrade was not properly compacted before the concrete was poured was suspected. It was determined that the concrete under the primary tank was in fair condition. The ground surrounding the secondary containment system is sloped to shed rainfall runoff to aid in preventing saturated soil. The containment system is walled-off and receives no direct vehicular traffic. The foundation walls and base are mass-poured in-place.

During this assessment, the concrete secondary containment area appeared to be in satisfactory condition. The walls and floor have a uniform sealant coating and an ongoing maintenance program repairs cracks on a continual basis. The ground surrounding the secondary containment system is sloped to shed rainfall runoff to aid in preventing saturation of the foundation soil.

The containment area and tanks are visually monitored on a daily basis for leaks. The floor is sloped to collect any drainage or spills. Any released tank contents or surface runoff will drain on top of the sloped concrete to the sump area. The accumulated liquids are then withdrawn within a specified time period. The secondary containment system is graphically depicted in the drawings included herein as Figures 4 and 5.

3.2 Design Standards. "As-Built" drawings for this area were obtained and utilized as a reference. The structural capacity of the foundation and walls were compared to those applicable sections in the API 653-95 and the American Concrete Institute (ACI 318/89/318r-89). These calculations were used as a guide to verify the ability of the system to contain hazardous waste.

3.3 Hazardous Characteristics of Wastes Stored. The wastes managed in the primary tank are both characteristic and listed waste, as found in 40 CFR Part 261, Subparts C and D. This tank is a storage tank where aqueous-based waste materials that required oxidation, neutralization, filtration, or settling (among other physical/chemical treatment methods) were
stored prior to evaporation or shipment off-site. Currently, the only material placed in the tank is treated wastewater. The waste managed in this tank has the following general characteristics:

- $4 < \text{pH} < 13$;
- $N > 1$;
- Temperature = Ambient; and
- Low-Solvent Constituents.

The hazardous characteristics of the waste treated in the primary tank were examined. It was determined that the pH and normality levels of the waste are the primary areas-of-concern.

### 3.4 Existing Corrosion Protection

The entire secondary containment area has been coated with Dudick, Inc. Protecto-Coat 200.

### 3.5 Documented Age of the Containment System

The secondary containment system was constructed and installed in 1987, thus making the system 28-years old at the time of this assessment. The system has undergone significant upgrading since it was initially installed to include the following:

- A coating was applied in June 2012. The secondary containment surface coating Chemproof Polymers-Permacoat 3000 on horizontal surfaces and Chemproof Polymers-Permacoat 3000V on vertical surfaces. Equivalent or superior coating materials are used during any necessary repairs to the coating. Information regarding Chemproof Polymere-Permacoat is included herein as Appendix H.
- Potential cross-connections were eliminated in 1993. The main lines from the primary treatment and storage areas exited the containment area through the floor of the secondary containment area down to the final treatment area, thereby potentially allowing material from a tank failure to migrate into the secondary containment area within the final treatment area. Elimination of this potential cross-connection acts to segregate the secondary containment area for EF1 and EF2 from any other.

### 3.6 Results of Leak Test

A visual inspection of the containment area was conducted to satisfy the requirements of a leak test. No evidence of leakage from the manways or signs of penetration of the tank or containment area was observed. Based on this inspection, this area appears to be adequate to contain any leaks or spills.

### 3.7 Existing Data Obtained

The collected data associated with the secondary containment area is summarized in Table 3.1.

### 3.8 Calculation of Existing Capacity

The volume containment capacity available (CCA) calculation is:
CCA = Gross Volume - Volume of Items in Containment - Volume of Rainfall

Detailed calculations of the available containment volume are included in Appendix I. The containment capacity available equals 59,487-cf.

<table>
<thead>
<tr>
<th>TABLE 3.1</th>
<th>SECONDARY CONTAINMENT AREA DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>14,589-ft.²</td>
</tr>
<tr>
<td>Available Wall Height</td>
<td>5.5-ft.</td>
</tr>
<tr>
<td>Material</td>
<td>Concrete</td>
</tr>
<tr>
<td>Gross Volume</td>
<td>80,240-ft.³</td>
</tr>
</tbody>
</table>

3.9 **Required Volume.** The containment capacity required (CCR) is calculated as follows:

\[
CCR = \text{Volume of Largest Tank in Secondary Containment} = (EF2) = 47,785-cf
\]

3.10 **Comparison of Available Volume to Required Volume.** The containment capacity comparison is calculated as follows:

\[
\text{Containment Capacity Required} = 47,785-cf
\]
\[
\text{Secondary Containment Volume Available} = 59,487-cf
\]
\[
\text{Excess Containment Volume} = 11,702-cf
\]
\[
\text{Safety Factor} = 1.24
\]

CCA > CCR. Adequate capacity (under normal operating conditions) is available.

4. **CONCLUSIONS**

4.1 **Primary Tank Vessel.** The tank vessel at the time of inspection is appropriate for use with the present waste stream at given densities, chemical, and physical characteristics, as verified by Clean Harbors. While the useful life of the steel tank was originally estimated at 5-years, interim inspections have revealed satisfactory service conditions. Therefore, it appears that the life may be extended up to an additional 5-years, provided an annual tank foundation survey is conducted at the points previously identified in Figure 2 to ensure that the annual maximum settlement does not exceed 1-in.

In the event the tank foundation settles more than 1-in/yr., ENVIROTECH ENGINEERING & CONSULTING, INC. requests that a new tank assessment be conducted immediately.

4.2 **Secondary Containment.** The secondary containment area at the time of inspection is appropriate for use with the present waste stream at given densities, chemical, and physical
4.2 **Secondary Containment.** The secondary containment area at the time of inspection is appropriate for use with the present waste stream at given densities, chemical, and physical characteristics. While the useful life of the secondary containment was originally estimated at 5-years, interim inspections have revealed satisfactory service conditions. Therefore, it appears that the life may be extended up to an additional 5-years, provided the constraint addressed in Section 4.1 is complied with.

5. **RECOMMENDATIONS**

5.1 **Primary Tank.** Clean Harbors should continually ensure compatibility with the waste and densities stored. Daily inspections should be continued to detect any visual corrosion or defects. Due to the known history and pattern of movement, inspection in terms of collecting and evaluating the foundation survey for settlement shall be performed between one (1) to three (3) years.

5.2 **Secondary Containment.** The secondary containment should be visually inspected periodically for any deterioration as well as structural integrity.

5.3 **Routine Inspections.** When routine and preventive measures are to be implemented, the tank should be cleaned and internally inspected to determine any interior defects or corrosion. Continued routine painting and coating of tanks on the interior and exterior, as well as routine inspections, is recommended.

6. **CERTIFICATION**

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for collecting the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment, for knowing violations."

DATED this ___________ day of April, 2016.

Ron Erdman, P.E.
ENVIROTECH ENGINEERING & CONSULTING, INC.

C.A. 1960 - Expiration 06/30/2016
APPENDIX A.

PRIMARY TANK VOLUME CALCULATIONS
PRIMARY TANK VOLUME CALCULATIONS

☐ DIMENSIONS

Geometry................................................................. Cylindrical
Diameter............................................................ 60.00-ft.
Height................................................................. 16.90-ft.
Operating Height.................................................. 15.50-ft.
Bottom................................................................. Flat

☐ TANK VOLUME

Maximum Volume.................................................. 47,785.26-cf = 357,458.57-gal.
Operating Volume.................................................. 43,826.72-cf = 327,846.63-gal.

Total Primary Tank Volume....................................... 47,785.26-cf = 357,458.57-gal.

☐ WEIGHT ON FOUNDATION

Contents S.G........................................................... 1.3
Density............................................................... 81.12-lb/cf

☐ SURFACE AREA CALCULATION

Tank Top.............................................................. n/a
Tank Bottom......................................................... 2,827.53-sf
Tank Wall........................................................... 3,185.68-sf

Total Surface Area.................................................. 6,013.21-sf

Steel Thickness - Sidewalls........................................ 0.250-in.
Steel Thickness - Bottom......................................... 0.240-in.
Volume of Steel - Sidewalls...................................... 66.37-cf
Volume of Steel - Bottom......................................... 56.55-cf
Density of Steel.................................................. 490-lb/cf
Weight of Steel (Tank)............................................. 30.12-ton = 60,230.32-lb.

Weight of Tank Contents.......................................... 1,938-ton = 3,876,340-lb.

Total Weight of Tank and Contents.......................... 1,968-ton = 3,936,570-lb.
APPENDIX B.

PRIMARY TANK WALL THICKNESS
PRIMARY TANK WALL THICKNESS

DIMENSIONS

Geometry: Cylindrical
Diameter: 60.00-ft.
Height: 16.90-ft.
Specific Gravity: 1.30
Normal Operating Temperature: Ambient

STEEL THICKNESS CALCULATIONS

Thickness (t) = \( \frac{(2.6 * \text{H} * \text{D} * \text{S.G.})}{(s \times E)} + \text{CA} \)

Thickness (t) = 23,200.00-psi
E (Joint Efficiency) = 85.00%
Thickness (t) = 0.1738-in.
Corrosion Allowance = 0.0625-in.

Calculated Minimum Wall Thickness = 0.2363-in.
APPENDIX C.

SEISMIC CALCULATIONS
SEISMIC CALCULATIONS

**DIMENSIONS**

- Diameter: 60.00-ft.
- Height: 16.90-ft.
- Weight of Tank (Steel): 75,817.00-lb.
- Weight of Maximum Contents: 3,876,340.00-lb.
- Tank Shell Thickness: 0.25-in.
- Tank Bottom Thickness: 0.240-in.

**STRESS IN TANK SHELL FROM SEISMIC FORCES**

Max. weight of tank contents that may be used to resist shell overturning moment: \( W_I \)

\[
W_I = 7.9 \times t_b \times (F_{by} \times G \times H)^{0.5}
\]

- \( F_{by} \) (Minimum Yield Strength in Bottom Plate): 36,000.00
- \( t_b \) (Thickness of Tank Bottom): 0.240
- \( G \) (Design Specific Gravity of Liquid): 1.3
- \( W_I \): 1,686.18

Note: \( W_I \) Shall Not Exceed \( 1.25 \times G \times H \times D \)

\[
1,647.75-lb/ft. \text{ of Shell Circumference}
\]

- Density of Tank Shell Material: 490.00-lb/ft
- \( WT \) (Weight of Tank Shell): 172.52-lb/ft. of Shell Circumference
- \( M/(D^2)(WT+W_I) \): 0.1071

Maximum Longitudinal Compressive Force at the Bottom of Tank Shell:

\[
b \times WT + 1.273 \times M/D^2
\]

\[
G \times H \times D^2/t^2
\]

- \( Fa \) (10^6*t/D): 4,167-psi

\[
OR
\]

- \( Fa \) (.5*Fty): 18,000-psi
- Use Minimum Value for \( Fa \): 4,167-psi
- \( b/12 \times t \): 140.21-psi

Note: \( b/12t \) Cannot Exceed \( Fa \) for a Stable Tank

**OVERTURNING MOMENT**

Overturning Moment (\( M \)): \( Z \times I \times (C_1 \times W_s \times X_s + C_1 \times W_1 \times X_1 + C_2 \times W_2 \times X_2) \)

- Zone Coefficient (\( Z \)): 0.1875
- Essential Facilities Factor (\( I \)): 1.000
Lateral Earthquake Force Coefficient (C1) ........................................... 0.240
D/H ......................................................................................... 3.55
k Factor (@ D/H = 3.55) ....................................................... 0.680
Site Amplification Factor (S) ..................................................... 1.5
Natural Period of First Sloshing Mode (T) .................................... 5.11
Lateral Earthquake Force Coefficient (C2) ..................................... 0.07755
Weight of Tank (Wt) ................................................................ 60,230.32
Weight of Tank Contents (Wt) ...................................................... 3,876,340.00
W1 / Wt (@ D/H = 3.55) .......................................................... 0.32
W2 / Wt (@ D/H = 3.55) .......................................................... 0.60
Weight of Effective Mass (W1) ................................................... 1,240,428.80
Weight of Effective Mass (W2) ................................................... 2,325,804.00
Height from Bottom of Shell to Center of Shell (Xs) ...................... 8.45
X1/H ....................................................................................... 0.38
Height from Bottom of Center of Lateral Seismic Force (X1) .......... 6.422
X2/H ....................................................................................... 0.55
Height from Bottom of Center of Lateral Seismic Force (X2) .......... 9.295

Overturning Moment (M) .......................................................... 695,718-ft/lb.

Opposing Moment (M*) ............................................................ 118,097,110-ft/lb.
APPENDIX D.

WIND LOAD CALCULATIONS
WIND LOAD CALCULATIONS

DIMENSIONS

Diameter .............................................................................................................. 60.00-ft.
Height .................................................................................................................. 16.90-ft.
Weight of Tank (Steel) ....................................................................................... 60,230.32-lb.
Weight of Max. Contents .................................................................................. 3,876,340.00-lb.
Tank Shell Thickness ......................................................................................... 0.25-in.
Tank Bottom Thickness ..................................................................................... 0.240-in.

OVERTURNING MOMENT FROM WIND LOADS

\[ M = \text{Overturning Moment Due to Wind Loading} \]
\[ M = Pw \times Ap \times Hc \]
\[ Pw = \text{(Wind Pressure - Assume 18-psi for 100-MPH Wind on Cylinders)} \] = 18.00-psi
\[ Ap = \text{(Projected Frontal Area of Tank (H*D))} \] = 1,014-Ft²
\[ H1 = \text{(Height from Ground to Centroid of Tank)} \] = 8.45-ft.
\[ M = 154,229.40-ft-lb. \]
\[ M_{\text{Max}} = W \times \frac{(W + D)}{2} \]
\[ W = \text{(Weight of Tank)} \] = 60,230.32-lb.
\[ M_{\text{Max}} = 1,192,560-ft-lb. \]

\[ M \text{ Must Be Less Than } M_{\text{Max}} \]
APPENDIX E.

FOUNDATION INTEGRITY MONITORING DOCUMENTS
Annual Tank In-Service Inspection Checklist

Tank Name: EF-2
Tank Location: WWT
Inspected By: ______________
Date: 10-23-2014
Signature: ______________

Date of Last Inspection: ______________

I. Foundation

A. Measure foundation levelness and bottom elevations (8 points for EF-1 and 9 points for EF-2).
Note: No other tanks require foundation levelness and elevation survey.

**EF-1:**

<table>
<thead>
<tr>
<th>Point</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>47</td>
</tr>
<tr>
<td>271</td>
<td>279</td>
</tr>
</tbody>
</table>

**EF-2:**

<table>
<thead>
<tr>
<th>Point</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>1425.85</td>
</tr>
<tr>
<td>73</td>
<td>1425.94</td>
</tr>
<tr>
<td>31</td>
<td>1426.02</td>
</tr>
<tr>
<td>89</td>
<td>1425.92</td>
</tr>
<tr>
<td>131</td>
<td>1425.70</td>
</tr>
<tr>
<td>205</td>
<td>1425.62</td>
</tr>
<tr>
<td>211</td>
<td>1425.70</td>
</tr>
<tr>
<td>219</td>
<td>1425.79</td>
</tr>
<tr>
<td>227</td>
<td>1425.70</td>
</tr>
</tbody>
</table>

B. Has the yearly maximum settlement exceeded 1 inch? (EF-1 and EF-2 only)

**EF-1:**

Yes____ No____

**EF-2:**

Yes____ No____

C. Check 8 inch annular channel for deflection of more than 2 degrees from its correct position. (EF-1 only)

Deflection ______________

Comments:

_________________________________________________________________

_________________________________________________________________
Annual Tank In-Service Inspection Checklist

Tank Name: EF-2  Tank Number: 2

Tank Location: WWPT  Date:

Inspected By:  Signature:  

Date of Last Inspection: 12-03-2013

I. Foundation

A. Measure foundation levelness and bottom elevations (8 points for EF-1 and 9 points for EF-2).
   Note: No other tanks require foundation levelness and elevation survey.

   EF-1:
   37  47  55  283
   271  279  293  303

   EF-2:
   65  1425.84
   73  1425.95
   31  1426.03
   69  1425.88
   131 1425.70
   205 1425.62
   211 1425.70
   219 1425.79
   227 1425.79

B. Has the yearly maximum settlement exceeded 1 inch? (EF-1 and EF-2 only)

   EF-1:  
   EF-2:  
   Yes ______  No ______  Yes ______  No ______

C. Check 8 inch annular channel for deflection of more than 2 degrees from its correct position. (EF-1 only)

   Deflection

Comments:
November 22, 1993

Ir. Walter Sonne, P.E.
USPCI, Inc.
515 West Greens Road, Suite 500
Houston, Texas 77067

SUBJECT: REVISED REPORT OF GEOTECHNICAL EXPLORATION
Expansion of Wastewater Treatment Facilities--Lone Mountain Facility, Major County, Oklahoma
Law Engineering Projects No. 392-01406-01

Law Engineering, Inc. has completed the geotechnical exploration at the subject site. Our services were provided in accordance with our Revised Proposal for Geotechnical Exploration Services No. HP-8173-93G, dated September 22, 1993; and a Request for Change Order letter dated October 12, 1993. This report briefly discusses our understanding of the project information, describes our exploratory procedures and findings, and presents our recommendations and conclusions. The data obtained during the field exploration and from the laboratory testing program is presented in the endcices.

We will be happy to discuss our recommendations with you and would welcome the opportunity to provide the additional studies or construction testing services necessary to complete this project. We look forward to serving as your geotechnical engineer on the remainder of this project and on future projects.

If you have any questions, or if you require additional information, please do not hesitate to contact us.

Sincerely,

Law Engineering, Inc.

Fernando Pons, E.I.
Project Geotechnical Engineer

Distribution Copies:
Walter Sonne (2) - USPCI
Larry Mar (1) - USPCI/LAW COMPANIES GROUP, INC.

Michael W. Palmer, P.E.
Principal Geotechnical Engineer
USPCI - Client Manager

Michael H. Homan, P.E.
Principal Geotechnical Engineer
Oklahoma Registration No. 15777
REVISED REPORT OF GEOTECHNICAL EXPLORATION

EXPANSION OF WASTEWATER TREATMENT FACILITIES

LONE MOUNTAIN FACILITY
MAJOR COUNTY, OKLAHOMA

prepared for
USPCI, Inc.
HOUSTON, TEXAS

LAW ENGINEERING PROJECT NO. 392-1406-01

NOVEMBER 1993
1.0 PURPOSE OF EXPLORATION

The purpose of this exploration was to obtain specific subsurface data at the site and to provide recommendations and opinions for:

- General geotechnical design and construction criteria for the Expansion of Wastewater Final Treatment Facilities (WWFT): Phase I (Expansion of the WWFT Building) and Phase II (Leachate Storage Tanks).

- Site preparation and construction of compacted fills for the WWFT Phase I, and the WWFT Phase II.

- Soil stratigraphy at the Wastewater Pretreatment Facilities (WWPT): Phase III tanks.

It should be noted that it was not the purpose of this study to directly assess or to address any environmental conditions at the site, i.e., the presence of contaminants or substances in the soil, rock, or ground water. An additional study should be undertaken if USPCI decides to specifically address environmental conditions.
2.2 LEACHATE STORAGE TANKS

We understand that USPCI plans to construct three tanks within a containment area. The proposed site of construction is south of Cell 4. The proposed tanks will include a 60-foot diameter, 16-feet tall, 300,000 gallon tank; and two 33-foot diameter, 16-feet tall, 100,000 gallon tanks.

The proposed tanks, containing leachate with a specific gravity of 1.3, will be located within a concrete containment structure with walls on the order of 7 feet in height.

We understand that the preferred foundation system at the present time is a drilled pier underground system, 18-inch diameter, straight-sided drilled piers founded at 8-feet on centers. In turn, these drilled piers will support the containment wall and a 10-inch thick concrete slab on 6 inches of sand and 24 inches of structural fill.

2.3 WASTEWATER PRETREATMENT (WWPT) BUILDING

We understand that two existing on-line 300,000 storage tanks structures within the Wastewater Pretreatment (WWPT) Building are experiencing foundation distress. We further understand that these two tanks and the containment area are supported on shallow footings.
4.1.3 Wastewater Pretreatment (WWPT) Building

Exploration borings L-5, L-6, L-6A, and L-7 were drilled in this area. The measured surface elevation of these borings were 1418.35, 1428.62, 1428.48, and 1430.23 feet MSL, respectively, as provided by USPCI. The subsurface conditions for this area are generalized as follows:

AREA C

WASTEWATER PRETREATMENT BUILDING

(Borings L-5, L-6, L-6A, and L-7)

<table>
<thead>
<tr>
<th>STRATUM</th>
<th>DEPTH (ft)</th>
<th>DESCRIPTION</th>
<th>USCS CLASSIFICATION^1</th>
</tr>
</thead>
<tbody>
<tr>
<td>I C</td>
<td>0 to 2</td>
<td>FILL: GRAVEL</td>
<td>Unclassified</td>
</tr>
<tr>
<td>II C</td>
<td>1 to 22.5</td>
<td>FILL: Soft to hard, reddish brown with gray, silty CLAY, with gypsum fragments and gravel.</td>
<td>CL</td>
</tr>
<tr>
<td>III C</td>
<td>15.5 to 20.5</td>
<td>Very stiff to hard, reddish brown with gray, silty CLAY, with gypsum fragments and gray silt streaks.</td>
<td>CL</td>
</tr>
<tr>
<td>IV C</td>
<td>18.5 to TOB(^2)</td>
<td>Gray silty CLAYSTONE to reddish brown silty CLAYSTONE.</td>
<td>Unclassified</td>
</tr>
</tbody>
</table>

Termination of Boring
Unified Soil Classification System
ith reference to the Soil Stratum Summary, the TEST BORING RECORDS, Soil Profiles and the Laboratory Test Results, our discussion of the soil conditions for Area C is as follows:

Stratum IC consists of GRAVEL to gravelly fill soils encountered in all borings from a existing surface to approximately 2 feet below existing grade.

Stratum IIc consists of fill soils of soft to hard, reddish brown with gray, silty CLAY with epsom fragments and gravel. Law personnel performed continuous sampling with Shelby tubes, and utilized on-site extruding techniques to better identify the extent of this fill stratum. These fill soils were encountered from a depth of 1 foot from existing surface 22.5 feet below grade. Organic odor and wet seams were identified in the lower two feet of this formation in Borings L-6 and L-7. Plasticity for this stratum was medium with plasticity index values ranging from 17 to 21. Liquid limit values range from 43 to 45 percent and plastic limit values range from 24 percent to 26 percent. Stratum IIc soils were generally moist with occasional wet seams. Natural moisture contents ranged from 21 to 30 percent, and were from 0 to 2 percent above corresponding PL values.

Pocket penetrometer tests and laboratory unconfined compression tests, on relatively undisturbed samples, indicated shear strength values that varied erratically throughout the fill depth in Borings L-5 (easternmost boring). Shear strength values in Borings L-6 and L-7 were similar throughout the same depths of the fill stratum. There was a similar uniform decrease of shear strength values with depth in Borings L-6 and L-7 to a depth approximately 12.5 feet. (See TEST BORING RECORDS L-6 and L-7).

Stratum IIc consists of very stiff to hard, reddish brown with gray, silty CLAY with epsom fragments and gray silty streaks. These soils were encountered in all borings, except Boring L-5, from 15.5 feet from existing surface to a depth of 20.5 feet below grade. One Standard Penetration Test N-value was 40 blows per foot (bpf) at a depth of 17 feet in Boring L-6A. Plasticity for this stratum was medium with a plasticity index value of 13, a LL value of 32 percent, and a PL value of 19 percent. One natural moisture content was 24 percent. Based on this natural moisture content and corresponding Casagrande Limit tests, the soil was very moist with a moisture content 5 percent above the corresponding PL value. Pocket penetrometer tests resulted in cohesion values ranging from 3,750 psi to an excess of 4,500 psi.
Stratum IV-C consists of gray silty CLAYSTONE to reddish brown silty CLAYSTONE. This formation was encountered from a depth of 18.5 feet below existing surface to termination depth. Standard Penetration Test N-values resulted in refusal values ranging from 6 inches per 50 blows to 4.5 inches per 50 blows. One natural moisture content was 21 percent. All pocket penetrometer tests resulted in cohesion values in excess of 4,500 psf.

4.2 WATER LEVEL CONDITIONS

Water level observations were made in the boreholes during drilling operations and 24 hours after completion of drilling to investigate the short term ground water levels.

Ground water was identified during our subsurface exploration at depths of 7 feet and 3.5 feet in Borings L-1 and L-2A, respectively (24 hour readings). Ground water was encountered 1.5-feet to 1-foot above the top of the claystone formation in these borings.

Borings L-3 and L-4 were dry at the time of drilling and 24 hours thereafter.

Water was identified during drilling at a depth of 24 feet below existing ground surface in Boring L-5. Boring L-6 was dry to termination depth during drilling operations and 24 hours thereafter. Ground water was not identified in Borings L-6A and L-7 during and immediately following drilling operations. Law personnel could not obtain 24 hour water level readings at L-5, L-6A, or L-7, due to caving soils in L-5 at 15.8 feet, and surficial cuttings that obstructing the boreholes at L-6A and L-7.

Fluctuations in rainfall, evaporation, construction activity, surface runoff, and other site specific factors could cause ground water conditions at the time of construction to vary from that observed during our field exploration.
3.4.3 Settlement

Predicted settlements for the drilled piers will be relatively small and are expected to be limited to the elastic compression of the founding claystone formation. The maximum total settlement of any drilled shaft under the anticipated sustained loading conditions is predicted to be less than 0.25 inch.

3.5 CONSTRUCTION CONSIDERATIONS

Once a foundation excavation is completed, the setting of reinforcing steel and placement of concrete should proceed expeditiously to reduce exposure of the bearing stratum and possible disturbance of the material. Should the bottom of an excavation become disturbed due to ponding of water or desiccation, the disturbed soils should be removed before concrete is placed.

I recommend that the geotechnical engineer, or their representative, observe the dewatering excavations immediately prior to placing concrete. The engineer should compare the soils exposed with those encountered in the soil test borings and document the results. Any significant differences should be brought to the attention of the Owner's representatives along with appropriate recommendations. The foundation bearing area should be level or suitably benched. It should also be free of loose soil, ponded water and debris prior to the inspection.

3.6 WASTEWATER PRETREATMENT BUILDING STRATIGRAPHY

We understand that two existing on-line 300,000 storage tanks structures within the Wastewater Pretreatment (WWPT) Building are experiencing foundation distress. We further understand that these two tanks and the containment area are supported on shallow footings, which are currently bearing in fill soils consisting of soft to hard, reddish brown with gray, silty CLAY with gypsum fragments and gravel (Stratum II C).
As discussed previously in this report, the soil stratigraphy encountered in the WWPT area generally consists of silty fill soils to a maximum depth of 22.5 feet underlain by silty clay soils which grade into claystone. Law personnel performed continuous sampling in borings L-5, L-6, and L-7 and utilized Shelby tubes and on-site extruding techniques to better identify the extent of this fill stratum.

The properties of the soils, deemed significant in the evaluation of distress of the structures, are the following:

(a) the moist condition of the silty clay fill soils (Stratum II C) at the site;

(b) the medium shrink-swell potential of the silty clay matrix within the zone of major seasonal moisture change;

(c) the erratic variation in consistency of the fill soils encountered in Boring L-5;

(d) the similar uniform decrease in shear strength in Borings L-6 and L-7 to a minimum at approximately 13 feet from existing ground level;

(e) the presence of wet seams, organics, and organic odor in the fill soils of Boring L-6 and Boring L-5;

(f) the presence of ground water in Boring L-5 at a depth of 24.5 feet;
FIGURE 3
Boring Location Plan—Phase III
Expansion of Wastewater Treatment Facilities
Lone Mountain Facility
USPCI
Major County, OK
Law Engineering
#392-01406-01

☑ Bore Location

No Scale
### Boring Record

<table>
<thead>
<tr>
<th>BORING NUMBER</th>
<th>PROJECT NUMBER</th>
<th>DATE DRILLED</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-7</td>
<td>WWF Facilities</td>
<td>October 1, 1993</td>
</tr>
</tbody>
</table>

#### Sample Information

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>DESCRIPTION</th>
<th>MATERIAL</th>
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</thead>
<tbody>
<tr>
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</tbody>
</table>

#### Test Results

<table>
<thead>
<tr>
<th>PENETRATION (ip)</th>
<th>COHESION (lb/sq ft)</th>
<th>FRICTION (lb/sq ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
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<td>0</td>
</tr>
<tr>
<td>90</td>
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<td>8</td>
</tr>
<tr>
<td>10</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Soils

- **Claystone**
- **Sandstone**
- **Siltstone**
- **Gray clay**
- **Gray marl**

#### Descriptions

- Boring terminated at 75 feet.
- Reddish-brown with some depth.
- Lay with 50 feet of fine sand.
**DESCRIPTION OF MATERIAL**

**SURF. EL.: 1428.48 ft. MSL**

**VEL**
- Very stiff to soft, reddish brown, silty
- Contains gypsum fragments and gravel

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>ELEVATION</th>
<th>SCALES / TESTS</th>
<th>Plastic Limit (%)</th>
<th>NM (%)</th>
<th>Liquid Limit (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1423.5</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10</td>
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</tr>
<tr>
<td>25</td>
<td>1403.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COHESION (100 psi)**
- Cohesion (100 psi):
- 5.875 psi

**BORING TERMINATED AT 25 FEET**

---

**TEST BORING RECORD**

**BORING NUMBER**: L-6A

**DATES DRILLED**
- **Start**: October 1, 1993
- **Completer**: October 1, 1993

**PROJECT NUMBER**: 392-01406-01

**PROJECT**: Expansion of WWT Facilities

---

**KEY SHEET FOR EXPLANATION OF MBOLS AND ABBREVIATIONS USED ABOVE**

---

**LAW ENGINEERING**

*Tulsa, Oklahoma*
### Scription of Material

**Surface El:** 1428.620 MSL

**Legend:**
- LF: Layer
- G: Gravel
- S: Sand
- C: Clay
- O: Organic
- W: Water

**Soil Descriptions:**
- **Clay:** Soft to hard, reddish brown silty clay
  - with fragments and gravel
  - **Gray at 4'-6'**
  - Wet seams at 8'-10'
  - Some paper or plastic debris
  - Moist at 12'
  - Wet seams and organic at 10' - 12'
  - Organic odor and 1" to 2" thick wet seam
  - Loches, wet seams and organic
  - 7' to 15'
  - Brown with some gray, silty clay with
  - Silt streaks
  - Run from 16' to 18'

**Tests:**
- Plastic Limit (%)
- NEC (%)
- Liquid Limit (%)

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Depth (ft)</th>
<th>Plastic Limit</th>
<th>NEC</th>
<th>Liquid Limit</th>
</tr>
</thead>
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<td>4</td>
<td>15.0</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Key Sheet:**
- BOREHOLE: N10826.38 E9250.81
- Borehole advanced
- 15 truck-mounted drill rig using 3 1/4" I.D. hollow
- Borehole dry 24 hours after drilling.

**Test Boring Record**

- **Boring Number:** L-6
- **Dates Drilled:**
  - Start: October 1, 1993
  - Complete: October 1, 1993
- **Project Number:** 392-01406-01
- **Project:** Expansion of WWT Facilities

**Page:** 1 of 1
### Description of Material

**Surf. El.: 1418.35 ft. MSL**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Elevation</th>
<th>Samples / Tests</th>
</tr>
</thead>
<tbody>
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<tr>
<td>2</td>
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<td></td>
</tr>
<tr>
<td>15</td>
<td>1398.4</td>
<td></td>
</tr>
</tbody>
</table>

#### Description
- Soft to hard, reddish brown with gray, silty with some gravel
- Organic matter and organic odor at 22 ft
- Wet seam with some gravel
- Brown silty claystone
- Tube refusal at 23 ft
- Boring terminated at 25 ft

---

### Test Boring Record

**Boring Number:** L-5

**Dates Drilled:**
- Start: October 1, 1993
- Complete: October 1, 1993

**Project Number:** 392-01406-01

**Project:** Expansion of WWT Facilities

---

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE.
APPENDIX G.

FOUNDATION DESIGN ANALYSIS
FOUNDATION DESIGN ANALYSIS

DIMENSIONS

- Diameter: 60.00-ft.
- Height: 16.90-ft.
- Weight of Tank (Steel): 60,230.32-lb.
- Weight of Max. Contents: 3,876,340.00-lb.
- Tank Shell Thickness: 0.25-in.
- Tank Bottom Thickness: 0.240-in.

CONCRETE FOUNDATION DESIGN

- Assumed Footing Depth: 48-in.
- Assumed Footing Width: 12-in.
- Assumed Effective Soil Pressure - (Based on Law Engineering Investigation): 1,500-psf
- Max. Bottom Shell Compression - (Based on Seismic Analysis): 420.63-lb/ft. of circ.
- Footing Width: 1.00-ft.
- Actual Applied Loading: 420.63-psf

The actual applied loading is significantly less than the assumed effective soil pressure and therefore, the foundation should be stable.
APPENDIX H.

CHEMPROOF, PERMACOAT 3000 DOCUMENTATION
DESCRIPTION
PERMACOAT 3000 is a 100% solids floor coating. PERMACOAT 3000 can be utilized as a glaze coat for the PERMATEC high build floors, or as a two coat floor or containment system (30-80 mils). When applied as a two coat floor or containment system, a silica broadcast is used between coats.

The PERMACOAT 3000 consists of two components, resin and hardener, in both the horizontal and vertical formulations. Its application is accomplished with rubber squeegees and short nap paint rollers.

FUNCTION
PERMACOAT 3000 is designed as a medium duty (30-80 mils) floor coating and/or secondary containment system where moderate mechanical abuse and chemical exposure are anticipated, so you may use the Chemical Resistant Flooring. PERMACOAT 3000 can be installed over most sound floors, including new or old concrete, steel and wood, providing a cost effective alternative to high-build floor toppings.

TYPICAL APPLICATIONS
- Food processing plants
- Chemical processing plants
- Breweries
- Laboratories
- Pulp and paper mills

TYPICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids, by Volume</td>
<td>100%</td>
</tr>
<tr>
<td>Hardness Shore D</td>
<td>82-85</td>
</tr>
<tr>
<td>ASTM D2240</td>
<td></td>
</tr>
<tr>
<td>Taber Abrasion Loss/1000</td>
<td></td>
</tr>
<tr>
<td>CS 17 Wheels</td>
<td></td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>14,400 psi</td>
</tr>
<tr>
<td>ASTM C579</td>
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<tr>
<td>Flexural Strength</td>
<td>16,500 psi</td>
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<tr>
<td>ASTM D790</td>
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<tr>
<td>Tensile Strength</td>
<td>11,000 psi</td>
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<tr>
<td>ASTM D307</td>
<td></td>
</tr>
<tr>
<td>Bond Strength to Concrete</td>
<td>Exceeds tensile strength of concrete. Failure in concrete</td>
</tr>
<tr>
<td>ASTM D4541</td>
<td></td>
</tr>
</tbody>
</table>

PACKAGING & COVERAGE
PERMACOAT 3000 is packaged in one and three gallon units. Each unit consists of premeasured components, Part A (Resin) and Part B (Hardener).

Application thickness may vary from 30 to 80 mils, depending on the expected service conditions. Factors to consider are 1) length of chemical exposure; 2)mechanical abuses; and 3) substrate texture.
PERMACOAT 3000 Chemical Resistant Flooring

- Processing area in general where chemicals are used
- Any area that requires a safe, non-slip floor

**FEATURES**

PERMACOAT 3000 allows for fast, easy application. It also offers chemical resistance and physical performance much higher than those found in paints and other thin mil coatings.

Note: At 30-50 mils, PERMACOAT 3000 provides excellent chemical resistance for splash and spill exposures. In addition, when applied at 50-80 mils, it can often be recommended for containment service. (For specific recommendations refer to PERMATEC 3000 "Chemical Resistance Guide" and your local distributor.)

**OTHER FEATURES INCLUDE:**

- Rapid cure resulting in minimal "downtime"
- Odor-free
- Nonskid safety finish optional

**MIXING**

Prior to application, the PERMACOAT 3000 (Resin, Hardener, and Silica) and the substrate should be between 70 degrees and 95 degrees F.

Premix the Resin (Part A) for 30 seconds using a Jiffler mixer blade attached to a 500-750 RPM drill. Add the Hardener (Part B) only when the batch is ready to be applied. Mix for approx. 90-120 seconds. After mixing pour immediately onto floor.

**APPLICATION**

Use a rubber squeegee to spread

**CURE TIME**

The cure time of PERMACOAT 3000 and other resinous systems are very dependent upon the temperature of the substrate. The chart below represents the approximate times for the respective service conditions, following the last coat:

<table>
<thead>
<tr>
<th>Service (hours)</th>
<th>70°F</th>
<th>80°F</th>
<th>90°F</th>
</tr>
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<tr>
<td>Foot traffic</td>
<td>10</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Light Chemical</td>
<td>14</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Fork Lift</td>
<td>20</td>
<td>16</td>
<td>12</td>
</tr>
</tbody>
</table>

**CLEAN-UP**

All mixing and application equipment should be cleaned immediately after use. If this is done, soap and water, or biodegradable cleaners can be used. If the material has begun to set, more aggressive solvents may be necessary. Before using solvents, refer to their respective MSDS for handling considerations.

**MAINTENANCE**

For systems designed for splash and spill exposures, routine washdowns are recommended to reduce the length of chemical exposure. This step is not necessary where the product is recommended for containment service.

**WARRANTY**

For product warranty see ChemProof Polymers, Inc. "Standard Limited Warranty." If one is not included with this literature contact your local distributor or ChemProof Polymers, Inc. for a copy.

**STORAGE & SHELF LIFE**

PERMACOAT 3000 should be stored at 50-90°F out of direct sunlight. All containers should
the resin over the pre-measured area to be covered. Immediately back roll the PERMACOAT 3000 with a short nap (1/8 inches) wool or mohair roller. At this point several pre-specified readings should be made with a wet mil gauge to assure uniform coverage. After the coating has been back rolled and uniform thickness verified, the surface should be saturated with a silica broadcast.

After the first coat supports foot traffic, the excess silica can be removed. Within 24 hours a second coat of PERMACOAT 3000 should be applied using the same procedure, minus the silica broadcast.

Note: Additional broadcasts and roll coats can be utilized to increase floor thickness.

SAFETY
PERMACOAT 3000 contains blended Epoxies as the resin and blended Amines as the hardener. Protective clothing and gloves are recommended to prevent sensitization to these materials. In case of ingestion or eye contact, contact a physician immediately. MSDS are available for this product upon request.

remain unopened until ready for use. If stored as set out above, PERMACOAT 3000 has a minimum shelf life of one year.

WHERE PERMACOAT 3000 SHOULD NOT BE INSTALLED PERMACOAT 3000 should not be applied over substrates:

- which are wet during the application
- subject to hydrostatic pressure
- which are unsound
- which are contaminated and cannot be cleaned
- at temperatures below 70°F
  (consult ChemProof Polymers)
APPENDIX I.

SECONDARY CONTAINMENT CALCULATIONS
SECONDARY CONTAINMENT CALCULATIONS

☐ DIMENSIONS

EF Tank Diameter ................................................................. 60.00-ft.
PCL Tank Diameter ............................................................. 12.00-ft.
Secondary Containment Height - Hsc ...................................... 5.50
Secondary Containment Surface Area - Asc ............................. 14,589.00-sf
Gross Volume of Secondary Containment .............................. 80,239.50-cf

☐ DISPLACEMENT VOLUMES

EF Tank Base (PI*D^2/4*Hsc) .................................................. 15,551.42-cf
PCL Tank Base (PI*D^2/4*Hsc) ............................................... 622.06-cf

Note: Displacement volumes include only one of the EF tanks. It is assumed that a failed tank would not displace available secondary containment.

Displacement Volume ........................................................... 16,173.47-cf

☐ RAINFALL VOLUMES

Depth of Rainfall .................................................................... 6.150-in.
Impacted Area ........................................................................ 8,934.00-sf
Rainfall Volume ....................................................................... 4,578.68-cf

☐ CONTAINMENT CAPACITY AVAILABLE

CCA .............................................................. Gross Volume - Displacement Volume - Rainfall Volume
CCA ....................................................................................... 59,487-cf

Volume of Largest Tank (EF1) .................................................. 47,785.26-cf

Excess Containment Volume .................................................... 11,702-cf

Safety Factor ........................................................................... 1.24
SECTION EF3
Mr. Don Dillie
Project Engineer
USPCI, Inc.
Lone Mountain Facility
Route 2, Box 180A
Waynoka, Oklahoma 73860

Re: Evaporator Feed Tank No. 3 (EF3)
Tank Installation

June 14, 1993

Dear Mr. Dillie:

At the time of our inspection of Evaporator Feed Tank No. 3 (EF3) at the Lone Mountain Facility, there were no visual apparent weld breaks, punctures, scrapes of protective coatings, cracks, corrosion or damage due to construction or installation. This is to certify that Evaporator Feed Tank No. 3 was installed in such a manner which did not produce any structurally adverse conditions in accordance with 40 CFR 264.192(b).

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment of knowing violations.

If you have any questions please feel free to call us at 405-755-5325.

Sincerely,

E.E. Myers

cc: Larry Oden
Jim Williams
Dennis Dodd

FILE INSTRUCTIONS

Unit: Food Treatment
Project: EF3 Tank Assessment
Section: Tank Certification

Rev'd by: L.J. ODEN
ROUTE | COPY
File: D-5200

1102 NORTH STRATFORD DRIVE • SUITE 1400 • OKLAHOMA CITY • OKLAHOMA 73120 • 405/733-3525 • FAX 405/733-9
Mr. Don Dillie  
Project Engineer  
USPCI, Inc.  
Lone Mountain Facility  
Route 2, Box 160A  
Waynoka, Oklahoma 73060

Re: Evaporator Feed Tank No. 3 (EF3)  
Tank Leak Test

Dear Mr. Dillie:

Evaporator Feed Tank No. 3 (EF3) was tested for leaks by the tank manufacturer before shipping. Once the tank was installed, and before it was put into service, it was filled with water and allowed to remain in hydraulic static equilibrium for a period of several hours. The tank did not leak during this period in accordance with 40 CFR 264.192 (d).

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment of knowing violations.

If you have any questions please feel free to call us at 405-755-5325.

Sincerely,

E. E. Myers

cc: Larry Oden  
Jim Williams  
Dennis Dodd

FILE INSTRUCTIONS

Unit: Final Treatment
Project: Tank Assessment
Section: Tank Construction
Recvd. by: L. J. ODEN
ROUTE COPY
FILE D. DODD
SECTION 301
ASSESSMENT OF EVAPORATOR FEED STORAGE TANK No. 3 (EF3)
LONE MOUNTAIN HAZARDOUS WASTE FACILITY
U.S.P.C.I.
WAYNOKA, OKLAHOMA

A. TANK SYSTEM DESCRIPTION

The Evaporator Feed Storage Tank No. 3 (EF3) is a new cylindrical carbon steel aboveground vertical tank located in the wastewater treatment building of the Lone Mountain Hazardous Waste Facility. The Evaporator Feed Storage Tank No. 3 and its ancillary equipment are located together in a concrete curbed containment area.

B. PRIMARY TANK VESSEL

1. General Description

The Evaporator Feed Storage Tank No. 3 is being assessed to determine if the unit is adequately designed with sufficient structural strength, and compatibility with the waste to be treated. The Evaporator Feed Storage Tank No. 3 will be used to store treated wastes prior to entrance into the exchanger units. The tank is vertical in position, aboveground and cylindrical in shape. The tank is supported by a skirted base. The Feed Tank has a slightly elevated temperature due to the return waste line from the Flash Tank.

2. Design Standards.

Structure calculations were performed to compare the existing tank and supports to those sections that are applicable in the American Petroleum Institute Standard 650 - 1988 edition (API-650) and the American Institute of Steel Construction (AISC) Manual of Steel Construction (8th Edition). These calculations can be found in the Appendix of this report. The tank was built to API-650 Standards and the steel specifications and mill test reports will be located in Appendix F. Appendix A and M were utilized from API-650 due to the small diameter and elevated temperature.

3. Hazardous Characteristics of Wastes Treated

The wastes which are treated in this tank have the following characteristics:

Treated wastes
pH (4-12)
N < 6
Temperature = < 245°F
The hazardous characteristics of the waste treated in this tank were examined. It was determined that the pH and normality levels of the waste are the primary areas of concern. This was to determine the applicability of a corrosion allowance for the tank material type and thickness.

4. Existing Corrosion Protection

The tank is coated on the inside with Sherwin Williams Hi-Mil Sher Tar Epoxy. The exterior is painted with Glidden Epoxy Primer No. 5466. It should be noted that when thickness calculations were compared, a 1/8" corrosion allowance was used.

5. Documented Age of Tank

The tank was manufactured by Delta Tanks of Houston Texas in March of 1993. The tank was installed in April, 1993.

6. Result of Leak Tests

A leak test was performed by the manufacturer and witnessed by an inspector prior to shipment. An inplace leak was performed and no leaks were found.

7. Existing Data Obtained

| Diameter of Tank | 6'4" |
| Height           | 12'  |
| (Normal Operating Level) | 11'  |
| Material         | Carbon Steel (ASTM A-36) |
| Wall Thickness   | 0.375" |
| Specific Gravity | 1.5   |
| Operating Temperature | 245°  |
| Maximum Volume   | 1625 Gal. |
| Normal Operating Volume | 1389 Gal. |
| Seismic Zone     | 1     |

8. Calculation of Foundation Loading

Total Weight of Tank and Contents = 11.42 tons

Detailed calculations reflecting the volume and weight of the tank are found in appendix A. The minimum required foundation thickness and steel reinforcement are included in appendix E of this assessment.
9. Required Structural Calculation

The calculated required wall thickness for this tank is 0.1448 inches. 0.125 inches is added for corrosion allowance. This corrosion allowance is based on a best engineering estimate taking into account the materials being treated and a 20 year design life. (See appendix B of this assessment for detailed calculations or required wall thickness and structural analysis of the tank support system.) The API-650 standard and Appendix A and M were used in determining the maximum allowable stress. The maximum allowable stress for this tank will be 17,600 psi.

10. Comparison of Actual Structure to Theoretical Values

<table>
<thead>
<tr>
<th>Wall Thickness Comparison</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculated Required Wall Thickness</td>
<td>0.1448&quot;</td>
</tr>
<tr>
<td>Minimum Required Wall Thickness By API 650-88</td>
<td>0.1875&quot;</td>
</tr>
<tr>
<td>Measured Wall Thickness</td>
<td>0.375&quot;</td>
</tr>
</tbody>
</table>

C. SECONDARY CONTAINMENT SYSTEM

1. General Description of Secondary Containment

The secondary containment system is designed and operated to prevent any migration of wastes or liquids out of the system. (See appendix G for layout of secondary containment area.) The Evaporator Feed Storage Tank No. 3 is located inside the wastewater final treatment building within a concrete containment area. All associated piping is aboveground and a portion of the associated piping is contained in this area. The area is inspected on a daily basis.

Design or construction details were not available for detailed structural analysis of the concrete curb and floor. The minimum required foundation thickness and steel reinforcement were calculated and are included in the appendix E of this assessment. See appendix G for detailed drawings of the containment area. The section through the containment area is based on concrete cores taken in this area. The size and spacing of the steel reinforcement is not known, however, it would be acceptable to assume No. 3 bars spaced at 12" center to center in each direction. The concrete slab is resting on a sand base. The thickness of the slab in this area is no less than 6". The compressive strength determined from the concrete removed in the coring procedure was found to be approximately 7000 psi. For calculation purposes a compressive strength of 4000 psi was used.
The containment area and tanks are routinely visually monitored on a daily basis for leaks. A sump pump and drain are located in the containment area. The floor is sloped to the low area to collect any drainage or spills. Any released tank contents or surface runoff will drain on top of the sloped concrete to the sump area. The accumulated liquids are then removed and pumped to the wastewater pretreatment area within a maximum of 24 hours, as a permit condition.

2. Design Standards

The structural capacity of the foundation and walls were compared to those sections that are applicable in the API 650-88 and the American Concrete Institute (ACI 318-89/318R-89) and these calculations were used as a guide in verifying the ability of the system to contain hazardous waste. No design drawings or standards were found.

3. Hazardous Characteristics of Wastes Treated

The wastes which are treated in the primary tank have the following characteristics:

Treated Wastes
pH Level (4-12)
N < 6
Temperature < 245°

The hazardous characteristics of the waste treated in the primary tank were examined. It was determined that the pH and normality levels of the waste were the primary areas of concern. This was to determine the applicability of a corrosion allowance for the containment system material type and thickness.

4. Existing Corrosion Protection

The entire secondary containment area floor and walls have been coated with an impermeable coating (Overcrete Plus by Concrete Protection Systems, Inc. and Sentry Polymers, Semstone 805). The coating is compatible with the present waste stream as verified by USPCI.

5. Documented Age of the Containment Area

The secondary containment system was constructed and installed in 1987 thus making the containment system 5 years old.
6. Result of Leak Tests

A visual inspection of the containment area was performed and from this inspection there were no cracks or breaks in the impermeable coating, therefore it would be adequate to contain any leaks or spills. The area is inspected daily on a routine basis checking for leaks from the primary tank.

7. Existing Data Obtained

<table>
<thead>
<tr>
<th>Area</th>
<th>2396 s.f.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall Height</td>
<td>0.46 ft. (Lowest point)</td>
</tr>
<tr>
<td>Material</td>
<td>Concrete</td>
</tr>
</tbody>
</table>

See Appendix G of this assessment for detailed drawings of the containment area.

8. Calculation of Existing Capacity

**Containment Capacity Available (CCA)**

CCA = Gross Volume - Volume of items in the containment - Volume of rainfall.

See Appendix D of this assessment for detailed calculations of the available containment volume. The containment capacity available = 1186.60 c.f.

9. Required Volume

**Containment Capacity Required (CCR)**

CCR = Volume of Largest Tank in the secondary containment

Volume of Largest Tank = 315.24 c.f. (FT3 Section 303)

10. Comparison of Available Volume to Required Volume

**Containment Capacity Comparison**

| Containment Capacity Required = | 315.24 c.f. |
| Secondary Containment Volume Available = | 1186.60 c.f. |
| Excess Containment Volume = | 871.36 c.f. |

CCA>CRC Adequate Capacity (under normal operating conditions) is available.
D. CONCLUSIONS

1. Primary Tank System

The tank vessel at the time of inspection was fit for use with the present waste stream at given densities, chemical and physical characteristics as verified by USPCI. The useful life of the steel tank would be estimated at 20 years if the current waste stream is maintained. This useful life was determined by using a design life of 20 years less the period that the tank has been in use at the USPCI Lone Mountain Facility.

2. Secondary Containment System

The secondary containment area at the time of inspection was fit for use, if the present waste stream at given densities and chemical and physical characteristics as verified by USPCI were released from the primary tank. The useful life of the concrete containment area is estimated at 15 years. This useful life was determined by using a design life of 20 years less the period that the tank has been in use at the USPCI Lone Mountain Facility. There did not seem to be any extensive corrosion or deterioration of the secondary containment area.

E. RECOMMENDATIONS

The following repairs or modifications should be made:

1. Primary Tank

The tank should be cleaned and internally inspected periodically for corrosion. The tank should be checked periodically with ultrasonic testing procedures to establish a verified limit of corrosion. USPCI should continually insure compatibility with the waste and densities stored. Daily inspections should be continued to detect any visual corrosion or defects.

2. Secondary Containment System

The secondary containment should be checked periodically for any deterioration and structural integrity.

3. Routine Inspections

When routine and preventative measures are to be completed, the tank should be cleaned and internally inspected to determine any interior defects or corrosion. Continued routine painting and coating of tanks on the interior and exterior, and routine inspection is recommended.
F. CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

[Signature]
E. E. Myer
Engineer
Title: 4126
E. E. 4126 OKLA
SECTION 301 - APPENDIX A

EF3, Evaporator Feed Tank No.3

PRIMARY TANK VOLUME

DIMENSIONS:
Geometry: CYLINDRICAL
Diameter: 6.33 FEET
Max Height: 6.00 FEET
Normal Operating Height: 5.00 FEET
Cone Height: 2.50 FEET
Bottom Cone Diameter: 0.50 FEET
Cone Length: 4.03 FEET
Cone Volume: 28.46 C.F. or 212.88 Gal.

VOLUME CALCULATIONS
Max. Volume: 217.28 C.F. or 1625.26 Gal.
Normal Operating Volume: 185.81 C.F. or 1389.86 Gal.

| MAXIMUM OPERATING TANK VOLUME =  | 217.28 C.F. |
| OR                             | 1,625.26 GAL |

WEIGHT ON FOUNDATION

| CONTENTS S.G.: | 1.50 |
| DENSITY: | 93.60 LB/C.F. |

SURFACE AREA CALCULATION

| Tank Top = | 31.47 S.F. |
| Tank Bottom Cone = | 68.66 S.F. |
| Tank Wall = Clr’h | 119.32 S.F. |

TOTAL SURFACE AREA WALL AND TOP = 219.44 S.F.

Steel Thickness =

| Sidewalls and Top | 0.25 INCHES |
| Cone | 0.31 INCHES |

Volume of Steel =

| Sidewalls | 2.49 C.F. |
| Top and bottom | 2.61 C.F. |

Density of Steel = 490.00 LB/C.F.

Weight of Steel = 1.25 TONS

WEIGHT OF TANK CONTENTS = 10.17 TONS

TOTAL WEIGHT OF TANK AND CONTENTS = 11.42 TONS
SECTION 301 - APPENDIX B
EF3, Evaporator Feed Tank No.3
PRIMARY TANK WALL THICKNESS

DIMENSIONS:
Geometry: CYLINDRICAL
Diameter: 6.33 FEET
Height: 12.00 FEET
Specific Gravity: 1.50
Normal Operating Temperature = ambient

STEEL THICKNESS CALCULATIONS @ BOTTOM RING

Thickness (t) = (2.6 * H * D * S.G.) / (s * E) + CA
s = Allowable Design Stress = 17600.00 PSI ***
E = Joint Efficiency = 85.00%
Thickness (t) = 0.0198 INCHES
Corrosion Allowance = 0.1250 INCHES
Calculated Req'd Wall thk. = 0.1448 INCHES

*** THIS DESIGN STRESS IS OBTAINED FROM API-650-88 WITH THE USE OF APPENDIX A.

CONE WALL THICKNESS CALCULATION

Cosine Alpha = cos(67.6594)
0.3801
P1 = Internal Pressure = 3263.83 psi
=Density*s.g.*(x+D/6*col(alpha)
P2 = H*density*s.g.=33*62.4*1.5 = 3182.40 psi
Tc= top cone radius = 6.36 inches
Fb = Allowable stress 17600 psi

The required wall thickness of the cone will be the greater of the following Formulas.

1. Ts=P1*Tc/2*cos(alpha)*fb = 0.098 +1/8"C.A. = 0.228 in.
2. Ts=P2*D/cos(alpha)*Fb = 0.125 +1/8"C.A. = 0.250 in.
SECTION 301 - APPENDIX C

EF3, Evaporator Feed Tank

STRUCTURAL SUPPORT CALCULATIONS

GIVEN:

- Tank Diameter = 6.33 feet
- Total Height = 12.00 feet
- Weight of Tank = 2500.00 lbs
- Weight of Max. Contents = 22840.00 lbs
- Tank Nominal Thickness = 0.375 in

---SEISMIC DESIGN CHECK---

ZONE COEFFICIENT (Z): 0.1875
ESSENTIAL FACILITIES FACTOR (I): 1.000
LATERAL EARTHQUAKE FORCE COEFF. (C1): 0.240
D/H: 0.528
k factor: 0.590
SITE AMPLIFICATION FACTOR (S): 1.500
NATURAL PERIOD OF FIRST SLOSHING (T): 1.485
LATERAL EARTHQUAKE FORCE COEFF. (C2): 0.311
WEIGHT OF TANK SHELL (Ws): 2500.000 LBS
TOTAL WEIGHT OF TANK CONTENTS (Wt): 22840.000 LBS
W1/Wt: 0.950
W2/Wt: 0.100
WEIGHT OF EFFECTIVE MASS OF CONTENTS MOVES IN UNISON WITH THE TANK SHELL (W) 21698.000 LBS
WEIGHT OF EFFECTIVE MASS IN FIRST SLOS
HT FROM BTM OF SHELL TO CENT. OF SHELL 8.000 FEET
X1/H: 0.500
HT FROM BTM TO CENT. OF LAT. SEISMIC FO 8.000 FEET
X2/H: 0.900
HT FROM BTM TO CENT. OF LAT. SEISMIC FO 10.800 FEET

OVERTURNING MOMENT (M) = Z*(C1*Ws*Xs + C1*W1*X1 + C2*W2*X2)
OVERTURNING MOMENT (M): 10149.686 FT-LBS

Note: All of the above calculations are based on API-650-88 Seismic Design Procedure (Appendix E).

CHECK STRESS IN TANK SHELL FROM SEISMIC FORCES:

\[ W_l = \text{MAXIMUM WEIGHT OF TANK CONTENTS THAT MAY BE USED TO RESIST THE SHELL OVERTURNING MOMENT} \]

\[ W_l = 7.9*lb*(F_{by}*G*H)^{0.5} \]

\[ l_b = \text{THK. OF BTM. PLATE UNDER SHELL:} 0.375 \text{ IN} \]

\[ F_{by} = \text{MINIMUM YIELD STRENGTH OF BOTTOM PLATE:} 9000.000 \text{ PSI} \]

\[ G = \text{DESIGN SPECIFIC GRAV. OF LIQUID:} 1.50 \]

\[ W_l = 1192.38 \text{ LBS/FT OF SHELL CIRCUMFRENCE} \]

DENSITY OF TANK SHELL MATERIAL:

\[ \text{WT = WEIGHT OF TANK SHELL AND THE PORTION OF FIXED ROOF SUPPORTED BY TANK SHELL:} 490.00 \text{ LBS/CF} \]

\[ M/[D^2(WT+WI)]: 0.1839 \]

\[ b = \text{MAXIMUM LONGITUDINAL COMPRESSION FORCE AT THE BTM. OF TANK SHELL} \]

\[ b = \text{WT} + 1.273*M/D^2 \]

\[ b: 505.90 \text{ LBS/FT OF SHELL} \]
\[ G^*H^*D^2/t^2 = 5133.68 \]

\[ F_a = \text{MINIMUM OF } 10^*8^*D \text{ or } F_y/2 = 4500.00 \text{ PSI} \]

\[ F_y = \text{MINIMUM YIELD STRENGTH OF BTM. PLATE} = 9000.00 \text{ PSI} \]

\[ \text{MAX. LONGITUDINAL COMPRESSION STRESS IN THE TANK SHELL} = \frac{b}{12t} \]

\[ = 112.42 \text{ PSI} \]

**CHECK OVERTURNING MOMENT FROM WIND PRESSURE**

M must be Less Than or Equal To \(.66^*(WD)/2\)
If M is Greater Than \(.66^*(WD)/2\) Anchor Bolts Would Be Required

Where:

\[ W = \text{Shell Weight Available To Resist Uplift (lbs)} \]

\[ D = \text{Tank Diameter (feet)} \]

\[ M = \text{Overturning Moment} \]

\[ M = P_w^*\text{Projected Area}^*H_1 \]

\[ H_1 = \text{Height from ground to centroid of tank shell} \]

\[ P_w = \text{Wind Pressure (18 psf for 100 MPH Wind on cylinders)} \]

\[ .66^*(WD)/2: \]

\[ = 5224.73 \text{ FT-LBS} \]

\[ M: \]

\[ = 8207.57 \text{ FT-LBS} \]

M > \(.66^*(WD)/2\) therefore anchor bolts are required

Number of Anchors: 8.00

Anchor Diameter: 0.75 inches

Dia. of Anchor Circle: 6.66 feet

\[ t_B = \text{design tension load per anchor} \]

\[ t_B: \]

\[ = 303.41 \text{ pounds} \]

Allowable Load/Anchor: 8835.73 pounds

__Section 301 - Appendix C - Page 3__
SECTION 301 - APPENDIX D

Wastewater Final Treatment

SECONDARY CONTAINMENT VOLUME CALCULATIONS

AREA 13-1

<table>
<thead>
<tr>
<th>Area No. 13-1-1</th>
<th>Length = 50.33 feet</th>
<th>Width = 29.00 feet</th>
<th>Height = 0.46 feet</th>
<th>Surface Area = 1459.66 S.F.</th>
<th>Volume = 671.44 C.F.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Area No. 13-1-2</th>
<th>Length = 15.00 feet</th>
<th>Width = 13.25 feet</th>
<th>Height = 0.41 feet</th>
<th>Surface Area = 193.75 S.F.</th>
<th>Volume = 81.49 C.F.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Area No. 13-1 Sump (Trench)</th>
<th>Length = 49.17 feet</th>
<th>Width = 1.25 feet</th>
<th>Height = 0.83 feet</th>
<th>Surface Area = 61.46 S.F.</th>
<th>Volume = 51.22 C.F.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Area No. 13-1 Sump (Trench)</th>
<th>Length = 22.00 feet</th>
<th>Width = 1.25 feet</th>
<th>Height = 0.33 feet</th>
<th>Surface Area = 27.50 S.F.</th>
<th>Volume = 9.17 C.F.</th>
</tr>
</thead>
</table>

Gross Area = Sum of Area 1 and 2 * Height + Sumps
Gross Volume = 1658.41 S.F
813.31 C.F.

Section 301 - Appendix D Page 1 11/29/93
Volumes of Items of Displacement ** Area 13-1

1. DU Tank pad = 19'12"/12 = 38.00 C.F.
2. BB1 Tank Skirt = 2\pi r^2 \times \text{thk} \times 0.46 = 0.24 C.F.
3. BB1 pump base = 4 \times 1.333 \times 0.46 = 2.45 C.F.
4. Filter Base = 0.15 c.f.
5. Channel supports for LF2 = 5 \times 0.46 \times 3.83/144 = 0.18 C.F.
6. Walkway support legs = 4 \times 0.0875 \times 0.46 = 0.16 C.F.
7. Building supports = 8 \times (19.7/144) \times 0.46 = 0.60 C.F.
8. DU Pumps = 8 \times 1.333 \times 0.5 \times 0.25 = 1.33 C.F.
9. EV3 support legs = 4 \times 0.46 \times 7.34/144 = 0.09 C.F.
10. EB1 Support Legs = 4 \times 2 \times 19.7/144 = 1.09 C.F.
11. Sump for pipes = 6 \times 4 \times 0.46 = 11.04 C.F.
12. Small Base DU units = \pi \times D \times (5/12) \times 0.46 = 0.15 C.F.
13. Large Base DU units = \pi \times D \times (5/12) \times 0.46 = 0.10 C.F.

Total volume to deduct for items in containment area = 55.38 C.F.

Subtraction for volume of rainfall
This entire area is covered and will not receive any rain

TOTAL AVAILABLE VOLUME = Gross Volume - Subtractions = 813.31 C.F.
Items of displacement
Volume of rainfall

TOTAL AVAILABLE VOLUME AREA 13-1

757.93 C.F.

AREA 13-2

Area No.13-2
Length = 41.00 feet
Width = 18.00 feet
Height = 0.46 feet
Surface Area = 738.00 S.F.
Volume = 339.48 C.F.

Area No.13-2 Sump
Length = 2.00 feet
Width = 3.00 feet
Height = 2.54 feet
Surface Area = 6.00 S.F.
Volume = 15.25 C.F.

Area No. 13-2 Sump (Cont.)
Length = 4.00 feet
Width = 4.00 feet
Height = 4.92 feet
Surface Area = 16.00 S.F.
Volume = 78.67 C.F.

Gross Area =
Gross Volume =

Volumes of items of Displacement **
1. Bearing Pads = 12*(1.5*1.2/12) = 3.00 C.F.
2. Pump base (5" high steel) = 5*1.5*3.5' = 0.30 C.F.
3. Hydraulic unit support legs = 4*0.0064*.64 = 0.02 C.F.
4. Steps and supports, ladder supports =
5. 8" Tank support legs = 12*(17.2/144)*0.64 = 0.92 C.F.

Total volume to deduct for items in containment area = 4.73 C.F.

Subtraction for volume of rainfall
This entire area is covered and will not receive any rain

TOTAL AVAILABLE VOLUME = Gross Volume - Subtractions
Items of displacement
Volume of rainfall

TOTAL AVAILABLE VOLUME AREA 13-2

TOTAL AVAILABLE VOLUME AREA 13

1186.60 C.F.
OR
8875.77 GAL

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11/29/63
SECTION 301 - APPENDIX E

EF3, Evaporator Feed Tank No.3

FOUNDATION DESIGN ANALYSIS

ASSUMPTIONS:

\[ f'c = 4.00 \text{ KSI} \]
\[ f_y = 60.00 \text{ KSI} \]
Allowable Soil Press. = 2.20 KSI
Structural Steel = A36

GIVEN:
Tank Diameter = 6.33 feet
Sidewall Height = 12.00 feet
Weight of Tank (Shell) = 2500.00 lbs
Weight of Max. Contents = 20340.00 lbs

Tank is Resting on a concrete foundation.

CHECK CONCRETE FOUNDATION DESIGN:

Assume Footing Depth = 6.00 inches
Assume Footing Width = 12.00 inches
Assumed Effective Soil Press. = 1925.00 psf

Look at what is resisting overturning moment from seismic load:

\[ b = 506.00 \text{ lb/ft of circ.} \]

Where \( b \) is the maximum shell compression at the bottom of the shell.

If the footing is 12.00 inches wide then the actual applied pressure to the subgrade is 506.00 lb/sf

This is less than the effective soil pressure.
SECTION EF4

(OUT OF SERVICE)
ASSESSMENT OF EVAPORATOR FEED TANK NO. 4 (EF4)
LONE MOUNTAIN HAZARDOUS WASTE FACILITY
U.S.P.C.I./LAIDLAW
WAYNOKA, OKLAHOMA

A  TANK SYSTEM DESCRIPTION

Evaporator Feed Tank No. 4 (EF4) is a new replacement welded above-ground wastewater storage and treatment tank to be installed as a part of the final wastewater treatment plant at the Lone Mountain Facility. Evaporator Feed Tank #4 (EF4) is located within the Wastewater Final Treatment building on the first mezzanine level of the support structure. The tank system consists of Evaporator Feed Tank #4 (EF4), Circulating Pump (P76), Circulating Pump (P79), Heat Exchanger #4 (EU4), and associated piping and instruments.

B  PRIMARY TANK VESSEL

1. General Description

Evaporator Feed Tank No. 4 (EF4) is a circular steel tank with an outside diameter of 6'4" and a height of 12'0". The tank proper has a skirt that is anchored to the support structure, and it has a closed flat top that is vented to the atmosphere. The bottom of the tank is cone shaped. Flash Tank No. 4 is being assessed to determine if the unit is adequately designed with sufficient structural strength and compatibility with the waste to be stored.

2. Design Standards

The tank is designed and constructed to those sections that are applicable in the American Petroleum Institute Standard 650-1993 edition (API-650).

3. Hazardous Characteristics of Wastes Stored

The wastes which are stored in this tank are treated and untreated brine solutions. Representative samples of both the treated and the untreated wastes were sent for analysis. The results of those analyses are included in Appendix G of this assessment. In addition, the following characteristics of the wastes were verified:

Ignitability - Flash Point > 240º F

Corrosiveness
7 < pH < 12
2 < N < 7

(Feed Tank EF4)
((09/18/96) )
Reactivity - None

Temp < 300° F

From the examination of the hazardous characteristics of the waste to be stored in this tank, it was determined that the pH and normality levels (Corrosiveness) of the waste are the primary areas of concern. This is to determine the applicability of a corrosion allowance for the tank material type and thickness.

4. Corrosion Protection

The interior of the tank is coated with two layers of Sherwin Williams Hi-Mil Sher-Tar Epoxy. Each layer is applied at a dry film thickness of not less than 7.0 mils. The exterior coating consists of one layer of Glid-Guard Corrosion Resistant HS Epoxy No. 5466 series, at a dry film thickness of not less then 3.0 mils. Appendix F contains manufacturer’s information on both the interior and the exterior corrosion protection systems.

5. Documented Age of Tank

This tank was manufactured by Lide Tank Company of Mexia, Texas in November 1994 and installed in February of 1995.

6. Result of Leak Tests

The manufacturer conducted a hydrostatic leak test of the tank before shipping. A description of that test is included in Appendix D of this assessment. In addition, a visual inspection was performed of the interior and exterior of the tank after installation. This inspection was conducted specifically to detect the presence of any of the following items:

   a) Weld break
   b) Punctures
   c) Scraps of protective coatings
   d) Cracks
   e) Corrosion
   f) Other structural damage or inadequacies of construction and/or installation

The tank hydrostatic test after installation is included in Appendix D of this Assessment. A description of that procedure is also included in Appendix D of this assessment. From these tests it was determined that the primary tank was not leaking.

(Feed Tank EF4)
((09/18/96   ))
7. Existing Data Obtained

   a. Diameter of Tank  
   b. Nominal Height of Tank  
   c. Maximum Capacity  
   d. Overflow Liquid level  
   e. Overflow Volume  
   f. Design Specific Gravity  
   g. Maximum Bottom Pressure  
   h. Maximum Operating Temperature  
   i. Material of Construction
      i) Shell, Root & Bottom  
      ii) Reinforcing Pads  
      iii) Structural Supports  
      iv) Steel Pipe  
      v) Bolts  
      vi) Flanges, Blinds, Couplings & Plugs
   j. Wall Thickness  
   k. Operating Pressure  
   l. Seismic Zone

   6'4"  
   12'0"  
   1625 gal.  
   11'6"  
   1504 gal.  
   1.5  
   5.9 psi  
   250°F  
   ASTM A36  
   ASTM A36  
   ASTM A36  
   ASTM SA106, Grade B  
   ASTM SA193, B7  
   ASTM SA105  
   0.375"  
   Atmospheric  
   1

8. Calculation of Existing Foundation Loading

   Total Weight of Tank and Contents  
   27,350 lbs.

   Detailed calculations reflecting the volume and weight of the tank are included in Appendix A of this assessment.

9. Required Structural Calculation

   Calculations for the required wall thickness for this tank are shown in Appendix B. Metallurgical information on the materials used is included in Appendix E of this assessment. The minimum required thickness in accordance with API 650, is 0.148 inches. A corrosion allowance of 0.125 is provided for. The measured wall thickness is 0.375 inches.

   Design calculations for the support structure are included in Appendix C of this assessment. These calculations were done in accordance with BOCA National Building Code 1990 Edition.

   Structural analysis of the foundation is included in Appendix C of this assessment.
10. Comparison of Actual to Theoretical Structural Values

Wall Thickness Comparison

Calculated Required Wall Thickness 0.1875"
Minimum Required Wall Thickness By API 650 0.148"
Measured Wall Thickness 0.375"

Bottom Thickness Comparison

Calculated Required Bottom Thickness 0.150"
Minimum required Bottom Thickness by API 650 0.250"
Measured Bottom Thickness 0.375"

Support Structure Comparison

See Appendix C of this assessment for complete comparison of the loads and support information for vertical columns, horizontal beams and diagonal bracing.

Foundation Integrity Comparison

Maximum Calculated Load (6" Slab) 17.6 Kips
Calculated Foundation Support (6" Slab) 26.7 Kips

Maximum Calculated Load (17" Slab) 62.9 Kips
Calculated Foundation Support (17" Slab) 127.7 Kips

C ANCILLARY EQUIPMENT

1. General Description

The ancillary equipment for the Evaporator Feed Tank No. 4 (EF4) system includes the following:

a) Circulating Pump (P76) - a centrifugal pump designed to pump 80 GPM at 50 feet of discharge head with a suction head of 5 feet.

b) Circulation Pump (P79) -- a centrifugal pump designed to pump 80 gpm at 50 ft. discharge head with a suction head of 5 ft.

c) Heat Exchanger (EU4) - a plate and frame unit of stainless steel construction designed to operate at a pressure of 150 PSIG and a temperature of 300°F. Manufacturer's design information is included in Appendix B of this assessment.

d) Associated piping, valves and instruments - all piping is Schedule 40 carbon steel fitted with 150 psi flanges. All piping with an inside
diameter of 2" or smaller is socket-welded using, at a minimum, 3000# connections. All piping with an inside diameter greater than 2" is butt-welded. All valves, fittings & instruments are rated for 150 psi or higher.

2. Design Standards

All piping is to be installed according to ASME/ANSI Code section B31.3. Metallurgical information on the materials used is included in Appendix E of this assessment.

3. Corrosion Protection

The exterior of all waste piping will be coated with two layers of Kem-Kromik Universal Metal Primer - B50Z Series. Each layer is applied at a dry film thickness of not less than 5 mils. Detailed information on the coating is included in Appendix F of this assessment.

4. Documented Age of Piping System

The piping and other ancillary equipment was purchased during a period of time between December 1994 and January 1995. It will be installed in April 1995.

5. Result of Leak Tests

A Hydrostatic leak test was performed in accordance with ASME/ANSI B31.3 Chapter VI paragraph 345.5 using paragraph 345.4.2 to determine the pressure requirements of the test. A description of this testing procedure, along with the results of that test, are inserted in Appendix D of this assessment.

6. Data Obtained

Included in Appendix H of this assessment is a Piping and Flow Diagram of the treatment process. This Piping and Flow Diagram reflects data such as valves, blowoffs, vents, level controls and the overall flow pattern of the treatment process.

7. Piping Support System

A visual inspection of the pipe support system will be conducted. This inspection will include a look at such things as materials of construction, welds, and construction methods. From this inspection a determination will

(Feed Tank EF4)
((09/18/96   )
be made as to the adequacy of the piping support system.

D  SECONDARY CONTAINMENT SYSTEM

1. General Description of Secondary Containment

The secondary containment system was originally designed and operated to prevent any migration of wastes or liquids out of the system. Evaporator Flash Tank No. 1, Evaporator Flash Tank No. 2, Evaporator Flash Tank No. 3, Evaporator Blowdown Tank No. 2, and Evaporator Feed Tank No. 4 are located on a reinforced concrete base floor area with vertical concrete sidewalls. All associated piping is above ground and located within the secondary containment system. The area is inspected daily on a routine basis.

At the time of inspection the concrete area was withstanding daily operations, and routine climatic conditions. No cracks from compression or uplift were visually apparent.

Any released tank contents are removed and pumped to an appropriate storage area within the maximum time allowed as a permit condition.

2. Design Standards

Corings of the concrete in the existing containment area were taken and tested for comprehensive strength. A copy of the report generated from those tests is included in Appendix C of this assessment. The structural capacity of the foundation was compared to those sections that are applicable in the API-650 and the ACI-318, and these calculations were used as a guide in verifying the ability of the system to contain hazardous waste.

3. Corrosion Protection

There is an impermeable coating applied to the entire concrete floor and curbs. Appendix F of this assessment contains detailed information on the coating(s) employed.

4. Documented Age of the Containment Area

The secondary containment system was constructed and installed in 1987.

5. Result of Leak Tests

A visual inspection of the containment area was performed and from this inspection there were no cracks or breaks in the impermeable coating, therefore it appears to be adequate to contain any leaks or spills.

(Feed Tank EF4)

((09/18/96 )
6. Calculation of Capacity Available (CCA)

<table>
<thead>
<tr>
<th>Area</th>
<th>2738 s.f.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curb Height</td>
<td>0.25 ft.</td>
</tr>
<tr>
<td>Material</td>
<td>Concrete</td>
</tr>
<tr>
<td>Gross Volume</td>
<td>685 c.f.</td>
</tr>
</tbody>
</table>

See Appendix H for detailed drawings of this containment area. Appendix A of this assessment contains detailed calculations of the available containment volume. The containment capacity available = 685 c.f.

7. Required Volume

**Containment Capacity Required (CCR)**

CCR = Volume of Largest Tank in the secondary containment

Volume of Largest Tank = (FT1) = 401 c.f.

8. Comparison of Available Volume to Required Volume

**Containment Capacity**

<table>
<thead>
<tr>
<th>Containment Capacity Required</th>
<th>401 c.f.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Containment Volume Available</td>
<td>685 c.f.</td>
</tr>
<tr>
<td>Excess Containment Volume</td>
<td>284 c.f.</td>
</tr>
</tbody>
</table>

CCA > CCR Adequate Capacity (under normal operating conditions is available)

**E CONCLUSIONS**

1. The foundation, structural support beams, connections, and controls for the Evaporator Feed Tank No. 4 (EF4) System have been adequately designed.

2. The Evaporator Feed Tank No. 4 (EF4) system has sufficient structural strength, is compatible with the wastes to be stored and treated, and has adequate corrosion protection to ensure that it will not collapse, rupture or fail.

3. The Evaporator Feed Tank No. 4 (EF4) system was inspected on 3/1/95 for weld breaks, punctures, scrapes of protective coating, cracks, leaks, corrosion, and other structural damage or inadequacies of construction/installation.

4. The Evaporator Feed Tank No. 4 (EF4) was tightness tested on 3/1/95, and it was found that the tank test positive for tightness.

5. The Secondary Containment for the Evaporator Feed Tank No. 4 (EF4) system is (Feed Tank EF4) (09/18/96)
of sufficient structural strength and of sufficient volume to meet the requirements set forth in 40 CFR 264.193.

6. All ancillary equipment associated with the Evaporator Feed Tank No. 4 (EF4) system is properly supported and protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction.

7. The Evaporator Feed Tank No. 4 (EF4) system associated ancillary equipment have been tightness tested in accordance with ASME/ANSI B31.

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

[Signature]

[Date]

(Feed Tank EF4)

((09/18/96)
Primary Tank Volume Calculations
**EF4 Volume Calculations**

Shell Volume: \[ V = \pi r^2 h \]
\[ = 3.14 \times 3.175^2 \times 3.175 \times 6 \text{ ft} \]
\[ = 189.5 \text{ ft}^3 \]

Cone Volume: \[ V = \frac{1}{3} \pi r^2 h \]
\[ = 0.33 \times 3.14 \times 3.175^2 \times 3.175 \times 3 \text{ ft} \]
\[ = 31.25 \text{ ft}^3 \]

Total Volume: \[ V_{\text{total}} = V_{\text{shell}} + V_{\text{cone}} \]
\[ = 189.5 \text{ ft}^3 + 31.25 \text{ ft}^3 \]
\[ = 220.75 \text{ ft}^3 \]
Secondary Containment Volume Calculations
SECONDARY CONTAINMENT VOLUME CALCULATIONS

A. DIMENSIONS

1. Length 64' 9"
2. Width 44' 0"
3. Height 3" min

B. VOLUME (Before encroachments) 64.75'x 44'x .25' = 712.25 ft³

C. ENCROACHMENTS

1. Posts 16 @ 10"x 10"x 3"
2. Posts 9 @ 12"x 10"x 3"
3. Posts 1 @ 14"x 15"x 3"
4. Posts 1 @ 24"x 8"x 3"
5. Posts 2 @ 12"x 12"x 3"
6. Posts 2 @ 32"x 12"x 3"
7. Posts 1 @ 24"x 24"x 3"
8. Ramps 4 @ 14"x 30"x 3"
9. Ramps 1 @ 16"x 32"x 3"
10. Heat Exchangers 2 @ 2′x 51"x 3"
11. Pumps 4 @ 5′x 20"x 3"
12. Pumps 4 @ 3′x 1′x 3"

D. ENCROACHMENT VOLUME CALCULATIONS

1. 16 x 0.83 ft x 0.83 ft x 0.25 ft = 2.75 ft³
2. 9 x 1 ft x 0.83 ft x 0.25 ft = 1.87 ft³
3. 1 x 1.17 ft x 1.25 ft x 0.25 ft = 0.37 ft³
4. 1 x 2 ft x 0.67 ft x 0.25 ft = 0.34 ft³
5. 2 x 1 ft x 1 ft x 0.25 ft = 0.5 ft³
6. 2 x 2.67 ft x 1 ft x 0.25 ft = 1.34 ft³
7. 1 x 2 ft x 2 ft x 0.25 ft = 1.0 ft³
8. 4 x 1.17 ft x 2.5 ft x 0.25 ft = 2.93 ft³
9. 1 x 1.33 ft x 2.67 ft x 0.25 ft = 0.89 ft³
10. 2 x 2 ft x 4.25 ft x 0.25 ft = 4.25 ft³
11. 4 x 5 ft x 1.67 ft x 0.25 ft = 8.35 ft³
12. 4 x 3 ft x 1 ft x 0.25 ft = 3 ft³

TOTAL ENCROACHMENT VOLUME 27.59 ft³

AVAILABLE CONTAINMENT VOLUME 684.66 ft³

LARGEST TANK VOLUME (FT 1) 401 ft³

EXCESS CONTAINMENT 283.66 ft³
Manufacturers Design Information
QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)

(See QW-200-1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name: LIDE VESSELS INC.  
By: EVAN LEMON

Welding Procedure Specification No.: BB01  
Date: 6-1-82  
Supporting PQR No.(s): BB01

Revision No.: 1  
Date: 5-1-90  
Type(s): MANUAL

(Automatic, Manual, Machine, or Semi-Auto.)

**JOINTS (QW-402)**

Joint Design: SEE PRODUCTION DRAWINGS

Backin (Yes) F4  
(No) F3

Backin Material (Type): WELD METAL OR BASE METAL  
(Refer to both backing and retainers.)

☐ Metal  ☐ Nonfusing Metal  RETAINERS NOT USED

☐ Nonmetallic  ☐ Other

Sketches, Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Mgr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

**SE METALS (QW-403)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Group No. 1 &amp; 2</td>
<td>Group No. 1 &amp; 2</td>
</tr>
<tr>
<td>OR</td>
<td>OR</td>
</tr>
</tbody>
</table>

Specification type and grade:  
to Specification type and grade:  
OR Chem. Analysis and Mech. Prop.:  
to Chem. Analysis and Mech. Prop.:  
Thickness Range:  
Base Metal: Groove .1875 - 1.500 *  
Fillet: ALL  
Pipe Dia. Range: Groove ALL  
Fillet: ALL  
Other: PROCEDURE LIMITED TO 1.500 DUE TO NO PWHT

**FILLER METALS (QW-404)**

<table>
<thead>
<tr>
<th>Spec. No. (SFA)</th>
<th>5.1</th>
<th>5.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS No. (Class)</td>
<td>E6010</td>
<td>E7018</td>
</tr>
<tr>
<td>F-No.</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>A-No.</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Size of Filler Metals: 1/8" - 5/32"  
Deposited Weld Metal Thickness Range:  
Groove .250  
Fillet .614

Electrode-Flux (Class)  
Flux Trade Name  
Consumable Insert  
Per

Each base metal-filler metal combination should be recorded individually.
POSTWELD HEAT TREATMENT (QUAL-407)
Temperature Range: NA
Time Range: ----

GAS (QUAL-408)
Percent Composition
Gas(es) Mixture Flow Rate
--- --- ---
Shielding --- --- ---
Trailing --- --- ---
Backing --- --- ---

ELECTRICAL CHARACTERISTICS (QUAL-409)
Current AC or DC: DC
Amps (Range): SEE BELOW
Vols (Range): SEE BELOW
Polarity: REV

Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown below.

Tungsten Electrode Size and Type: --- (Pure Tungsten, 2% Thoriated, etc.)
Mode of Metal Transfer for GMAW: ---
(Spray arc, short circuiting arc, etc.)
Electrode Wire feed speed range: ---

TECHNIQUE (QUAL-410)
String or Weave Bead: ---
Orifice or Gas Cup Size: ---
Initial and Interpass Cleaning: (Brushing, Grinding, etc.) BRUSH, GRIND, OR CHIP AS NEEDED
Method of Back gouging: AIR ARG OR GRIND AS NEEDED
Oscillation: ---
Contact Tube to Work Distance: ---
Multiple or Single Pass (per side): MULTIPLE
Multiple or Single Electrodes: SINGLE
Travel Speed (Range): ---
Penning: ---
Other: NO SINGLE PASS TO EXCEED 1/2" IN THICKNESS ** 200°F MINIMUM PREHEAT FOR THICKNESSES OVER 1.25" AND THROUGH 1.5"

<table>
<thead>
<tr>
<th>Weld Layer(s)</th>
<th>Process</th>
<th>Class</th>
<th>Dia.</th>
<th>Type</th>
<th>Amp. Range</th>
<th>Volt Range</th>
<th>Travel Speed Range</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &amp; 2</td>
<td>SMAW</td>
<td>E6010</td>
<td>1/8&quot;</td>
<td>REV</td>
<td>75-125</td>
<td>18-24</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>5/32&quot;</td>
<td>&quot;</td>
<td>110-170</td>
<td>20-26</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>RFM</td>
<td>SMAW</td>
<td>E7018</td>
<td>1/8&quot;</td>
<td>&quot;</td>
<td>115-165</td>
<td>20-26</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>5/32&quot;</td>
<td>&quot;</td>
<td>150-220</td>
<td>21-27</td>
<td>&quot;</td>
<td></td>
</tr>
</tbody>
</table>

Other:
(i.e., Remarks, Comments, Hot Wire, Addition, Technique, Torch Angle, etc.)
QW-483 SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION RECORD (PQR)
(See QW-200.2, Section IX, ASME Boiler and Pressure Vessel Code)
Record Actual Conditions Used to Weld Test Coupon.

Company Name: LIDE VESSELS INC.
Procedure Qualification Record No. BB01 Date 5-26-82
WPS No. BB01
Welding Process(es): SMAW
Types (Manual, Automatic, Semi-Auto.) MANUAL

JOINTS (QW-402)

Groove Design of Test Coupon
(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.)

BASE METALS (QW-402)
Material Spec. SA-106
Type or Grade E
No. 1 to P-No. 1
Thickness of Test Coupon 0.864
Diameter of Test Coupon 6-5/8" OD
Other

FILLER METALS (QW-404)
SFA Specification 5.1 5.1
AWS Classification E6010 E7018
Filler Metal F-No. 3 4
Weld Metal Analysis A-No. 1 1
Size of Filler Metal 1/8" 1/8"
Other

POSTWELD HEAT TREATMENT (QW-407)
Temperature NA
Time
Other

GAS (QW-408)
Percent Composition
Gas(es) Mixture Flow Rate
Shielding
Trailing
Backing

ELECTRICAL CHARACTERISTICS (QW-409)
Current DC
Polarity REV
Amos. F3-120, F4-120 Volts F3-20, F4-24
Tungsten Electrode Size NA
Other

POSITION (QW-405)
Position of Groove 6G
Weld Progression (Uphill, Downhill) F3-DOWN, F4-UP
Other

EHEAT (QW-406)
Reheat Temp. 70°F
Interpass Temp. 500°F
Other

TECHNIQUE (QW-410)
Travel Speed NOT RECORDED
String or Weave Bond STRING
Oscillation NONE
Multiple or Single Pass (per side) MULTIPLE
Single or Multiple Electrodes SINGLE
Other

(12/89)
**BASE METALS (CW-403)**

<table>
<thead>
<tr>
<th>Material Spec.</th>
<th>SA-36</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFA Specification</td>
<td>5.1</td>
</tr>
</tbody>
</table>

**FILLER METALS (CW-404)**

<table>
<thead>
<tr>
<th>SFA Specification</th>
<th>5.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS Classification</td>
<td>E6010 - E7024</td>
</tr>
<tr>
<td>Filler Metal F-No.</td>
<td>3 - 1</td>
</tr>
<tr>
<td>Weld Metal Analysis A-No.</td>
<td>1 - 1</td>
</tr>
<tr>
<td>Size of Filler Metal</td>
<td>3/16&quot;</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

**POSTWELD HEAT TREATMENT (CW-407)**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

**GAS (CW-408)**

<table>
<thead>
<tr>
<th>Gas (es)</th>
<th>Mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shielding</td>
<td></td>
</tr>
<tr>
<td>Trailing</td>
<td></td>
</tr>
<tr>
<td>Backing</td>
<td></td>
</tr>
</tbody>
</table>

**ELECTRICAL CHARACTERISTICS (CW-409)**

<table>
<thead>
<tr>
<th>Current</th>
<th>DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polarity</td>
<td>REV</td>
</tr>
<tr>
<td>Amps</td>
<td>F3-110, F1-250 VoF3-20, F1-22</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

**TECHNIQUE (CW-410)**

<table>
<thead>
<tr>
<th>Heat Temp.</th>
<th>70°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpass Temp.</td>
<td>500°F</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

**POSITION (CW-405)**

<table>
<thead>
<tr>
<th>Position of Groove</th>
<th>1G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weld Progression (Uphill, Downhill)</td>
<td>FLAT</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

**DEPOSITED WELD METAL (CW-406)**

<table>
<thead>
<tr>
<th>Deposited Weld Metal</th>
<th>.250&quot; - .500&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>
### QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)

**See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code**

**Company Name:** LIDE VESSELS INC.  
**By:** EVAN LEMON

<table>
<thead>
<tr>
<th>Welding Procedure Specification No.</th>
<th>BB02</th>
<th>Date: 5-28-82</th>
<th>Supporting POR No(s): BB02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision No.</td>
<td>1</td>
<td>Date: 3-7-89</td>
<td></td>
</tr>
<tr>
<td>Welding Processes</td>
<td>SMAW</td>
<td>Type(s): MANUAL</td>
<td></td>
</tr>
</tbody>
</table>

**JOINTS (QW-402) SEE PRODUCTION DRAWINGS**

<table>
<thead>
<tr>
<th>Joint Design</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Backing (Yrs)</td>
<td>(No) XX</td>
</tr>
</tbody>
</table>

**Metal**  
**Nonfusing Metal**  
**Nonmetallic**  
**Other**

**Details**

No Retainers used

Sketches, production drawings, weld symbols, or written description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Mfr., sketches may be attached to illustrate joint design, weld layers, and bead sequences, e.g., for notch toughness procedures, for multiple process procedures, etc.)

**SE METALS (QW-403)**

<table>
<thead>
<tr>
<th>Specification type and grade</th>
<th>Specification type and grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>to</td>
<td>to</td>
</tr>
</tbody>
</table>

**Thickness Range:**

- **Base Metal:**
  - Groove: 1.875" - 1.5"
  - Filler: ALL

- **Plate Dia. Range:**
  - Groove: ALL
  - Filler: ALL

**FILLET METALS (QW-404)**

<table>
<thead>
<tr>
<th>Spec. No. (SFA)</th>
<th>5.1</th>
<th>5.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS No. (Class)</td>
<td>E6010</td>
<td>E7024</td>
</tr>
<tr>
<td>F-No.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>A-No.</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Size of Filler Metals:**

- 1/8", 5/32"  
- 1/8", 5/32", 3/16"

**Deposited Weld Metal:**

- **Thickness Range:**
  - Groove: .250
  - Filler: .500

**Electrode-Flux (Class):**

<table>
<thead>
<tr>
<th>Electrode-Flux (Class)</th>
<th>Other</th>
</tr>
</thead>
</table>

**Other:**

*Each base metal-filler metal combination should be recorded individually.*
### POSTWELD HEAT TREATMENT (QW-407)

Temperature Range: NA

Time Range: —

### GAS (QW-408)

<table>
<thead>
<tr>
<th>Gas(es) (Mixture)</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shielding</td>
<td>—</td>
</tr>
<tr>
<td>Trailing</td>
<td>—</td>
</tr>
<tr>
<td>Backing</td>
<td>—</td>
</tr>
</tbody>
</table>

### ELECTRICAL CHARACTERISTICS (QW-409)

- Current AC or DC: DC, Polarity: REV
- Amps (Range): SEE BELOW
- Volts (Range): SEE BELOW

(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown below.)

- Tungsten Electrode Size and Type: —
  (Pure Tungsten, 2% Thoriated, etc.)
- Mode of Metal Transfer for GMAW: —
  (Spray arc, short circuiting arc, etc.)
- Electrode Wire feed speed range: —

### TECHNIQUE (QW-410)

- String or Weave Bead: STRING
- Orifice or Gas Cup Size: —
- Initial and Interpass Cleaning (Brushing, Grinding, etc.): BRUSH, GRIND, OR CHIP AS NEEDED

- Method of Back Gouging: AIR ARC OR GRIND AS NEEDED
- Oscillation: —
- Contact Tube to Work Distance: —
- Multiple or Single Pass (per side): MULTIPLE
- Multiple or Single Electrode: SINGLE
- Travel Speed (Range): —
- Peening: NONE
- Other: NO SINGLE PASS TO EXCEED 1/2" IN THICKNESS
  * 200°F MINIMUM PREHEAT FOR THICKNESSES OVER 1.25"
  AND INCLUDING 1.5"
API STANDARD 650

1993

NOMINAL DIAMETER 8.77
NOMINAL HEIGHT 1.2
NOMINAL CAPACITY 6,432 GAL
DESIGN LIQUID LEVEL

FABRICATED BY
LIDE TANK CO.

ERECTED BY
LIDE TANK CO.

2 - 3/8"
84.56
## Tensile Test (CW-150)

<table>
<thead>
<tr>
<th>Specimen No.</th>
<th>Width</th>
<th>Thickness</th>
<th>Area</th>
<th>Ultimate Total Load</th>
<th>Ultimate Unit Stress</th>
<th>Type of Failure &amp; Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.505</td>
<td>DIA.</td>
<td>.200</td>
<td>14120</td>
<td>70600</td>
<td>WLD DUCT</td>
</tr>
<tr>
<td>2</td>
<td>.506</td>
<td>DIA.</td>
<td>.201</td>
<td>13740</td>
<td>68400</td>
<td>BM DUCT</td>
</tr>
</tbody>
</table>

## Guided-Bend Tests (CW-160)

<table>
<thead>
<tr>
<th>Type and Figure No.</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIDE BEND CW-462.2</td>
<td>ACCEPTABLE</td>
</tr>
<tr>
<td>SIDE BEND CW-462.2</td>
<td>ACCEPTABLE</td>
</tr>
<tr>
<td>SIDE BEND CW-462.2</td>
<td>ACCEPTABLE</td>
</tr>
<tr>
<td>SIDE BEND CW-462.2</td>
<td>ACCEPTABLE</td>
</tr>
</tbody>
</table>

## Toughness Tests (CW-170)

<table>
<thead>
<tr>
<th>Specimen No.</th>
<th>Notch Location</th>
<th>Notch Type</th>
<th>Test Temp.</th>
<th>Impact Values</th>
<th>Lateral Exp.</th>
<th>Drop Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>% Shear</td>
<td>Mils</td>
</tr>
</tbody>
</table>

## Fillet-Weld Test (CW-180)

Result — Satisfactory: Yes ——— No ——— Penetration into Parent Metal: Yes ——— No ———
Macro—Results

## Other Tests

Type of Test
Deposit Analysis
Other

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Welder's Name: BILLY LIDE
Clock No. ____________ Stamp No. ____________
Tests conducted by: SOUTHWESTERN LABORATORIES Laboratory Test No. D7-8220-1
Manufacturer: LIDE VESSELS INC.

Date 9-11-90
By [Signature]
(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)
### Tensile Test (CW-150)

<table>
<thead>
<tr>
<th>Specimen No.</th>
<th>Width</th>
<th>Thickness</th>
<th>Area</th>
<th>Ultimate Total Load (lb)</th>
<th>Ultimate Unit Stress (psi)</th>
<th>Type of Failure &amp; Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>506</td>
<td>DIA</td>
<td>.201</td>
<td>15800</td>
<td>79600</td>
<td>BM DUCT</td>
</tr>
<tr>
<td>2</td>
<td>506</td>
<td>DIA</td>
<td>.201</td>
<td>15800</td>
<td>79600</td>
<td>BM DUCT</td>
</tr>
</tbody>
</table>

### Guided-Bend Tests (CW-160)

<table>
<thead>
<tr>
<th>Type and Figure No.</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIDE BEND CW-462.2</td>
<td>ACCEPTABLE</td>
</tr>
<tr>
<td>SIDE BEND CW-462.2</td>
<td>ACCEPTABLE</td>
</tr>
<tr>
<td>SIDE BEND CW-462.2</td>
<td>ACCEPTABLE</td>
</tr>
<tr>
<td>SIDE BEND CW-462.2</td>
<td>ACCEPTABLE</td>
</tr>
</tbody>
</table>

### Toughness Tests (CW-170)

<table>
<thead>
<tr>
<th>Specimen No.</th>
<th>Notch Location</th>
<th>Notch Type</th>
<th>Test Temp.</th>
<th>Impact Values</th>
<th>Lateral Exp.</th>
<th>Drop Weight</th>
</tr>
</thead>
</table>

### Fillet-Weld Test (CW-180)

Result — Satisfactory: Yes No Penetration into Parent Metal: Yes No
Macro—Results

### Other Tests

Type of Test: BNH F3 WELD-174 HAZ-179, F4 WELD-179 HAZ-182 & 185
Deposit Analysis
Other

Velder’s Name: JOHN MCKINNEY
Clock No. 114
Stamp No. M

Tests conducted by: SOUTHWESTERN LAB
Laboratory Test No. 09-8220-2

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code.

Manufacturer: LIDE VESSELS INC.

By [Signature]

Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.
Tank Wall Thickness
Secondary Containment Drawings
CHECK SEISMIC

\[ \frac{D}{H} = \frac{5.0}{12.0} = 0.42 \]

**Tank Shell** = 3360 lb
**Tank Roof** = 400 lb
**Tank Contents** = 14,780 lb

**Find Effective Mass W1 + W2**

From API 6E Fig. E-2 For \( \frac{D}{H} = 0.42 \)
\[ T = 1.0 \]
\[ t = 1.875 \text{ for Zone 1} \]

\[ \frac{W_1}{W_T} = 0.1 \quad \frac{W_2}{W_T} = 0.9 \]

\[ W_1 = 1470 \text{ lb} \quad W_2 = 13,230 \text{ lb} \]

**Find X1 & X2 From Fig. E-3**

\[ X_1 / H = 0.43 \quad X_2 / H = 0.85 \]

\[ X_1 = 5.2 \text{ ft} \quad X_2 = 43.2 \text{ ft} \]

**Natural Period**
\[ T = K \sqrt{D} \quad \text{where} \quad K = 0.59 \text{ for Fig. E-4} \]

\[ T = 0.59 \sqrt{5} = 1.12 \quad \Rightarrow \quad C_1 = 1.24 \quad C_2 = 1.30 \]

\[ C_2 = 1.34 \quad \text{for} \quad s = 1.5 \quad \text{Unknown Soil Condition} \]

**M** = \( E I (C_1 W_1 X_1 + C_1 W_2 H_2 + C_1 W_1 X_2 + C_2 W_2 X_2) \)

\[ \frac{\text{shell}}{\text{tank}} \]

\[ M = 10.75(1.10) \left[ 0.24(3360) \cdot 9.0 + 0.24(400) \cdot 12 + 0.24(1470) \cdot 5.2 + 1.34(13,230) \cdot 10.2 \right] = 19,524 \text{ ft-lb} \]

**For Anchorage**

**Tank Check Shell Comp. Stress b**

\[ b = \frac{4 \cdot 903}{510} + 1.273(10.524) = 903 \text{ lb/ft of Circ} \]

**Sress:**

\[ \frac{503}{12(3.25)} = 270 \text{ psi} \quad \text{OK} \]

**Allow. Compressive:**

\[ 150 \text{psi} = 15(3) \]
Shell Design

\[ t_s = \frac{2.4 \cdot D(H-1)}{E \cdot (21000)} + CA \]

\[ t_s = \frac{2.4 \cdot 6(3.5)}{4 \cdot (21000)} + \frac{1}{8} = 0.008 + 0.125 = 0.133" \]

3/8" shell is OK.

Head Design

\[ t_h = \frac{t_s / A_0 \cdot 2}{t_c} = \frac{0.008 \cdot 2}{0.047} = 0.109 + \frac{1}{8} = 0.136" \]

3/8" cone is OK.

Top Head: Flat Plate Design

Loading is 50% (Dead + Live) Live Load

\[ 150 \cdot \frac{1}{144} = 1.04 \text{ kip} \]

\[ t_n = \frac{D \cdot \sqrt{E}}{5} + \frac{1}{8} = \frac{60 \cdot \sqrt{29,000}}{5} + \frac{1}{8} = 0.211 + 0.125 = 0.336" \]

3/8" head plate OK.

Check Wind

Assume: Tensile Emty

Effective Dia = 4'
Shape Factor = 0.80

Wind Area = 100.25 \cdot (100)^2 = 2625 k

Wind Force = 2625 \cdot (0.8) \cdot 0.1 \cdot (12') = 1500 k

Moment = 1500 \cdot \frac{1}{2} (12') = 4500 k \cdot (0.33) = -2130 (f
t16)

No Uplift
**Structural Design**

5' 0" I.D. x 12' 0" T.A.U.

**Design Conditions:**

- **Atmospheric Tank**
- **Design Temp.** 250°F
- **Wind Velocity** 100 mph
- **Seismic Zone** 1
- **S.G.** = 1.5
- **Corrosion Allow.** = 1/8"  

**Shell & Head 3/8" THK**

- **Cone Angle α = 42.7°**
- **Tank Empty** 9200 gal
- **Tank Full** 17,200 gal

**Stress Correction for 250°F = \(0.90 Y_s\)**

\[0.90 \times (360) = 32,400/\pi\]

\[\text{Allowable} = \frac{2}{3} Y_s = \frac{2}{3} (32,400)\]

\[\text{Allowable} = 21,600 \text{ psi}\]
Heat Exchanger

### Alfa Laval

#### Side

![Diagram of a heat exchanger with dimensions and connections](image)

#### Footing

- 2" (50) B
- 1 3/8" (35) A
- Two (2) Ø 1 9/16" Holes (40)
- One (1) Ø 1 1/16" Hole (20)
- 2 9/16" (65)

B = 42 5/16" (1075)  A = See Plate Spec Documentation  Dimensions in ( ) are millimeters (mm)

<table>
<thead>
<tr>
<th>LOC</th>
<th>Function</th>
<th>Fluid</th>
<th>Connections Material</th>
<th>Size</th>
<th>Rating</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Hotside Inlet</td>
<td>30.7 psig Steam</td>
<td>SS</td>
<td>6&quot;</td>
<td>150#</td>
<td>STUD</td>
</tr>
<tr>
<td>S2</td>
<td>Hotside Outlet</td>
<td>30.7 psig Steam</td>
<td>SS</td>
<td>6&quot;</td>
<td>150#</td>
<td>STUD</td>
</tr>
<tr>
<td>S3</td>
<td>Coldside Inlet</td>
<td>Solution</td>
<td>SS</td>
<td>6&quot;</td>
<td>150#</td>
<td>STUD</td>
</tr>
<tr>
<td>S4</td>
<td>Coldside Outlet</td>
<td>Solution</td>
<td>SS</td>
<td>6&quot;</td>
<td>150#</td>
<td>STUD</td>
</tr>
</tbody>
</table>

Notes: Carboline 134 1.5 mils DFT (Alfa Laval Blue)

CERTIFIED

APPROVED FOR FABRICATION

BY [Signature]

DATE [Date]

Customer Name: USPCI
P.O. Number: 20572
Item: # 2 Heat Exchangers
Order Number: 942005
A/L Serial#(s): 30101-96638 thru 96639

M15-FFG
Plate Heat Exchanger

Alfa Laval Thermal Inc.
Manufactured in Richmond, Virginia

Design Press/Temp.: 150 PSI / 300 °F
Plate/Gasket Mat'l: AISI 316 / EPDM
Plates Actual/Max.: 39 / 64 (0.5mm)
Weight Dry/Flooded: 2350 lb / 2607 lb
Length EB/TS: 900 mm / 750 mm
**Subject: M15-FFD**

**BACKGROUND**
Given are standard ASME/ASTM materials of construction.

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Quantity</th>
<th>Material</th>
<th>Notes</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Frame Plate</td>
<td>1</td>
<td>SA516-70</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Pressure Plate</td>
<td>1</td>
<td>SA516-70</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3a.</td>
<td>Carrying Bar</td>
<td>1</td>
<td>Aluminum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3b.</td>
<td>T-Profile Cladding</td>
<td>2</td>
<td>SA240,304SS</td>
<td></td>
<td>900 mm</td>
</tr>
<tr>
<td>4.</td>
<td>Guide Bar</td>
<td>1</td>
<td>SA479,304SS</td>
<td></td>
<td>900 mm</td>
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<tr>
<td>5.</td>
<td>Tightening Bolt</td>
<td>8</td>
<td>SA193,87</td>
<td></td>
<td>750 mm</td>
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<tr>
<td>6.</td>
<td>Tightening Nut</td>
<td>8</td>
<td>SA194,2H2</td>
<td>2</td>
<td>2&quot; - 4 1/2 UNC</td>
</tr>
<tr>
<td>7.</td>
<td>Support Column</td>
<td>1</td>
<td>Aluminum</td>
<td></td>
<td>2&quot; - 4 1/2 UNC</td>
</tr>
<tr>
<td>8.</td>
<td>Support Foot</td>
<td>1</td>
<td>SA36</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Frame Foot</td>
<td>2</td>
<td>SA36</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Stud Bolt</td>
<td>48</td>
<td>SA193,87</td>
<td>2</td>
<td></td>
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<tr>
<td>11.</td>
<td>Connection Liner</td>
<td>4</td>
<td>SA240,316SS</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>13.</td>
<td>Channel Plate Gasket</td>
<td>40</td>
<td>EPDM</td>
<td></td>
<td>Electropolished</td>
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<tr>
<td>14.</td>
<td>Channel Plate</td>
<td>39</td>
<td>SA240,316SS</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Not Shown
- OSHA Shroud 1 Aluminum 3

Notes: (1) Painted. (2) Zinc Plated. (3) Not Shown

*Drawing is not an accurate depiction, see certified print.*
**ALFA-LAVAL THERMAL**

**PLATE HEAT EXCHANGER**

**Specification Sheet**

**CUSTOMER:** USPCI  
**Supplier:** Alfa Laval Thermal Inc.  
**Agent:** Charles Martin, Thermal Engineering Co  
**Tag#: #2 Heat Exchangers**  
**Order#: 942005**  
**P.O.#: 20572**  
**Quantity:** 2  
**Serial#: 30101-96638 thru 96639**  
**PHE Model Type:** M15-FFG

### HOT SIDE

<table>
<thead>
<tr>
<th>Fluids</th>
<th>30.7 psig Steam</th>
<th>Solution</th>
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<tbody>
<tr>
<td>Flow rates</td>
<td>10349</td>
<td>312000</td>
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<tr>
<td>Inlet temperature</td>
<td>275.0</td>
<td>180.0</td>
</tr>
<tr>
<td>Outlet temperature</td>
<td>272.2</td>
<td>230.0</td>
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<tr>
<td>Pressure drops</td>
<td>2.0</td>
<td>8.9</td>
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<table>
<thead>
<tr>
<th>Total Surface Area</th>
<th>260 sq ft</th>
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<table>
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<tr>
<th>Flow regimen fluids</th>
<th>counterflow</th>
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<tr>
<td>Connection locations in</td>
<td>S1  S3</td>
</tr>
<tr>
<td>out</td>
<td>S2  S4</td>
</tr>
<tr>
<td>Material in connections</td>
<td>SS  SS</td>
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<table>
<thead>
<tr>
<th>Total number of plates</th>
<th>39</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plates material thickness</td>
<td>AISI 316</td>
</tr>
<tr>
<td></td>
<td>0.5mm</td>
</tr>
<tr>
<td>Gasket material</td>
<td>EPDM Clip-on</td>
</tr>
<tr>
<td>Design pressure</td>
<td>150 PSI</td>
</tr>
<tr>
<td>Design temperature</td>
<td>300 F</td>
</tr>
<tr>
<td>Liquid volumes US gallon</td>
<td>13</td>
</tr>
<tr>
<td>Total unit dry weight</td>
<td>2300 lb</td>
</tr>
</tbody>
</table>

(CERTIFIED)  
APPROVED FOR FABRICATION  
BY [Signature]  
DATE [Date]
CUSTOMER: USPCI

ALFA-LAVAL THERMAL PLATE HEAT EXCHANGER

Model Type    M15-FFG
Quantity       2
Serial#        30101-96638 thru 96639
Supplier       Alfa Laval Thermal Inc.
Agent          Charles Martin, Thermal Engineering Co
Order#         942005
Tag#           # 2 Heat Exchangers

Gasket sides of the plates are facing the frame plate.
Plates with parallel flow.

Plates material   AISI 316
thickness          0.5mm
Gasket material    EPDM Clip-on
A - Dimension (See Drawing)  174 mm
Total number of plates 39
Total unit dry weight 2300 lb
Extra/Inspection port location Side 1:

-----------SAMPLE FLOW DIAGRAMS-----------

Sample SINGLEPASS Flow Diagram

121   End Plt1 76A H  ===<==========
120   Chan Plt 03B L  O   U---<---O------U
119   Chan Plt 03A L   O   U   O   U

3      Chan Plt 03A H  U==<==>O======U   O
2      Chan Plt 03B H   O   U---<---O-----U
1      End Plt2 83A H   O   O   O   O
-S4----S3------S2------S1-

Sample MULTIPASS Flow Diagram

121   Tran Plt 43A H  O   O   O   O
120   Turn Plt 04B H   O   U------
119   Chan Plt 03A L   U==<==>U   O   O

71      Chan Plt 03B H   O   O   U==<==>U
70      Chan Plt 03A L   U==<==>U   O   O
69      Turn Plt 11B H   O   -----><--U
68      Chan Plt 03A L   U><===>U   O   O

4      Chan Plt 03A L   O   O   O   O
3      Chan Plt 03B H   O   O   U--><--U
2      Chan Plt 03A L   U><===>U   O   O
1      End Plt2 84B H   O   O

---T3------T2------

L   G
E   R
A
F   M
L   S
O
W

See following page for Flow Diagram Descriptions.
*** SEE PAGE 1 FOR YOUR FLOW DIAGRAM. ***
FLOW DIAGRAM DESCRIPTIONS

Singlepass....Plate heat exchanger with connections on frame plate
(stationary cover) only.

Multipass....Plate heat exchanger with both frame plate and pressure
plate (movable cover) connections.

S1,S2,S3,S4....Frame plate connection designations.
T1,T2,T3,T4....Pressure plate connection designations.
(See drawing for locations of T and S ports.)

---PLATE DESCRIPTIONS---

1 to 121...Plate position starting from frame plate.
Chan Plt....Channel Plate. Standard 4-port channel plate. Gasketed so
that flow from two ports opens to the channel plate center.
End Plt2...End Plate 2. Channel plate adjacent to frame plate. With
port holes fully gasketed so that flow does not go between
this plate and the frame plate.
End Plt1...End Plate 1. Channel plate adjacent to pressure plate
on single pass unit.

Turn Plt....Turning Plate. Redirects flow with port locations which are
not punched (no U or O) on multipass units.

Trn Plt....Transition Plate. Channel plate adjacent to both pressure
plate and partition plates on multipass unit.
Par Plt....Partition Plate. Thicker steel plate required on some
multipass units.

Twin Plt....Twin plate. Channel plate type used on welded units only.
76,03,83....Plate hole punching description. A-L internal use only.

---PORT PUNCHING---

0....Port surrounded by ring gasket. Fluid in this port
U....Flow opening port. Fluid flows into this channel.
No U or O....If no U or O is shown then this port location is not punched
and fluid does not flow through this port.

---PLATE ORIENTATION---

A,B....Plate orientation, as seen from gasketed side of plates:

A Plate => || U \ 0 ||
| \ <-----gasket diagonal------>/ U |
| | || | ||
| \ / \ <-----chevron direction------>/ |
(Channel plate arrangements alternate between A and B plates)

........High Theta channel plate. Chevrons at angle greater than
90 degrees.
........Low Theta channel plate. Chevrons at angle less than 90
degrees.
(Channel plate arrangements can have all Highs, all Lows or
a mixture of Highs and Lows.)
2*15-F CH__ AISI_316 0.5mm EPDM_Clip-on

1*19 L S1->S2 30.7 psig Steam
1*19 L S4<=S3 Solution

<p>| | | | | | |</p>
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<thead>
<tr>
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<tbody>
<tr>
<td>39</td>
<td>End Plt1 16B</td>
<td>H</td>
<td>U==&lt;===U</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>38</td>
<td>Chan Plt.03A</td>
<td>L</td>
<td>O</td>
<td>O</td>
<td>U</td>
</tr>
<tr>
<td>37</td>
<td>Chan Plt.03B</td>
<td>L</td>
<td>U</td>
<td>U</td>
<td>O</td>
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<tr>
<td>36</td>
<td>Chan Plt.03A</td>
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<td>O</td>
<td>O</td>
<td>U</td>
</tr>
<tr>
<td>35</td>
<td>Chan Plt.03B</td>
<td>L</td>
<td>)</td>
<td>)</td>
<td>)</td>
</tr>
<tr>
<td>34</td>
<td>Chan Plt.03A</td>
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<td>U</td>
<td>U</td>
<td>O</td>
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<tr>
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<td>Chan Plt.03B</td>
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<td>O</td>
<td>U==&lt;===U</td>
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<td>U</td>
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<td>U</td>
<td>O</td>
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<td>L</td>
<td>O</td>
<td>O</td>
<td>O</td>
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<td>Chan Plt.03B</td>
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<td>O</td>
<td>O</td>
<td>U==&lt;===U</td>
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<td>L</td>
<td>U</td>
<td>O</td>
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<td>O</td>
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<tr>
<td>24</td>
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<td>L</td>
<td>O</td>
<td>O</td>
<td>U==&lt;===U</td>
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<td>U</td>
<td>O</td>
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<tr>
<td>22</td>
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<td>O</td>
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<tr>
<td>21</td>
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<td>O</td>
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<td>U</td>
<td>O</td>
<td>O</td>
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<td>Chan Plt.03B</td>
<td>L</td>
<td>O</td>
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**Plates:**  M15-F CH_ AISI 316 0.5mm EPDM_Clip-on

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<td>Chan Plt.03 L</td>
<td>Channel plate</td>
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<tr>
<td>2</td>
<td>1</td>
<td>End Plt1 16B H</td>
<td>End plate 1 0.6mm</td>
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<td></td>
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<tr>
<td>2</td>
<td>1</td>
<td>End Plt2 83B H</td>
<td>End plate 2</td>
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**Gaskets:**  EPDM_Clip-on

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<tr>
<td>74</td>
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<td>32330-1804-3</td>
<td>Channel plate gasket</td>
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<td>1</td>
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<td>Channel plate gasket</td>
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<td>2</td>
<td>1</td>
<td></td>
<td>End plate gasket II consists of:</td>
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<tr>
<td>4</td>
<td>2</td>
<td>32330-1804-3</td>
<td>2 Channel plate gaskets</td>
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</table>
Structural Support Calculations
COLUMN LOADS

A-1 - 3.6 k
B-1 - 14.3 k
C-1 - 14.1 k
D-1 - 19.0 k
E-1 - 14.2 k
A-2 - 4.5 k
B-2 - 36.3 k
D-2 - 62.9 k
E-2 - 34.1 k
A-3 - 8.4 k
B-3 - 27.9 k
C-3 - 28.8 k
D-3 - 19.9 k
E-3 - 14.4 k
A-5 - 9.8 k
B-5 - 17.6 k
A-7 - 4.8 k
B-7 - 8.5 k
C-7 - 11.5 k
F-7 - 12.1 k
C-6 - 24.2 k
F-6 - 24.2 k
C-4 - 28.1 k
F-4 - 24.2 k
F-3.1 - 12.0 k

EXCEPT @ GRID F, ALL COLUMNS WILL BE 14.3 k.
WITH KL 13.0 ALLOWABLE
COLUMN IS 93.0 k.
THIS SATISFIES ALL CONDITIONS.
\[ \frac{3.72}{4} \times 0.8150 = 0.937 \text{ kips per col.} \]

\[ 0.8150 \times 11.5 = 9.37 \text{ k} \text{ ft moment} \]

\[ \frac{9.37 \times 12 \times 1000}{21400} = 5.12 \text{ kips per sq ft} \]

\[ \text{W} = 2.31 \times 27.5 = 63.2 \text{ kips per column} \]
**Horiz. Forces & Dia. Bracing.**

7.26 kips  o  C-7 to F-7
12.93  o  E-2 to E-3
6.10  o  A-1 to A-2
14.64  o  D-1-1 to E-1

**Col. Uplift.**
21.65 k

Neglecting dead load.

**Dia. Braces.**
H 4-3/8 x 1.50"  26.13 kips  17.42 ksi  < 2x
Brace OK.

**Column Uplift.**
21.65
W/4 x 3/4" Epoxy Anchors

Pullout Test on 3d+ Epoxy Anch. w/ 6" Insulation is 24 kips. With a safety factor of 4 to 1
24 kips per anchor

6 k x 4 = 24 > 21.65  OK.
DESIGN LOADS (1990 BOCN NATIONAL PILE CODE)

LIVE LOAD ... 100 PSF. (LIGHT MANUFACTURING - PAGE 24)
DEAD LOAD ... 200 PSF.
TOTAL ... 120 PSF.

TANKS FT1, FT2, & FT3 47300 LBS. EACH (FILLED)
TANK FT4 25,300 LBS (FILLED)

LATERAL FORCES FOR EARTHQUAKE LOADS

\[ V = 2.5 A_v I K C S W \]  
\[ A_v = 1.1 \] (ZONAL 1)  
\[ I = 1.0 \] (TABLE 1113.1, PAGE 275)
\[ K = 1.0 \] (TABLE 1113.4.3, PAGE 278)
\[ C = 1.2 \] (PAGE 279)
\[ S = 1.5 \] (TABLE 1113.4.6, PAGE 281)
\[ W = \text{WEIGHT} \]

\[ V = 2.5 \times 1.1 \times 1.0 \times 1.0 \times 1.2 \times 1.5 \times W \]  
\[ V = .045 \ W \]
Beam Grid A-1 to P-1

2.4

3.08

3.08

3.08

H = 0 = 2.4 x 3.08 = 7.4

From A50 2.174 allowable M = 27.3 > 7.4

Beam Grid A-2 to B-2

2.4

3.08

1.42

1.66

1.11

2.37

H = 0 = 3.3 x 3.08 = 10.2

H = 0 = 3.3 x 4.50 - 2.4 x 1.42 = 11.4

H = 0 = 4.3 x 3.08 - 1.9 x 1.11 = 11.9

H = 0 = 4.3 x 2.37 = 10.2

From A50 2.174 allowable M = 27.3 > 11.9
**BEAM & GRID: B-2 TO D-2**

- \( 2.31 \) - \( 2.92 \) - \( 2.52 \) - \( 7.21 \)

**M**

- \( 0 \): \( 2.10 \times 2.21 \) = 4.64
- \( 1 \): \( 7.10 \times 5.13 - 204.192 - 48.82 = 48.82 \)
- \( 2 \): \( 7.10 \times 2.21 \) = 46.4

From ASD: 2.173 Allowable M = 91.5 > 48.82

**BEAM & GRID: D-2 TO E-2**

- \( 2.31 \) - \( 2.92 \) - \( 2.52 \) - \( 7.21 \)

**M**

- \( 0 \): \( 2.64 \times 2.21 \) = 58.3
- \( 1 \): \( 7.4 \times 5.13 - 78.6252 \) = 60.1
- \( 2 \): \( 7.4 \times 2.21 \) = 58.3

From ASD: 2.173 Allowable M = 66.3 > 60.1
Bean a Grid D1-1 To E-1 & D1-3 To E-3 (W19, W25)

\[
\begin{align*}
N &= 0.154 \times 4.7 = 10.3 \\
M &= 0.154 \times 3.59 - 129,1280 = 17.6 \\
H &= 11.0 \times 7.21 = 79.3
\end{align*}
\]
From ASD 2.173, allowable N = 66.5 > 10.3

Bean a Grid B-1 To C-11 (W19)

\[
\begin{align*}
N &= 0.64 \times 2.91 = 14.1 \\
M &= 0.64 \times 5.13 = 7.5 \times 2.52 = 10.9 \\
H &= 9.2 \times 6.7 = 60.2
\end{align*}
\]
From ASD 2.174 allowable N = 42.5 > 14.1
**BEAM - GRID A-3 TO B-3**

\[ \begin{align*}
N_x &= 4.4 \times 0.75 \\
N_y &= 4.4 \times (3.75 - 1.5) = 13.8 \\
N_{xz} &= (3.75 \times 5.74) - (1.9 \times 2.37) \\
N &= 3.7 \times 2.37 \\
\text{From ASD, R = 174, Allowable M = 77.3} \\
\end{align*} \]

**BEAM - GRID A-5 TO A-7**

\[ \begin{align*}
M &= 6.1 \times 3.55 + 20.4 \\
M &= 6.1 \times 7.17 - 3.1 \times 3.82 = 31.9 \\
M &= 6.2 \times 6.44 - 27 \times 3.35 = 27.9 \\
M &= 6.2 \times 2.89 = 17.9 \\
\text{From ASD, R = 172, Allowable M = 76.5 > 31.9} \\
\end{align*} \]
BEAM o GRID A-3 TO A-5

Unbraced Lenth 4.0

\[ T = 4.0 \times 3.31 = 13.2 \]

\[ N = 4.0 \times 6.42 \times 1.8 \times 3.31 = 22.0 \]

\[ M = 4.0 \times 7.96 - 2.2 \times 3.98 = 23.4 \]

\[ N = 4.0 \times 3.98 = 15.9 \]

From ASD 2-172 Allowable M = 76.2 > 41.4

BEAM o GRID B-3 TO B-5

Unbraced Lenth 4.0

\[ T = 3.31 \times 3.31 \times 4.00 \times 3.98 = 39.8 \]

\[ N = 7.6 \times 3.31 = 25.1 \]

\[ N = 7.6 \times 6.42 - 3.31 \times 3.31 = 39.3 \]

\[ M = 7.1 \times 7.96 - 3.98 \times 3.98 = 41.2 \]

\[ N = 7.1 \times 3.98 = 28.4 \]

From ASD 2-172 Allowable M = 76.2 > 41.4
**BEAM & GRID R-5 TO R-7**

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<th>1.5</th>
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<tbody>
<tr>
<td>M</td>
<td>3.35</td>
<td>3.35</td>
<td>3.35</td>
<td>3.35</td>
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<tr>
<td>N</td>
<td>7.0</td>
<td>7.0</td>
<td>7.0</td>
<td>7.0</td>
</tr>
</tbody>
</table>

\[ N \cdot L = 6.9 \cdot 3.35 = 23.1 \]
\[ N \cdot Q = 6.9 \cdot 7.17 - 3.5 \cdot 3.35 = 36.1 \]
\[ N \cdot Q = 7.0 \cdot 6.24 - 3.1 \cdot 3.35 = 33.3 \]
\[ N \cdot Q = 7.0 \cdot 3.35 = 23.1 \]

From ASD 2.172 allowable M = 7.072 > 33.3

**CROSS BEAM UNDER FT 12.13 (CROSSED 5-HO SPAN 148.18)**

\[ N \cdot L = 7.0 \cdot 1.42 = 9.9 \]
\[ N \cdot L = 7.0 \cdot 2.92 \cdot 1.50 = 10.4 \]
\[ N \cdot Q = 7.0 \cdot 1.42 = 9.9 \]

From ASD 2.174 allowable M = 8.03 > 10.4
BECAN -GRID C-3 TO C-4

\[
\begin{align*}
\text{1.87} & \quad 1.48 & \quad 2.52 & \quad 1.71 & \quad 2.81 & \quad 9.8 & \quad 3.00 \\
\text{1.11} & \quad 1.11 & \quad 1.11 & \quad 1.11 & \quad 1.11 & \quad 1.11
\end{align*}
\]

\[
H_0 \ (\text{1}) = 13.7 \times 1.87 = 25.6
\]
\[
H_0 \ (\text{2}) = 13.7 \times 3.35 = 46.5
\]
\[
H_0 \ (\text{3}) = 13.7 \times 5.21 = 72.9
\]
\[
H_0 \ (\text{4}) = 11.1 \times 6.19 = 69.0
\]
\[
H_0 \ (\text{5}) = 11.1 \times 3.18 = 35.3
\]

From ASD: R = 172. Allowable: M = 91.2 > 54.4

BECAN -GRID F-31 TO F-4, F-4 TO FC

\[
\begin{align*}
\text{3.35} & \quad 4.79 & \quad 3.35 \\
\end{align*}
\]

\[
H_0 \ (\text{1}) = 9.2 \times 3.35 = 30.8
\]
\[
H_0 \ (\text{2}) = 9.2 \times 3.35 = 30.8
\]

From ASD: R = 172. Allowable: M = 66.8 > 30.8
BEAM GRID C-6 TO C-7

\begin{align*}
H_{\theta} & = 10.2 \times 3.35 = 34.12 \\
M_{\theta} & = 10.2 \times 6.25 - 9.8 \times 2.90 = 35.3 \\
H_{\theta} & = 16.8 \times 3.35 - 1.5 \times 1.43 = 34.0 \\
H_{\theta} & = 16.8 \times 1.5 = 25.2
\end{align*}

FROM ASD 2.173 ALLOWABLE M \leq 44.8 \geq 35.3
BEAM UNDER E.F. A (2 Places)  

\[ \text{Unpressed Length: } 5'10.3" \]

\[ \begin{array}{c|c|c|c|c|c} \hline \text{F} & \text{C} & \text{C} & \text{F} & \text{F} \\ \hline 3.85 & 1.06 & 3.74 & 1.06 & 3.55 \\ \hline \end{array} \]

\[ M = 0 \text{ of } 4 = 8.1 \times 3.55 = 28.8 \]

\[ I = 0 \text{ of } 3 = 8.1 \times 4.63 - 49 \times 1.06 = 32.0 \]

FROM ADS 2-173 ALLOWABLE M = 66.0 ft-lb > 28.8

BEAM B-3 TO C-7-3  

\[ \begin{array}{c|c|c|c} \hline \text{12.9} & \text{11.1} & \text{13.7} \\ \hline 2.01 & 2.02 & \text{6.4} \\ \hline \end{array} \]

\[ M = 0 \text{ of } 2 = 12.8 \times 2.01 = 25.8 \]

\[ I = 0 \text{ of } 2 = 12.8 \times 5.13 - 12.9 \times 2.92 = 78.0 \]

\[ I = 0 \text{ of } 3 = 25.8 \times 1.46 - 13.7 \times 0.9 = 26.4 \]

\[ I = 0 \text{ of } 4 = 25.8 \times 0.7 \]

\[ \text{FROM ADS 2-172 ALLOWABLE M = 91.2 ft-lb > 28.8} \]
Cross Beam Under FF4 (2 Places) \( E \times 10 \text{ Span} \) (U8x18) \\ Undercrossed 11g

\[ M = 4.3 \times 1.50 = 6.45 \]
\[ N = 4.3 \times 2.92 = 12.96 \]
\[ H = 4.3 \times 1.40 = 6.02 \]

From ASD 2-74 Allowable \( N = 30.3 > 6.02 \)

Beam Under Flash Tank (8 Places) \( U12x24 \) \\ Undercrossed Length 51.03

\[ M = 12.9 \times 3.55 = 46.8 \]
\[ H = 12.9 \times 9.63 = 125.2 \]

From ASD 2-74 Allowable \( H = 65.8 > 52.2 \)
BEAM - GRIP E-2 TO E-3  \( W_{y} = 24 \)  
\[ M = \frac{1.8 \times 12.33 \times 2.8}{8} \]  
FROM ASD 2-174 ALLOWABLE \( M = 38.3 > 2.8 \)

BEAM - GRIP B-2 TO B-3  \( W_{y} = 24 \)  
\[ M = \frac{3.6 \times 12.33 \times 5.5}{8} \]  
FROM ASD 2-174 ALLOWABLE \( M = 38.3 > 5.5 \)

BEAM - GRID B-1 TO B-2  \( W_{y} = 24 \)  
\[ M = \frac{4.12 \times 12.33 \times 6.5}{8} \]  
FROM ASD 2-174 ALLOWABLE \( M = 38.3 > 6.5 \)

BEAM - GRID A-1 TO A-2  \( W_{y} = 24 \)  
\[ M = \frac{2.4 \times 12.33 \times 3.7}{8} \]  
FROM ASD 2-174 ALLOWABLE \( M = 38.2 > 3.7 \)

BEAM - GRID A-5 TO B-5  \( W_{y} = 24 \)  
\[ M = \frac{34.9 \times 9.25 \times 3.9}{8} \]  
FROM ASD 2-174 ALLOWABLE \( M = 38.3 > 3.9 \)
BEAM 7-178 SOUTH OF GRID B-1 TO C-1

\[ M = \frac{3.2 \times 7.25}{8} = 2.9\, kN \cdot m \]

From ASD page 2-175 Allowable \( M = 11.5 > 2.9 \).

UNBRACED LATH 7-3

BEAM 6-13 NORTH OF GRID B-5 TO C-5

\[ M = \frac{3.2 \times 7.25}{8} = 2.9\, kN \cdot m \]

From ASD 2-175 Allowable \( M = 11.5 > 2.9 \).

UNBRACED LATH 7-3

BEAM 2-103 NORTH OF GRID B-5 TO C-5

\[ M = \frac{2.8 \times 7.25}{8} = 2.5\, kN \cdot m \]

From ASD 2-175 Allowable \( M = 11.5 > 2.5 \).

UNBRACED LATH 7-3

BEAM 3-133 SOUTH OF GRID B-15 TO C-5

\[ M = \frac{3.0 \times 7.25}{8} = 2.7\, kN \cdot m \]

From ASD 2-175 Allowable \( M = 11.5 > 2.7 \).

BEAM 6-172 SOUTH OF GRID B-5 TO C-5

\[ M = \frac{3.2 \times 7.25}{8} = 2.9\, kN \cdot m \]

From ASD 2-175 Allowable \( M = 11.5 > 2.9 \).
BEAM 2 1/2" NORTH OF GRID A-5 To B-5 (US110)
M = 3.4 x 9.25 = 31.9 k-ft

FROM ADS 2-175 ALLOWS M = 9.0 > 31.9

BEAM 6 1/2" NORTH OF GRID A-5 To B-5 (US110)
M = 4.0 x 9.25 = 46 k-ft

FROM ADS 2-175 ALLOWS M = 9.0 > 46

BEAM 7 1/2" SOUTH OF GRID A-7 To B-7 (US110)
M = 4.0 x 9.25 = 49 k-ft

FROM ADS 2-175 ALLOWS M = 9.0 > 49

BEAM 3 4/4" SOUTH OF GRID A-7 To B-7 (US110)
M = 4.0 x 9.25 = 44 k-ft

FROM ADS 2-175 ALLOWS M = 9.0 > 44

BEAM 3 4/4" SOUTH OF GRID B-5 To C-5 (US110)
M = 3.0 x 1.25 = 37.5 k-ft

FROM ADS 2-175 ALLOWS M = 11.5 > 37.5
BEAM 0-GRID D-2 TO D-3 
M = 3.8 x 11.28 = 47.1 k

FROM ASD 2-175 ALLOWABLE M = 20.75 > 47.1

BEAM 0-GRID D-1 TO D-2 

N = 3.125 x 5.0 = 15.6 k

FROM ASD 2-175 ALLOWABLE N = 17.0 > 15.6

BEAM B-4 \(\pm 7.113\) NORTH 0-GRID A-3 TO B-3 
N = 4.4 x 9.25 = 41.1 k

FROM ASD 2-175 ALLOWABLE N = 9.0 > 41.1

BEAM 0.1\(\pm 6.79\) SOUTH OF GRID A-5 TO B-5 
M = 4.2 x 9.25 = 39.6

FROM ASD 2-175 ALLOWABLE M = 9.0 > 39.6

BEAM 3/1/4 SOUTH OF GRID A-5 TO B-5 
M = 3.6 x 9.25 = 33.2

FROM ASD 2-175 ALLOWABLE M = 9.0 > 33.2
Beam 3-1.462 West of Grid B-1 To B-2 (7 Places)

\[ M = \frac{4.8013 \times 7.8 \times 10^4}{8} \]  
From ASD 0.175 Allowable M = 17.1 > 7.8

Beam 3-1/4" Water golf B-2 To B-3 (W.15)

\[ M = \frac{3.813 \times 6.2 \times 10^4}{8} \]  
From ASD 0.175 Allowable M = 12.1 > 6.2

Beam Under Tanks (6 Places) (W.10)

\[ M = \frac{1.6 \times 5.5 \times 10^4}{8} \]  
From ASD 0.175 Allowable M = 15.6 > 1.2

Beam @ Tanks 3/8" Span (6 Places) (W.10)

\[ M = \frac{4.2 \times 3.55 \times 10^4}{8} \]  
From ASD 0.175 Allowable M = 15.6 > 0.5
BEAM - GRID A-7 TO B-7

\[ M_e = \frac{8 \times 9.25 \times 21}{8} \]
FROM ASD 2.174 ALLOWABLE M = 38.3 > 21

BEAM - GRID B-7 TO C-7

\[ M_e = \frac{1.4 \times 7.25 \times 1.3}{8} \]
FROM ASD 2.174 ALLOWABLE M = 38.3 > 1.3

BEAM - GRID B-5 TO C-5

\[ M_e = \frac{2.6 \times 7.25 \times 2.4}{8} \]
FROM ASD 2.174 ALLOWABLE M = 38.3 > 2.4

BEAM - GRID C-7 TO F-7

\[ M_e = \frac{3.5 \times 18.24 \times 8.1}{8} \]
FROM ASD 2.174 ALLOWABLE M = 31.4 > 8.1
BEAM @ GRID C-6 TO F-G & C-4 TO F-A (SW 12.16)

\[ N = \frac{7.2 \times 18.64}{8} = 16.2 \text{ kN} \]

\[ N = \text{CON.T.} = \frac{40 \times 5.45^2}{4} = 5.9 \text{ kN} \]

From ASD 2.174 allowable \( N < 31.4 > 16.2 \)

BEAM @ GRID C-3.1 TO F-3.1 (SW 12.16)

\[ N = \frac{6.6 \times 18.64}{8} = 14.9 \text{ kN} \]

\[ N = \text{CON.T.} = \frac{20 \times 5.45^2}{4} = 3.0 \text{ kN} \]

From ASD 2.174 allowable \( N = 31.4 > 14.9 \)

BEAM @ FILTER PRESSURE GRID C TO F (GPOSS) (SW 12.16)

\[ M = \frac{3.6 \times 18.34}{8} = 8.1 \text{ kN} \]

\[ N = \text{CON.T.} = \frac{40 \times 5.45^2}{2} = 6.8 \text{ kN} \]

From ASD 2.174 allowable \( M = 31.4 > 8.1 \)
BEAM 41/2 # 31/4 NORTHERN GRID B-3 TO C-3  

\[
N_e = 3.6 \times 7.25 = 3.1 \text{ kN}
\]

FROM ASD. 2.175 ALLOWABLE N = 11.5 > 3.1

BEAM @ GRID E-1 TO E-2  

\[
N_e = 1.8 \times 11.25 = 20.25
\]

FROM ASD. FACT 2.175 ALLOWABLE N = 5.2 > 20.5

BEAM @ GRID A5 TO A-6  

\[
N_e = 1.8 \times 13 = 2.9 \text{ kN}
\]

FROM ASD. 2.175 ALLOWABLE N = 4.8 > 2.9
MEZZ. BEAM - GRID B-1 TO C-9-1

\[ \text{UNREACED LOAD} \quad 4.0 \]

\[ \begin{align*}
\text{I} & \quad \Theta = 2.8 \times 1.58 = 4.4 \\
\text{II} & \quad \Theta = 2.1 \times 3.12 = 6.6 \\
\text{III} & \quad \Theta = 2.8 \times 1.58 = 4.4
\end{align*} \]

FROM ASD 2.175 ALLOWABLE M = 23.6 > 6.6

MEZZ. BEAM - GRID B-2 TO D-2

\[ \text{UNREACED LOAD} \quad 7.0 \]

\[ \begin{align*}
\text{I} & \quad \Theta = 5.2 \times 1.54 = 8.0 \\
\text{II} & \quad \Theta = 5.2 \times 3.12 = 16.3 \\
\text{III} & \quad \Theta = 5.2 \times 5.19 = 27.2 \times 2.0 = 54.4 \\
\text{IV} & \quad \Theta = 6.7 \times 3.12 = 21.4 \times 1.58 = 14.4 \\
\text{V} & \quad \Theta = 6.7 \times 1.54 = 10.3
\end{align*} \]

FROM ASD 2.174 ALLOWABLE M = 29.6 > 14.4
MEZZ BENCH & GRID D-2 TO E-2

N = 2 N (Fig No. 7)

\[ N = 6 + 0.5 \times 6 = 8.0 \]

\[ N = 6.0 + 0.5 \times 6.0 = 10.1 \]

\[ N = 4.0 + 1.54 = 5.54 \]

\[ N = 2.14 \times 1.54 \]

\[ N = 10.1 > 10.1 \]

\[ N = 27.6 > 10.1 \]
MEZZ BEAM: C19.1 TO C19.2

(N 3.6 x 126 = 51.7 k)

N = \frac{3.6 \times 126}{8} = 51.7 k

From ADS 2.175 Allowable N = 21.0 > 51.7

MEZZ BEAM: D1.1 TO D1.2

(WE 15)

(N 5.7 x 126 = 82.2 k)

M = \frac{82.2}{8} = 10.3 k

From ADS 2.175 Allowable M = 21.0 > 10.3

MEZZ BEAM: 114 mm TO C18.1 TO C18.2

(U8x15)

(M 4.2 x 13 = 54.6 k)

N = \frac{4.2 \times 13}{8} = 7.1 k

From ADS 2.175 Allowable N = 21.25 > 7.1

MEZZ BEAM: 54 mm EAST OF B1 TO B-9

(1.9 x 15)

(N 5.6 x 13 = 97.6 k)

M = \frac{5.6 \times 13}{8} = 8.9 k

From ADS 2.175 Allowable M = 21.25 > 8.9

MEZZ BEAM: 114 mm EAST OF B3 TO B3

(U8x15)

(M 4.0 x 13 = 52.0 k)

N = \frac{4.0 \times 13}{8} = 8.0 k

From ADS 2.175 Allowable N = 21.0 > 8.0
MEZZ. BEAM & GRID: E-1 TO E-12 (UB-10)
R-1 TO B-3 & EN TO E-3
M = 12.13, 1.95 k'
(UNBROKEN GUTH 13')

FROM ADS 2.175 ALLOWABLE M = 4.0 > 1.95

MEZZ. BEAM & GRID: B-1 TO B-7 (UB-10)
M = 36.13, 4.2 k'
(UNBROKEN GUTH 6.8)

FROM ADS 2.175 ALLOWABLE M = 12.7 > 4.2

MEZZ. BEAM & GRID: C-9 TO C-7 & D-1 TO D-12 (UB-15) UNBROKEN GUTH 7.8
M = 52.13, 8.5 k'

FROM ADS 2.175 ALLOWABLE M = 21.2 > 8.5

MEZZ. BEAM: V.L. WEST OF EI TO EN & EN TO E-3 (UB-15)
M = 40.13, 6.8 k'
(UNBROKEN GUTH 10.2)

FROM ADS 2.175 ALLOWABLE M = 21.2 > 6.8
MEZZ. BEAM 2'-11" SPAN, 6' PLACES, 14'-8" O.D.

2'-11" UNBRACED (5TH)

N. = \frac{\gamma_L + 2.32 + \gamma_E}{2}

FROM ADG 7-175 ALLOWABLE N = 16.0 > 4

MEZZ. BEAM @ TANK OPENING, 6' PLACES (17'-8"

\gamma_L \cdot \frac{G \times 7.16}{4}

FROM ADG 7-175 ALLOWABLE N = 16.0 > 1.1
Columns on G" Slab

Max. Load Is At B.S. = 17,6 kips

G" slab, 4,000 psi Conc. W/ #4 @ 12 in. o.c.

Allowable M. per ft. of slab

As #13 20 x 4,000 x 0.85 x 3 x 17,240 = 11,940 ft-lbs

Critical Section

Shear of 2 way (Punching) shear

4 x 6" x 6" x 11 71,000 + 26,710 K = 17,6. K. O.K.

Required Moment Per Ft. Of Slab

2500 x 11.5 x 11.5 / 12 = 91,856 lbs < 12,940 lbs. O.K.

From ASD page D. for beam diag. #20
Horz. Forces & Sides

F

3.36
12.5
11.5

3.1

3.75 kips per col.

8.15 x 11.5 = 9.37 k. moment

9.37 / 11.5 = 0.805 < 5.2 Read 5.2

8.31 x 27.5 = 227.2 columns OK

Combined Loads:

\[
\frac{5.2}{27.5} + \frac{24.2}{149} \approx 0.351 < 1 \text{ Col: O.K.}
\]

from 400 = 3.3
Horz Force on M25: Hoop. Load: 82 = 71.1 k
  22 = 12.3 k
  En. = 5.1 k

Horz Force on A21: (34 + 10.3 + 5.7) x 0.45 = 11.4 k
  114 = 38 k; Horz Force per Con.
  3

M3 West: Anc. or Con. = 35% 12.05 = 4.6 k

Res. Sz = 4.2 k x 18 = 0.59 < 5.63 5k
  21.6

Combined Loading

\[
\frac{0.59}{5.63} + \frac{12.5}{95} < 1
\]

Cols. OK.
Moment at Col. Cap. Plate on Col. F3.1, F4.5, 9.7

Forces at Col. F3.1: 9.37 x 12 = 14.86 k
(2 - 1.435)

Axial on Flanges: 70 x 4 = 280 > 14.86 O.K.

Max. Tensile Forces: 9.37 x 12 = 112.46 k

16.66 = 3.38 per bolt < 9.3 O.K.
Foundation Design Analysis
To: USPCI
Lone Mountain Facility
Route 2, Box 180A
Waynoka, Okla. 73806
Attn: Lawson Fenton

March 28, 1995

The following is an investigation for the foundation support for the mezzanine platforms for the Wastewater Final Treatment Facility, and the calculations for the design of the beams, columns, and bracing for the structure. The design loads are per the 1990 BOCA National Building Code and are shown on page #7 of the following submittal.

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<th>COLUMN</th>
<th>LOAD, KIPS</th>
<th>FOUNDATION CONDITION</th>
<th>REMARKS</th>
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<td>17&quot; floor slab</td>
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<td>A-2</td>
<td>4.5</td>
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<td>A-3</td>
<td>8.4</td>
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<td>A-5</td>
<td>9.8</td>
<td>6&quot; floor slab</td>
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<td>A-7</td>
<td>4.8</td>
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<td>B-1</td>
<td>14.3</td>
<td>17&quot; floor slab</td>
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<td>8.5</td>
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<tr>
<td>C-4</td>
<td>28.1</td>
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</tbody>
</table>
**Columns on G'' Slabs**

Max. Cal. Load is at B.5 - 17.6 Kip.

G'' slab, 4,000 psi concrete with 4" dia. rebars @ CTR.

Allowable N per ft. of slabs

\[ A_s \times f_s \times d = 0.20 \times 4,000 \times 1.85 \times 3 \times 17.240'' \text{ LBS.} \]

\[ 36'' \times (-30) \]

Critical section moment

Check of 2 way (Punching) shear

\[ 4 \times 10'' \times 7'' \times 1000 = 26,700 \text{ K.} \geq 17.6 \text{ K. O.K.} \]

Required moment per ft. of slab

\[ \frac{2500 \times 11.5 \times 11.5}{4} = 6,888'' \text{ LBS. < 17,240'' LBS. O.K.} \]
COLUMNS 5'N. 17" SLATS W/ 3'-12" E.W. TAB

Max. Col Load is at Grid D-2 - 62.9 KIPS

Allowable Moment in slab
\[ 44 \times 24,000 \times 12 = 122,720 \text{ lb. ft.} = 10.56 \text{ k' } \]

Allowable Soil Res. = 7,500 \times 180 = 23,250

\[ \frac{62.9}{2.32} = 27.11 \text{ for req'd area } = 5'-3" \text{ square} \]

2 Way (Punching) Shear \[ 4 \times 12.7 \times 17 = 1.1 \times 74,000 \times 127.7 \text{ k' } > 62.9 \text{ k' } \text{ OK} \]

Req'd Moment in Grade beam

\[ \frac{29.5 \times 2.32}{1.31 \text{ k' } < 10.56 \text{ k' } \text{ OK}} \]
COLUMNS ON 24" X 36" GRADE BEAM

Max col load is at col C-4 - 93.1 Kips.

Grade beam has 2-1/2" top, CTR & 13' OTT (According to Lawson Fenton)

Allowable Moment in Grade Beam (Figuring 7" I typ.)
At fr. 14'-1.88 x 2400 = 30 x 633.240" LB. = 52.8 K!

Allowable Soil BRG 2500 - GB. weight 360 x 2140
23,100 = 6' 6" length of grade beam to support col.
2140 x 2

Read Moment in Grade Beam.

\[ \frac{2,140 \times 6.67}{2} = 18.2 \text{ K} < 52.8 \text{ K} \text{ o.k.} \]
CORE HOLE TO BE FILLED WITH SEMSTONE 140 WITH SAND BINDER

FILL PLUG TO 1/4" BELOW FINISH GRADE, LEAVE SURFACE ROUGH

PROTECTIVE COATING TO MATCH EXISTING.

EXIST. CONCRETE (VARIABLE THK.)

REMOVE DIRT AROUND FULL CIRCUMFERENCE 1 1/2" WIDE MIN.

FILL TO 1 1/2" BELOW CONC. W/ BENTONITE PELLETS

CORE PLUG DETAIL
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PMT - Pre-Water Treatment
FMT - Final Water Treatment

* Samples which were not able to pull out of the hole.
March 27, 1995

Mr. Jim Richenbaugh  
Black & Veatch Waste Science  
4717 Grand Avenue, Suite 500  
Kansas City, MO 64112

Re: USPCI Lone Mountain Facility  
Subject: Waste Water Treatment Floor Structural Design

The concrete floors in the area where the mezzanine has been erected were poured as part of two different building expansions. The first expansion was poured in the spring of 1987 and was designed to be eighteen inches thick with two layers of 3/4 inch reinforcement bars tied on one foot centers and separated by twelve inches between the top and bottom mats. All reinforcement bars were kept within three inches of the slab’s surfaces and were supported by concrete brick on a two inch layer of sand. This slab underlies the area that supports the Flash Tanks and EF4 and extends to the south edge of the filter press mezzanine.

The second expansion attaches to the north side of the first slab and was poured in November of 1987. It was poured around four existing boiler foundations that were 2 feet wide, 3 feet deep, and 24 feet long. The floor slab was poured six inches thick and used a layer of 1/2 inch reinforcement bars tied on one foot centers, supported on a concrete brick and a 2 inch layer of sand. This slab underlies the area supporting the filter presses.

Both slabs were poured using a 4000 psi concrete strength mix as verified by the core sample tested by Meyers Engineering of which a report has been sent to you earlier this week.

I hope this will provide the information you needed for the certification work now in progress.

Sincerely,

Lawson Fenton  
Project Manager

Our Mission:  
Provide the highest quality waste and by-product management services that consistently meet or exceed customer needs and regulatory requirements at competitive cost while enhancing shareholder value.
**Tank Loading**

Tank Volume = 1625 gal.

Fluid Sp. Gr. = 1.5 maximum

Fluid weight (max) = 1625 gal. x 8.35 lb/gal x 1.5 = 20,350 lb

Tank Weight = 7000 lb.

Weight of Tank + contents = 7000 lb + 20,350 lb = 27,350 lb

**Tank Base Plate**

Height distribution to base plate:

Base plate area = \( \pi R^2 - \pi r^2 = \pi (R^2 - r^2) \)

= \( 3.14 \left[ (4.5')^2 - (2.5')^2 \right] \)

= 10 ft²

Loading = \( \frac{\text{wt. (tank + contents)}}{A} \)

\[ L = \frac{27,350 \text{ lb}}{10 \text{ ft}^2} = 2735 \text{ lb/ft}^2 \]
Tank Leak Tests
Hydrostatic Test Record

Customer: USPCI - Lone Mt. Facility
Project: Evaporation Feed Tank No. 4
Location: Waynoke, OK

Test Start Date 3/1/95  Test Start Time 7:45 a.m.
Test Finish Date 3/1/95  Test Finish Time 11:45 a.m.

Test Procedure:
Fill evaporator feed tank to the top mtd. nozzle with water.

Results:
All tank nozzles were flanged off below the test water level. There was no change in water level inside the feed tank. Visual inspection of tank and tank nozzles indicated no water leaks.

Witness ___________________________ Date: 3/1/95
**WISco, INC.**

11811 North Fwy., Suite 670  
Houston, Texas 77060  
(713) 820-8066

<table>
<thead>
<tr>
<th>Customer</th>
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<th>Attn.</th>
<th>Bruce Patterson</th>
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<td>Dated</td>
<td>Rev.</td>
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<td>Matl Destination</td>
<td>Lone Mt. Facility, Waynoka, OK</td>
<td>Req. Date</td>
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<td>Shipment Date is now</td>
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<td>As of</td>
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<td>11/24/93</td>
<td>Order is</td>
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<td>Lide Tank Co.</td>
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<td>Mr. Billy Lide</td>
<td>Position</td>
<td>Customer Contact</td>
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**Report Date:** 11/19/93  
**Report No.:** 001

**MATERIAL DESCRIPTION:**

Two (2) tanks - one 6' 4" OD x 12' 0" high; one 5' 0" OD X 12' 0" high  
To specifications of USPCI and API 650

**STATUS OF ORDER:** Engineering, Materials, Fabrication, Inspection, Completion

The following was performed on each item:

- Dimensional checks covering elevation, orientation, projection of all nozzles and manways. All of which were noted to be acceptable and as noted on shop approved drawings.

- Fit-up of material: seams, junctions and welding of same was found to be very good. Visual inspection on nozzle fit-up and welding was noted as very good.

- Review of two (2) spot x-rays (one on each item) was found to be satisfactory.

- Leak test on each item was performed and noted as acceptable. Vessels were filled for over twelve (12) hours. Visual inspection disclosed no leaks or seeps.

- Inspection of blasting and painting is scheduled for Wednesday, 11/24/93.
Piping Leak Tests
Piping Pressure Test

Customer: USPCI - Lone Mt. Facility

Project: Discharge piping from Evaporation Feed Pumps P76 and P79 to
(1) the block valve located just before suction side of Pump P75.
(2) the block valves located on either side of Preheat Exchanger EU-4.
(3) the check valves located between the normally closed (NC) valves and the
   TEEs connecting to the suction side of Filter Press Pumps P77, P80, and P83
   (including by-pass lines).
(4) the flange located on suction side of Pump P-5.

Location: Waynoka, OK

Test Start Date: 8/5/96  Test Start Time: 3:55 p.m.
Test Finish Date: 8/5/96  Test Finish Time: 5:55 p.m.

Test Procedure:

Fill piping section between Pumps P76 and P79 discharge to valves described above. Apply water
pressure to system up to 105 psig by hydro pump and hold this pressure for minimum 2 hours.

Results:

Piping section was isolated from Pumps P76, P79, and P-5 by flange and Pump P75, EU-4, and Pump
P83 by valve. System was pressured up to 105 psig and held this pressure for 2 hours. No change
in pressure gauge reading was observed.

Signature: Geoffrey E. Brueggemann, P.E.
Envirotech Services, Inc.

Date: Aug. 20, 1996
Tank Metallurgy
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<th>BURN THRU</th>
<th>CRACK</th>
<th>UNDERCUT</th>
<th>INC. PENET</th>
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ADIOPHGRAPHER: D. Stark
LEVEL II
Authorized Inspector: reviewed by D. Allen

Q.C. MGR. E. Van Lionen DATE: 11-19-93
DATE: 11-19-93
COMMENTS: WISCO INC.
## Test Report

**THIS IS TO CERTIFY THAT THE PRODUCT DESCRIBED HEREIN WAS MANUFACTURED, SAMPLED, TESTED AND/OR INSPECTED IN ACCORDANCE WITH THE SPECIFICATION AND FULFILLS REQUIREMENTS IN SUCH RESPECTS.**

**Edward J. Bradley**

**CORPORATE DIRECTOR, QUALITY**

**DATE: 09-23-93**

---

**Geneva Steel**

P.O. BOX 2500

PROVO, UTAH 84603

**Mannesmann Pipe Steel Corp**

1990 Post Oak Blvd

Houston, TX 77056-3811

**Oneal Steel Inc**

10848 Luna Road

Dallas, Texas

---

H.R. SHEET C.25 MAX P.040 MAX S.050 MAX HR365050 Y/P 36 KSI MIN

T/S 58 KSI MIN DRY NO OIL (FOR CONVERSION TO ASTM A-36)

---

**01 MILL RA/SN CERTIFIED T/R**

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**'Geneva Steel Company CERTIFIES ALL SMELTING, MELTING AND MANUFACTURING PROCESSES OCCURRED IN THE USA.'**

---

**008064 IN*** 

---

PAGE 01
**Geneva Steel**
P.O. Box 2500
Provo, Utah 84603

**Manhansmann Pipe & Steel Corp**
1990 Post Oak Blvd
Houston, TX 77056-3811

**Ferro Union**
7400 Mesa Road
SP SPIN#243093
Houston, Texas

**H. R. Sheet**
C25MAX P.040MAX S.050MAX HR36S058 Y/P 36 KSI MIN T/S
58 KSI MIN DRY NO OIL

01 MILL RA/SN CERTIFIED T/R ANALYSIS REPORT TEST RESULTS PER PROD

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**Heat No.:**

C3269 HEAT 23

**Geneva Steel Company Certifies All Smelting, Melting and Manufacturing Processes Occurred in the USA.**

**End of Data***
Piping Metallurgy
**BELLVILLE TUBE CORP**

**HILL CERTIFICATION**

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**SPECIAL INSTRUCTIONS:** 25' BEVELED FOR WELDING

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All material has passed API flattening tests, and Hydrostatic tests.

Notwithstanding any other provision in this contract, B.T.C. makes no warranty as to the suitability or fitness of this product for upgrading by furnace and temper or any other process, unless B.T.C. shall be consulted in advance and give its approval in writing.

We hereby certify that the above information is true and correct as contained in the records of this division.
CERTIFIED TEST REPORT

ITEM | QUANTITY | DESCRIPTION/SPECIFICATION | HEAT CODE
--- | --- | --- | ---
6 STD LR 90 | A106B 09 / U60907 | A234-92A/SA234 WPB | CB6W
SOLD TO: M & K SUPPLY CO
P.O. BOX 548
DUNCAN OK 75533

CODE | C | Mn | P | S | Si | Cr | Mo | Cu | Ni | V | Nb | C.E.-
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
CB6W | .17 | .77 | .011 | .007 | .20 | .02 | .00 | .01 | .01 | .00 | .00 | .90

HEAT CODE | TENSILE KSI | YIELD KSI | % Elong. IN 2” | Hardness HB | Size MM x 10 mm | Temp. °F | FOOT POUNDS | LATERAL EXPANSION | % SHEAR
--- | --- | --- | --- | --- | --- | --- | --- | --- | ---
CB6W | 65.9 | 41.9 | 33.0 | 126

*LONGITUDINAL, T = TRANSVERSE

CB6W CONFORMS TO THE REQUIREMENTS OF NACE MR0175-92

The above items were heat treated in accordance with the requirements of the specification to which they were manufactured.

The products covered by this report comply with the applicable requirements of ASTM and/or ASME specifications, as noted for each item.

I certify that the above figures are correct, as contained in the records of the Company.

[Signature]

PUBLIC TESTING LABORATORY
29000 W. Butterfield Rd
Oak Park, IL 60304
(708) 848-0100
<table>
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<tr>
<th>ITEM</th>
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<td>C67R</td>
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<td>6 STD LR-90 A234-92/A/SA234 WP5</td>
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**Physical Properties:**

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<th>YIELD KSI</th>
<th>% Elong. IN 2&quot;</th>
<th>Hardness HB</th>
<th>Size MM x 10 mm</th>
<th>Temp. °F</th>
<th>FOOT POUNDS</th>
<th>LATERAL EXPANSION</th>
<th>% SHEAR</th>
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* L = LONGITUDINAL, T = TRANSVERSE

1293LBC67R CONFORM TO THE REQUIREMENTS OF NACE MR0175-92

The items were heat treated in accordance with the requirements of the specification to which they were manufactured.

We certify that the products covered by this report comply with the applicable requirements of ASTM and/or ASME specifications, as noted for each item.

We hereby certify that the above figures are correct, as contained in the records of the Company.
**MILL TEST REPORTS FURNISHED BY TEXAS PIPE & SUPPLY CO., INC.**

**CUTOMER**

**CERTIFIED TEST REPORT**

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<tr>
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<td>API 5L X42/B</td>
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<td>INSSH O/D NO.</td>
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**MECHANICAL PROPERTIES - LONGITUDINAL**

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<td>(KSI)</td>
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<td>(INCHES)</td>
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**CHEMICAL ANALYSIS - INSSH**

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<th>Cr</th>
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**HYDROSTATIC TEST (PSI):** 2560

**SUPPLEMENTAL REQUIREMENTS - YEB! NO.**

- **HARDNESS:** HB AVG 85
- **CHARPY IMPACT TEST:** PASSED
- **FLATTENING TEST:** PASSED
- **NACE TEST:** PASSED
- **DRAIN SIZE:** PASSED
- **OTHER:** PASSED

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<th>REMARKS</th>
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**SPECIFICATIONS IN:**

- **ASME A516 Rev. 96**
- **ASME A516 Rev. 91**
- **ASME SA-516 Rev. 96**
- **ASME SA-516 Rev. 91**

**CERTIFIED QUALITY CONTROLLED TO BEFORE ME**

**THERMO: 01-07**

**HEAT NUMBER:**

**PRODUCT NUMBER:**

**OTHER:**

**SIGNED:**

[Signature]

**DATE:** 2-2-94

**REMARKS:** THIS CERTIFICATE IS CONTROLLED TO BEFORE ME
**KOPPEL DIVISION**
**AMBRIDGE DIVISION**

**TEST REPORT**

**SOLD TO:**
TEXAS PIPE & SUPPLY CO., INC.
ATTN: PURCHASING DEPARTMENT
2330 HOLMES ROAD
HOUSTON, TX 77051

**SHIP TO:**
TEXAS PIPE & SUPPLY CO., INC.
HOUSTON, TX 77419-E
S. FIERCE JUNCTION TEAM TRACK

**SPECIFICATION(S):**
ASTM ASME SA/A53-90a SA/A106-90/ API 5L GR B/ X42

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**LOT  | SPECIMEN | YIELD KSI | TENSILE KSI | ELONG | 2" | R/A | BHN | ROCK | WROUL | GRAIN | SIZE | HAUCH | 7 |
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**MATERIAL MELTED AND MANUFACTURED IN USA**

**OTHER**

- **HYDRO - 3000 PSI, 5 EXC HOLD**
- **PLATES - DX**
- **CERTIFIED MACE H0175**
- **WILL TEST REPORTS FURNISHED BY TEXAS PIPE & SUPPLY CO., INC.**

**CUSTOMER**

**CUSTOMER PO#**

**DATE: 7-26-94**

**QUALITY ASURING**

**MATERIAL WAS NOT EXPOSED TO MERCURY DURING PROCESSING.**

**NO WELDING OR WELD REPAIR PERFORMED ON THIS MATERIAL.**

**Koppell Steel Corporation**

**Ambridge Tube Operations**
P.O. Box 410
Ambridge, PA 15003

**Koppell Steel Operations/German Hill**
P.O. Box 770
Beaver Falls, PA 15010
Phone 412-847-7100, FAX 412-847-7122
MILL TEST REPORTS FURNISHED BY
TEXAS PIPE & SUPPLY CO., INC.

CUSTOMER ____________________________

CUSTOMER PO # ______________________

KOPPEL DIVISION
AMBRIDGE DIVISION
PHONE 412-843-7100
FAX 412-847-4971

TUBULAR

TEST REPORT

ORDER NO: T3561

SOLD TO:
TEXAS PIPE & SUPPLY CO., INC.
ATTN: PURCHASING DEPARTMENT
2330 HOLMES ROAD
HOUSTON, TX 77058

SHIP TO:
TEXAS PIPE & SUPPLY CO., INC.
RALT SPIN NO. 774190
HOUSTON, TX

SPECIFICATION(S): AAWM 16KE 8A/AS2-93 8A/AS106-93/ API 5L GR B/242
CERTIFIED MACE MRO175

O.D. 3.5000
WALL .325
WT/FT 7.58
GRADE 1023M
QUALITY SEAMLESS HOT FINISH

CONDITION (SPECIAL): ________________

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MATERIAL MELTED AND MANUFACTURED IN USA

OTHER

HIDRO - 3000 PSI 5 SEC HOLD
FLATS - OK

16

10-11-94

DATE

QUALITY ASSURANCE

MATERIAL WAS NOT EXPOSED TO MERCURY DURING PROCESSING.
NO WELDING OR WELD REPAIR PERFORMED ON THIS MATERIAL.

TEST REPORT

Koppel Steel Corporation

Ambrose Tube Operations
P.O. Box 410
Ambridge, PA 16003

Koppel Steel Operations/Great Lakes Operations
P.O. Box 780
Beaver Falls, PA 15010
Phone 412-442-1600, Fax 412-447-4235

FROM 412-843-3399
10-11-94 10:55 AM PST
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**MATERIAL DESCRIPTION**

- **Size**: 2.3/8
- **Wall**: 154
- **Specification & Grade**: ASTM A639-90GR, E, AG9, ER, SA53
- **Material**: BML
- **Heat No. 1**: N66003
- **Heat No. 2**: N66003
- **Heat No. 3**: N66003
- **Heat No. 4**: N66003

**END OF DATA SHEET**

ALL MELTING AND MANUFACTURING TOOK PLACE IN THE USA.
MILL TEST REPORTS FURNISHED BY
TEXAS PIPE & SUPPLY CO., INC.

CUSTOMER

KOPPEL DIVISION
AMBRIDGE DIVISION
PHONE: 412-343-7100
FAX: 412-347-4071

TUBULAR

TEST REPORT

ORDER NO: 71354

SOLD TO:
TEXAS PIPE & SUPPLY CO., INC.
ATTN: PURCHASING DEPARTMENT
2330 HOLMES ROAD
HOUSTON, TX 77081

SHIP TO:
TEXAS PIPE & SUPPLY CO., INC.
RAIL SPIN 774190
HOUSTON, TX

SPECIFICATION(S): ASTM A53 SA/A53-93/SA/A106-93/AFL 5L GR B/X47

O.D. 2.3750
WALL 0.154
WT/FT 3.65
GRADE 1023H
QUALITY SEAMLESS HOT FINISH

CONDITION (SPECIAL): 

HEAT # 413527 L
C .19 .52
Mn .066 .29
Si .03 .09
P .016 .23
S .010 .27
Mn .10 .18 .018
Cr .02 .08 .19 .019
Ni .02 .09 .09 .02 .018
Cu .18 .018 .020
Al .02 .020
Si .02 .020

LOT # YIELD TENSILE ELONGATION Rock
SPECIMEN KG2 KG2 24" N/A DHN WELL GRAIN SIZE HAUSAFLUX
750 STR 54.9 73.8 33 38
54.4 73.1

MATERIAL MELTED AND MANUFACTURED IN USA

OTHER

HYDRO - 3000 PSI 5 SEC HOLD
BENDS - OK
CERTIFIED NACE MR0175

1) MILL TEST REPORTS FURNISHED BY
TEXAS PIPE & SUPPLY CO., INC.

CUSTOMER

CUSTOMER PO #

9-24-94

DATE

QUALITY ASSURANCE

MATERIAL HAS NOT EXPOSED TO MERCURY DURING PROCESSING.
NO WELDING OR WELD REPAIR PERFORMED ON THIS MATERIAL.

TEST REPORT

Koppell Steel Corporation
Ambridge Tube Operations
P.O. Box 417
Ambridge, PA 15003

Ambridge Steel Corporation
P.O. Box 10
 Beaver Falls, PA 15014

TOTAL P.02
CERTIFIED TEST REPORT

<table>
<thead>
<tr>
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PHYSICAL PROPERTIES

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<tr>
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<th>YIELD KSI</th>
<th>% Elong. IN 2&quot;</th>
<th>Hardness HB</th>
<th>Size MM x 10 mm</th>
<th>Temp. °F</th>
<th>FOOT POUNDS</th>
<th>LATERAL EXPANSION</th>
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*L = LONGITUDINAL, T = TRANSVERSE, R = ROUND, S = STRIP.

Hackney is a domestic manufacturer, and these items conform to the following specifications as they apply:


These items were heat treated as required by the applicable specification. They also conform to the requirements of Parts 192 and 195, Title 49, Code of Federal Regulations. All welded fittings are welded by certified welders to ASME Section IX, and 100% radiography examined per Article 2, ASME Section V. All made in accordance with the requirements of Paragraph UG-11, Section VIII, Division 1 of the ASME code. Hackney weld caps meet ASME Division 1, Section VIII, Part D. Vessel Code Requirements, Paragraph UCS-79d. We certify these fittings and flanges capable of passing a hydrostatic test compatible with their rating, and that the above figures are correct as contained in the records of the Company. Hardness testing and stamping are per NACE MR01-75.
### CERTIFIED TEST REPORT

<table>
<thead>
<tr>
<th>ITEM</th>
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#### CHEMICAL ANALYSIS

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#### PHYSICAL PROPERTIES

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<th>% Elong, Per 2&quot;</th>
<th>Hardness HB</th>
<th>Size MM x 10 mm</th>
<th>Temp, °F</th>
<th>FOOT POUNDS</th>
<th>LATERAL EXPANSION</th>
<th>% SHEAR</th>
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HACKNEY is a domestic manufacturer, and these items conform to the following specifications as they apply:

**FLANGE SPECIFICATIONS**


**FLANGES**

- All welds and forgings are certified to ASME Section X, and 100% radiographically examined per Article 2, ASME Section V. All and in accordance with the requirements of Paragraph UG-11, Section VII, Division 1 of the ASME code. Hackney weld caps meet ASME Division 1, Section VIII Pressure Vessel Code Requirements, Paragraph UCS-79d. We certify that these flanges and fittings capable of passing a hydrostatic test and are marked with the proper marking per NACE MR01-75.**
**CERTIFIED TEST REPORT**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>DESCRIPTION/SPECIFICATION</th>
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**CHEMICAL ANALYSIS**

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**PHYSICAL PROPERTIES**

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<th>% Elong.</th>
<th>% Red.</th>
<th>% Red. Elong.</th>
<th>Sided Notch Charpy</th>
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L = LONGITUDINAL, T = TRANSVERSE, R = ROUND

**ACKNEY is a division of Trinity Industries, and these items conform to the following specifications as they apply:**

- **FITTINGS:** ASTM A234 WPB, ASME SA234 WPB, ANSI B16.3, B16.20, and NACE MR01-75.
- **FLANGES:** ASTM A105 and AS16-70, ASME SA105, ANSI B16.5, and NACE MR01-75.
- All welds are in accordance with Paragraph UG-11, Section VII, Division 1 of the ASME code. Hackney uses the approved welding procedures and materials as required by the ASME code. Each weld is inspected and tested in accordance with the requirements of Paragraph UG-12, Section VIII, Division 1 of the ASME code.
- All welds are in accordance with Paragraph UG-11, Section VII, Division 1 of the ASME code. Hackney uses the approved welding procedures and materials as required by the ASME code.Each weld is inspected and tested in accordance with the requirements of Paragraph UG-12, Section VIII, Division 1 of the ASME code.
## CERTIFIED TEST REPORT

<table>
<thead>
<tr>
<th>ITEM</th>
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### CHEMICAL ANALYSIS

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### PHYSICAL PROPERTIES

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L - LONGITUDINAL; T - TRANSVERSE; R - ROUND; S - STRIP

HACKNEY is a domestic manufacturer, and these items conform to the following specifications as they apply:


The welds were prepared as required by the applicable specification. They also conform to the requirements of Parts 192 and 195, Title 49, Code of Federal Regulations, and the requirements of Paragraph UG-11, Section VII, Division 1 of the ASME code. Hackney weld caps meet ASME Division 1, Section VIII Pressure Vessel Code Requirements, Paragraph UCS-79d. We certify these flanges and fittings capable of passing a hydrostatic test compatible with their rating, and that all test results are correct as contained in the records of the Company. Hardness testing and stamping are per NACE MR01-75.
**CERTIFIED TEST REPORT**

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<tr>
<th>TEM</th>
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**PHYSICAL PROPERTIES**

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<th>% SHEAR</th>
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* L - LONGITUDINAL, T - TRANSVERSE, R - ROUNDES, S - STRIP

ACKEY is a domestic manufacturer, and these items conform to the following specifications as they apply:

**FITTINGS:** ASTM A234 WPB, ASME SA234 WPB, ANSI B16.9, B16.31, and NACE MR01-75.

**FLANGES:** ASTM A105 and AS16-70, ASME SA105, ANSI B16.5, and NACE MR01-75.

They are heat treated as required by the applicable specifications. They are also conform to the requirements of Parts 182 and 195, Title 49, Code of Federal Regulations, with the requirements of Paragraph UG-11, Section VII, Division 1, of the ASME code. Hackney weld caps meet ASME Division 1, Section VIII Pressure Vessel Code Requirements, Paragraph UCS-79d. We certify these flanges and fittings capable of passing a hydrostatic test compatible with their rating, and that the above figures are correct as contained in the records of the Company. Hardness testing and stamping are per NACE MR01-75.
<table>
<thead>
<tr>
<th>ITEM</th>
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<th>DESCRIPTION/SPECIFICATION</th>
<th>HEAT CODE</th>
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**CERTIFIED TEST REPORT**

- Item 1: A105-938/SA105, AS FORGED
- Item 2: A234-92/A-SA234 WPB, STRESS RELIEVED AT 1200 F

**NOTES:**

- Hackney is a domestic manufacturer and all weldments conform to the requirements of Parts 192 and 195, Title 49, Code of Federal Regulations.
- All weldments are welded by certified welders to ASME Section IX and 100% radiographically examined per Article 2, ASME Section V. All are in accordance with the requirements of Paragraph UG-11, Section VIII, Division 2 of the ASME Code. Hackney weld caps meet ASME Division 1, Section VIII Pressure Vessel Code Requirements, Paragraph UG-11. We certify these flanges and fittings are not altered, no weld was passed a hydrostatic test, and that all above figures are correct as contained in the records of the Company. Hackney issued test reports are per NACE MR01-75.
**CERTIFIED TEST REPORT**

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<tr>
<th>EM. QUANTITY</th>
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<th>SPECIFICATION</th>
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**CHEMICAL ANALYSIS**

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**PHYSICAL PROPERTIES**

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*LONGITUDINAL, T - TRANSVERSE

---

- 593CA0593AX CONFORM TO THE REQUIREMENTS OF NACE MR0175-92

---

* Items were heat treated in accordance with the requirements of the specifications to which they were manufactured.

* Verify that the products covered by this report comply with the applicable requirements of ASME and or ASME specifications, as noted for each item.

* By certify that the above figures are correct, as contained in the records of the Company.
Tank Corrosion Protection
PROTECTIVE MAINTENANCE COATINGS DATA
For Industrial Use and Professional Application Only
Rust Inhibitive Polyamide Epoxy Coating
GLID-GUARD® Corrosion Resistant HS Epoxy No. 5465 Series
For Interior-Exterior Metal

TECHNICAL DATA
All data shown is for a mixed (converted) gallon unless otherwise noted

*Product No. — 5467/5468
*Generic Type—Polyamide epoxy
*Color—White
*Gloss—Approximately 30 @ 60°
*Percent Solids by Weight — 71% ± 1%
*Percent Solids by Volume — 54% ± 1%
*Theoretical Coverage per 1.0 dry mil (1.9 mls wet) — 856 sq.ft./gallon
**Recommended Film Build/Coverage (theoretical, uncorrected)
Minimum — 3.0 mls dry (5.5 mls wet)
288 sq.ft./gallon
Typical — 5.0 mls dry (3.5 mls wet)
173 sq.ft./gallon
Maximum — 8.0 mls dry (15.0 mls wet)
108 sq.ft./gallon
(wet mil figures rounded to the nearest
0.5 mil)

When computing working coverage, allow for application losses, surface irregularities, any solvent addition, etc.

*Percent Vehicle (Solids) by Weight — 28% ± 1%
*Percent Pigment by Weight — 43% ± 1%
*Percent Solvent by Weight — 29% ± 1%
*Viscosity — 95-100 KU
Weight per Gallon — 11.1 lbs.
Flash Point (Closed Cup) Base No. 5467 — 46°F. Curing Agent No. 5469 — 43°F.
VOC — 3.24 lbs/gallon (388 gm/liter) uncorrected
3.48 lbs/gallon (417 gm/liter) reduced
7% by volume with No. 5568
3.56 lbs/gallon (427 gm/liter) reduced
10% by volume with No. 5568
Drying Time (70°F, 50% Relative Humidity)
Touch — 1-2 hours
Handle — 7 hours
Recoat — 7 hours
Full Cure — 7 days
Reduction Solvent — GLID-GUARD Epoxy
Solvent No. 5568 (10% maximum)
Clean-Up Solvent — GLID-GUARD Epoxy
Solvent No. 5568 or MEK
Type of Cure — Converted
Mixing Ratio (Base/Curing Agent) by Volume — 1 to 1
Induction Before Use — 30 minutes @ material temperatures >70°F.
60 minutes @ material temperatures 60°-70°F.
Pot Life — 4 hours @ 70°F.
Tinting — DO NOT TINT

*Compositional data for other products in this series may differ slightly.
**As measured over the peaks of any surface projections or blast profile.

PRODUCT DESCRIPTION
GLID-GUARD® Corrosion Resistant HS Epoxy is a low VOC, high solids, two-package polyamide epoxy coating intended for direct application to interior and exterior metal. It is rust inhibitive and resistant to moisture and many chemicals. The product's excellent penetrating properties result in superior adhesion.

This product is an excellent choice for application to metal when surface preparation is limited to Hand Tool or Power Tool Cleaning. It is also suitable for use as a high-build intermediate coat in heavy-duty industrial systems and may be used as a topcoat when the color and sheen are acceptable.

Like most epoxy coatings, GLID-GUARD® Corrosion Resistant HS Epoxy will chalk and lose gloss on exposure to direct sunlight but will maintain excellent film integrity and continue to provide excellent protection to the substrate.

PRODUCTS AVAILABLE
GLID-GUARD® Corrosion Resistant HS Epoxy Red No. 5465 (Component A)
GLID-GUARD® Corrosion Resistant HS Epoxy Gray No. 5465 (Component A)
GLID-GUARD® Corrosion Resistant HS Epoxy White No. 5467 (Component A)
GLID-GUARD® Corrosion Resistant HS Epoxy Aluminum Mastic No. 5468 (Component A)
GLID-GUARD® Corrosion Resistant HS Epoxy Curing Agent No. 5469 (Component B)

NOTE: Refer to Protective Maintenance Coatings Data Sheet Section 8 No. 29 for detailed information on Aluminum Mastic No. 5468.

TYPICAL USES
Ideal for use as a primer and intermediate build coat on storage tanks, structural steel, machinery and equipment in the food processing industries, chemical industries, petroleum refineries, paper mills, mining structures, mining industries, waste water treatment facilities, and general industrial buildings.

PRODUCT ADVANTAGES

- Low VOC
- Rust inhibitive
- Tolerates surface moisture during application
- Long term flexibility — does not become brittle with age
- Hard, tough film
- Free of toxic amine curing agents
- Excellent alkali and solvent resistance
- High film build
- Protection in fresh or salt water immersion
- Lead and chromate free
- Simple 1 to 1 mixing ratio

SERVICE CONDITIONS
Do not use for potable water or direct food contact service. Do not use on unprimed wood or unprimed gypsum wallboard. Do not use on surfaces that may be subjected to severe abrasion.

Will withstand 250°F. continuous and 300°F. intermittent dry heat. The color may change as these limits are approached, but the film will remain intact.

REGULATORY RESTRICTIONS
The application VOC of this product may be restricted by law in some locations. Application VOC is increased by thinning with solvent. If the application VOC is restricted to 420 gms/liter (3.5 lbs/gal.), thinning must not exceed 7% by volume (8 fl.oz./gal.) with GLID-GUARD Epoxy Solvent No. 5568. If the application VOC is restricted to 450 gms/liter (3.75 lbs./gal.) or higher or is not restricted, thinning with up to 10% (12 fl. oz./gal.) is permissible.

THE GOLDEN COMPANY
EPOXY METAL PRIMER
Corrosion Resistant
August 1991
GLID-GUARD Corrosion Resistant HS Epoxy (Continued)

MATERIAL PREPARATION

Do not add unspecified curing agents or solvents or mix with other paints. Do not tint.

Thoroughly mix the selected GLID-GUARD Corrosion Resistant HS Epoxy (Component A) and Corrosion Resistant HS Epoxy Curing Agent No. 5469 (Component B) separately, then combine the two components in equal parts by volume using power agitation. If agitation equipment is not explosion proof, provide good ventilation to prevent build up of vapors. Allow the combined material to stand 30 minutes before use. Extend this induction (standing) time to 60 minutes if the surface or material temperature is 60° - 70°F. After the induction period has elapsed, add up to 10% by volume GLID-GUARD Epoxy Solvent No. 5568 (12 fluid ounces per gallon of combined material) if necessary for application and mix thoroughly (see "Regulatory Restrictions" above). Pot life is 4 hours at 70°F., less at higher temperatures.

SURFACE PREPARATION

All surfaces should be clean, dry and free of all contaminants.

Metal Surfaces

Ferrous Metal
Surface preparation is dependent upon service conditions as follows:

TYPE A—AGGRESSIVELY CORROSIVE
This exposure is an area characterized by aggressive chemical fumes, mists or dusts or other chemical contaminants that combine with high humidity and condensed moisture to corrode zinc at rates greater than one mill per year. The need to limit air pollution and protect personnel generally confines chemical concentrations of such an aggressive nature to within a radius of about 50 yards from the source of contamination. For Type A environments and all immersion exposures, White Metal Blast Cleaning (SSPC-SP-6-B2 and SSPC-SP-COM) is recommended. For splash and spillage, Near-White Blast Cleaning (SSPC—SP10-B2 and SSPC-SP-COM) is satisfactory.

TYPE C—CORROSIVE
This exposure is less destructive than Type A exposure and is characterized by moderately aggressive chemical fumes, mists, or dusts that combine with moisture and high humidity to corrode zinc at rates less than one mill per year. Type A exposure may, in many instances, become Type C exposure outside of a radius of about 50 yards from the source of contamination for a limited further distance. For Type C environments, Near-White Blast Cleaning (SSPC-SP-6-B2 and SSPC-SP-COM) is recommended.

TYPE M—MODERATE
This exposure is generally outdoors and is characterized by normal atmospheric weathering and/or light or moderate concentrations of chemical fumes that combine with humidity and condensed moisture to corrode carbon steel at rates less than 0.003 mills per year. Zinc in this exposure is virtually free of corrosion. Light to moderate chemical fume concentrations in indoor areas without excessive humidity may produce similar conditions. For Type M environments, Commercial Blast Cleaning (SSPC-SP-6-B2 and SSPC-SP-COM) is recommended. Where exposure is normal weathering only, Brush-Off Blast Cleaning (SSPC-SP-6-B2 and SSPC-SP-COM), Power Tool Cleaning (SSPC-SP-6-B2 and SSPC-SP-COM), or Hand Tool Cleaning (SSPC-SP-6-B2 and SSPC-SP-COM) will provide excellent service.

TYPE P—PROTECTED (ARCHITECTURAL)
In this category, surfaces are generally indoors and are not subjected to high humidity or chemical contaminants that will attack paint or steel. For Type P environments, Brush-Off Blast Cleaning (SSPC-SP7-B2 and SSPC-SP-COM), Power Tool Cleaning (SSPC-SP-6-B2 and SSPC-SP-COM), or Hand Tool Cleaning (SSPC-SP-6-B2 and SSPC-SP-COM) will provide the sound substrate needed for proper adhesion.

Galvanized and Aluminum
Sandblasting is unnecessary. Remove oil, grease, dirt, dust and chemical contaminants using the prescribed cleaning methods.

Poured Concrete
Verify that all surface projections have been leveled. Remove all oils, grease, dust, dirt and chemical contaminants with the prescribed cleaning methods. Remove weak or powdery surfaces by acid etching or brush abrasive blasting. Dull very smooth concrete by similar means. Prime with this product thinned 10% by volume with GLID-GUARD Epoxy Solvent No. 5568 (see "Regulatory Restrictions" above).

Previously Painted Surfaces
The performance of this coating over previously painted surfaces is directly influenced by the type, age and condition of the old finish. For best results in immersion situations, completely remove any old coating and prepare as for new surfaces. For non-immersion service, remove all blistered, loose or peeling old coating. Hard or glossy finishes should be dulled by sanding or other abrasive means. Apply to a test area; if wrinkling or lifting occurs after overnight drying, remove the old coating.

APPLICATION

Do not apply when air or substrate temperature is below 60°F.

For best appearance, primary application should be by airless or conventional spray. Use brush or roller application for small areas only. Pveloping and leveling will be limited. Spray application is required to obtain 5.0 mils dry in a single coat. Application by brush or roller will limit the film thickness to 3.0-4.0 mils dry per coat.
SPRAY APPLICATION

Airless Spray
Glidden equipment is specified.
Gun: ASM 400 Fluid Tip: 315-619
Pump: GLIDDEN 500™, GLIDDEN 750™, GLIDDEN 750GE™, GLIDDEN FORMULA ONE™
Pressure: 2000-2500 psi
NOTE: All pumps must be kept well away from areas where vapors from this product may collect.

Conventional Spray
Gun: Binks Model 18, Binks 2001, or equivalent
Needle: Binks Model 63A or equivalent
Fluid Nozzle: Binks Modes 83PB or equivalent
Air Cap: Binks Model 63B or equivalent

COVERAGE
Typical coverage (calculated, uncorrected) is 173 sq.ft./gallon at 5.0 mils dry (9.5 mils wet). Minimum film thickness is 3.0 mils
dry (5.5 mils wet) 289 sq.ft./gallon, maximum is 8.0 mils dry (15.0 mils wet) 108 sq.ft./gallon. All wet mil figures are rounded
to the nearest 0.5 mil. When computing working coverage, allow for application losses, surface irregularities, any solvent admix-
ture, etc.

DRYING
Dries to touch in 1-2 hours, to handle in 7 hours, to recoat in 7 hours, to full cure in 7 days at 70°F., 50% relative humidity. Allow
longer drying times under cooler or more humid conditions.

CLEAN-UP
Clean all equipment immediately after use with GLID-GUARD Epoxy Solvent No. 5568 or methyl ethyl ketone.

TOPCOATS

SOLVENT EPOXY FINISHES
GLID-GUARD Corrosion Resistant HS Epoxy No. 5465/5469 series
GLID-GUARD Chemical Resistant Epoxy No. 5240/5242 series
GLID-GUARD High Solids Epoxy No. 5430/5434 series
GLID-GUARD® DURAMASTER™ High Solids Epoxy No. 5295/5299 series
GLID-GUARD® METALLITE™ High Build Epoxy No. 5475/5476
GLID-GUARD Cold Cure Epoxy No. 5281/5265
GLID-GUARD Coal Tar Epoxy No. 5270/5271
GLID-GUARD Hi-Build Coal Tar Epoxy No. 5273/5274
GLID-GUARD® GLID-TILE™ Epoxyide No. 5550/5552 series
NU-PON® COTE Color Coat No. 7240/7200 series

WATER-BORNE EPOXY FINISHES
GLID-GUARD Acrylic Epoxy No. 5277/5278
GLID-GUARD Amine-Adduct Epoxy No. 5585/5586 series

POLYURETHANE FINISHES
GLID-THANE™ ONE Moisture Cured Polyurethane No. 6100 series
GLID-THANE II Acrylic Polyurethane No. 6200/6252 series
GLID-GUARD High Solids Acrylic/Polyester Urethane No. 5410/5414 series

SOLVENT VINYL FINISHES
GLID-GUARD Double Build Vinyl No. 5514
GLID-GUARD® VINYL-COTE™ High Build No. 5522

WATER-BORNE ACRYLIC FINISHES
LIFEMASTER™ PRO HI Performance Acrylic No. 6900 series
LIFEMASTER PRO HB Acrylic No. 5440 series
## Hi-Mil Sher-Tar™ Epoxy—B69B40/B60V40

### Description
Hi-Mil Sher-Tar Epoxy is a high build, polyamide cured epoxy coal tar coating. Can be applied at high film thicknesses in one coat.

### Characteristics
- **Color:** Black
- **Coverage:**
  - Recommended: 25-65 sq. ft./gal. (5-14 mils wet)
  - Theoretical, no loss: 1060 sq. ft./gal. @ 1.0 mil dry
- **Curing Mechanism:** Crosslink Polymerization
- **Drying Schedule:** (temperature and humidity dependent)
  - @ 77°F & 50% RH @ 29 mls wet:
  - To Touch: 8-10 hours
  - Tack Free: 48 hours
  - To Recoat: Minimum @ 60°F 24 hours
  - @ 60-80°F 16 hours
  - @ 80-100°F 8 hours
  - @ 100-120°F 1 hour
- **Finish:** Semi-Gloss
- **Flash Point:** 110°F (Pensky-Martens Closed Cup)
- **Number of Components (Ratio):** 2 (3:1)
- **Pot Life:** 4 hours @ 77°F
- **Sweat-In time:** 30 minutes @ 77°F
- **Solvent/Reducer:** Reducer #54
- **Vehicle Type:** Polyamide Epoxy
- **VOC:** 308 grams/liter; 2.55 lbs/gal
- **Volume Solids:** 68 ± 2%
- **Weight Solids:** 77 ± 2%
- **Weight per Gallon:** 10.3 ± .3 lbs

### Application
- **Application Conditions:**
  - Temperature (air, surface, material): 50-100°F
  - (surface temp. at least 5°F above dew point)
  - Relative humidity: 90% max.
  - **Brush:** No reduction required. Use a natural bristle brush.
  - **Roller:** No reduction required. Use a 3/4" woven nap with phenolic core.
  - **Airless spray:**
    - Pump: 30:1
    - Pressure: 2500 - 3000 psi
    - Tip: 0.31"
    - Hose: 3/8" - 1/2" I.D.
  - **Conventional spray:**
    - Gun: Binks 18 gun
    - Air Pressure: 60 psi
    - Fluid Pressure: 40 psi
    - Fluid/Air Nozzle: 66/63 PB
    - Hose: 1/2" I.D.

### Specifications
- **Substrate:**
  - Surface Preparation (See pages 2 through 5)
  - Primer (see primer page for additional details)...
  - Aluminum, atmospheric only...
  - No primer needed
  - Concrete...
  - SW-6, A
  - No primer needed
  - Galvanized Metal, atmospheric only...
  - No primer needed
  - Steel, atmospheric only...
  - No primer needed
  - Zinc Clad Primer...
  - 115-120
  - Tile-Clad II Epoxy Primer...
  - 109
  - Steel, immersion...
  - SPC-SP5/SW-16
  - No primer needed

### Performance Specifications
- **Physical Properties:**
  - Abrasion Resistance (ASTM D4060, 1000 cycles)...
  - 101 mg
  - Direct Impact (ASTM D149)...
  - >80 inch lbs.
  - Dry Heat Resistance (ASTM D2425)...
  - 250°F
  - Elcometer Adhesion (ASTM D4541)...
  - 600 psi
  - Flexibility (ASTM D522, 180° bend)...
  - 1" mandrel
  - Moisture Condensation Resistance (ASTM D4555) 1000 hours
  - Pencil Hardness (ASTM D3363)...
  - 4H
  - Salt Fog Resistance (ASTM B117) 1000 hours
  - Thermal Shock (ASTM D2246)...
  - 250 cycles
  - Wet Heat Resistance (not immersion)...
  - 120°F

### Resistance Guide:
- (Resistance to fumes, vapor, and spray - not immersion-ASTM D3912)
  - Acid Salt Solutions...
  - Severe
  - Alliphatic Hydrocarbons...
  - Severe
  - Alkalis...
  - Severe
  - Alkali Salt Solutions...
  - Severe
  - Aromatic Hydrocarbon Solvents...
  - Moderate
  - Chlorinated Solvents...
  - Moderate
  - Fresh Water...
  - Immersion
  - Salt Water...
  - Immersion
  - Glycol ethers, alcohols, formaldehyde...
  - Severe
  - Inorganic Acids...
  - Severe
  - Oils (cutting, vegetable, lubricating)...
  - Severe
  - Organic Acids...
  - Severe
  - Oxygenated Solvents...
  - Moderate
WIŠco, INC.

11811 North Fwy., Suite 670
Houston, Texas 77060
(713) 820-8066

Customer: USPCI
Order No.: 12418-30-46

Attn: Bruce Patterson
Dated

Material Destination: Lone Mt. Facility, Wavnoka, OK
Inspector estimated shipment date
Vendor: Delta Tank Co.
Manufacturer: Lide Tank Co.
Shop Location: Mexia, TX
Inspector's Contact: Mr. Billy Lide
Report is: x Interim ___ Final Regarding: x Inspection ___ Expediting ___ Status

MATERIAL DESCRIPTION:
Two (2) tanks - one 6' 4" OD x 12' 0" high; one 5' 0" OD X 12' 0" high
To specifications of USPCI and API 650

STATUS OF ORDER: Engineering, Materials, Fabrication, Inspection, Completion

Writer's visit to vendor on Wednesday, 11/24/93, was to witness sandblast, initial paint coating and first coat of Sher-Tar epoxy.

Sandblast was verified to be as required SSPC-SP6, but due to immediate change in weather conditions, writer informed vendor's Mr. Billy Lide, that painting and/or epoxy coating at this time was not recommended. He also agreed. Items are to be reblasted and inspection of first coatings is to be on Monday, 11/29/93 or Tuesday, 11/30/93, weather permitting.

A spark or holiday test is to be performed on Sher-Tar epoxy along with micro-test of same and external coating of Glidden epoxy #5466-3 to 4 mils. A requirement of 7 mils on Sher-Tar epoxy will also be verified.

INSPECTOR: Dub Greer
INSPECTION ORDER: 12418-30-46
VISAR® brand fax transmittal memo 7671

To  

Bruce Patterson  

From  

Leevar  

Co.  

Dated  

Report Date  

12/3/93  

Report No.  

003  

Customer USPCI  

Atttn: Bruce Patterson  

Manufacturer Lide Tank Co.  

Shop Location Mexia, TX  

Ship Date is now  

As of  

Dated  

Order No.  

12/3/93  

Order No.  

Dated  

Vendor Delta Tank Co.  

Phone 817-562-5526  

Shop Order TKE-B2 & TKE-F4  

Reorder No. 12418-30-46  

Reorder No.  

Dated  

Inspection Date  

12/3/93  

Inspection Date  

Dated  

Inspector estimated shipment date  

12/3/93  

Order is 100 percent completed  

As of  

Dated  

Report is: X Final  

Regarding: X Inspection  

Expediting  

Status  

MATERIAL DESCRIPTION:  

Two (2) tanks - one 6' 4" OD x 12' 0" high; one 5' 0" OD X 12' 0" high  

To specifications of USPCI and API 650  

STATUS OF ORDER: Engineering, Materials, Fabrication, Inspection, Completion  

Writer's visits to vendor on Tuesday, 11/30/93, and Friday, 12/3/93, inspection functions were performed as follows:  

11/30/93  

First coat of Sher-Tar epoxy (internally) was micro-tested. Results were noted to be acceptable with an average of 3.5 mils.  

Sandblast was verified to be SSPC-SP-6 with anchor pattern of 3.5 to 4.0. A Keane-Tator surface comparator was used to verify anchor pattern on each vessel.  

12/3/93  

Writer verified Sher-Tar epoxy to have mil thickness ranging from 7.2 to 14.8 on each vessel.  

External gray primer paint range from 3.5 to 6.5 on each vessel.  

A holiday test was performed internally on each vessel and found to be satisfactory. Items were released for shipment.  

INSPECTOR: Dub Greer  

INSPECTION ORDER: 12418-30-46
Piping Corrosion Protection
Kem Kromik Universal Metal Primer—B50Z Series

Description
Kem Kromik Universal Metal Primer is a low VOC, modified alkyd resin primer designed for use over iron and steel substrates. Can be used as a “universal” primer under high performance topcoats and is also suitable as a “barrier” coat over conventional coatings which would normally be attacked by strong solvents in high performance coatings.

Characteristics
- Color: Brown, Off White, and Buff
- Coverage:
  - Recommended: 204-273 sq. ft./gal.
  - Theoretical, no loss: 618 sq. ft./gal, @ 1.0 mil dry
- Curing Mechanism: Oxidation
- Drying Schedule: (temperature & humidity dependent)
  - 6 mils wet, 100% R. H. and:
    - @ 40°F: 87°F @ 110°F
  - To Touch: 2 hours
  - Tack Free: 2 hours
  - To Recool with:
    - alkyds: 2 hours
    - epoxy: 36 hours
    - urethane: 36 hours
- Finish: 0-10 units @ 85°
- Flash Point: 80°F (Pensky-Martens Closed Cup)
- Solvent: Xylene
- Vehicle Type: Phenolic Alkyd
- VOC: 415 grams/liter; 3.45 lbs./gal.
- Weight Solids: 51 ± 2%
- Weight per Gallon: 12.5 ± .5 lbs

Meets the performance requirements, not necessarily composition, of Federal Specification: TT-P-6640

Application
- Temperature (air, surface, material): 40-120°F
- Relative humidity: 85% maximum.
- Brush: No reduction required. Use a natural bristle brush.
- Roller: No reduction required. Use a 3/8" woven nap with phenolic core.
- Airless spray:
  - Pressure: 1800-3000 psi
  - Tip: .015" - .019"
  - Hose: 1/4" I.D.
  - Filter: 60 mesh

Note: normally no reduction required

Specifications
<table>
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<tr>
<th>Substrate</th>
<th>Surface Preparation (See pages 2 through 5)</th>
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<tbody>
<tr>
<td>Steel</td>
<td>SSPC SP2/ SW-14</td>
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</tbody>
</table>

2 topcoats are recommended over all primers/substrates.

Suggested topcoats
- A-100 Exterior Latex Finishes
- Carathene II Satin Polyurethane
- DTM Acrylic Coating
- Heavy Duty Epoxy
- Hi-Bild Aliphatic Polyurethane
- Hi-Solids Polyurethane
- Industrial Enamel
- Industrial Enamel HS
- Metalatex Semi-Gloss Coating
- ProMar Interior & Exterior Alkyd & Latex Topcoats
- Sher-Tile Epoxy
- Silver-Brite Aluminum
- Tile-Clad High Solids Epoxy
- Water Based Catalyzed Epoxy

Performance Specifications

<table>
<thead>
<tr>
<th>Physical Properties</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion Resistance (ASTM D4060, 1000 cycles)</td>
<td>250 mg</td>
</tr>
<tr>
<td>Direct Impact (ASTM G14)</td>
<td>70 inch lbs.</td>
</tr>
<tr>
<td>Dry Heat Resistance (ASTM D2248)</td>
<td>200°F</td>
</tr>
<tr>
<td>Elcometer Adhesion (ASTM D4541)</td>
<td>260 psi</td>
</tr>
<tr>
<td>Exterior Durability (with chalk)</td>
<td>Good</td>
</tr>
<tr>
<td>Flexibility (ASTM D522, 180° bend)</td>
<td>1/4&quot; mandrel</td>
</tr>
<tr>
<td>Moisture Condensation Resistance (ASTM D4585)</td>
<td>500 hrs.</td>
</tr>
<tr>
<td>Pencil Hardness (ASTM D3322)</td>
<td>H</td>
</tr>
<tr>
<td>Salt Fog Resistance (ASTM B117)</td>
<td>500 hours</td>
</tr>
<tr>
<td>Thermal Shock (ASTM D2248)</td>
<td>5 cycles</td>
</tr>
</tbody>
</table>

Resistance Guide:
- Resistance to fumes, splash and spillage - not immersion-ASTM D3912)
- Acid Salt Solutions: Moderate
- Aliphatic Hydrocarbons: Moderate
- Aromatic Hydrocarbon Solvents: Not recommended
- Chlorinated Solvents: Light
- Fresh Water: Not recommended
- Salt Water: Moderate
- Glycol ethers, alcohols, formaldehyde: Moderate
- Oils (cutting, vegetable, lubricating): Severe
- Organic Acids: Light
- Oxygenated Solvents: Not recommended
Secondary Containment Corrosion Protection
Primer 67/67C

100% SOLIDS, MOISTURE-TOLERANT EPOXY PRIMER FOR STEEL AND CONCRETE 3-4 MILS (0.1 mm)

RECOMMENDED APPLICATIONS
Concrete Substrates
Steel Substrates
Primer for Epoxy and Urethane
Floor Toppings, Linings, Coatings and Grout

PHYSICAL PROPERTIES
Tensile Strength
ASTM C-307
2,000 - 2,500 PSI

Tensile Elongation
ASTM C-307
12-25%

Adhesion to Concrete
ASTM D-4541
Cohesive Failure of concrete

Adhesion to Steel
ASTM D-4541
2,200-2,500 PSI

Electrical Properties
NFPA #99
< 25,000 ohms
ASTM F-150

SPECIFICATIONS
Primer shall be 3-4 mils thick, 100% solids bisphenol A epoxy cured with an amine adduct as manufactured by Dudick Inc. Primer 67 shall be brush, roller or spray applied in accordance with the manufacturer’s recommended practices. Primer 67C must be spray or roller applied.

PRIMER 67

Primer 67 is designed to prevent abrasive-blasted steel from developing rust bloom prior to the application of a Dudick coating or lining system. For maximum performance all steel surfaces should be primed, but primer may not be needed for mild, non-immersion service. Concrete, however, must always be primed to aid in the “wetting out” required for good adhesion.

PRIMER 67C - CONDUCTIVE PRIMER

Primer 67C is a 100% solids, two component epoxy primer designed to be used over concrete whenever the coating or lining system must be spark tested.

ESTIMATING QUANTITIES AND ORDER BILL OF MATERIAL

<table>
<thead>
<tr>
<th>SQUARE FEET PER GALLON</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONCRETE</td>
</tr>
<tr>
<td>Primer 67</td>
</tr>
<tr>
<td>Primer 67C</td>
</tr>
</tbody>
</table>

Quantities shown are for estimating purposes only. Actual field usage may vary. Primer 67/67C are available in 1 and 2 gallon units.

APPLICATION INSTRUCTIONS

SURFACE PREPARATION
Metal: Surfaces must be abrasive blasted to an appropriate finish.

Immersion and heavy spillage service: White Metal SSPC SP-5 or NACE #1, 3.0 mil minimum profile.

Heavy, non-immersion service (i.e. fumes and spillage): Near white SSPC SP-10 or NACE #2, 2.0 mil minimum profile.

Atmospheric service: Commercial SSPC SP-6 or NACE #3, 2.0 mil minimum profile.
Concrete: Concrete must be abrasive blasted or etched with muriatic acid (Solution of 1 part 20' Be HCl and 1 part water) to remove surface laitance and other contaminants. Concrete must be free of curing compounds and form release agents. Surface texture should be similar to 40-60 grit sandpaper. The prepared surface should have a minimum tensile strength of 250 PSI per ASTM D-4541.

All concrete substrates must be checked for moisture prior to product application using the Plastic Sheet Test, ASTM D-4263.

Additional surface preparation will be required if a 40-60 grit texture is not achieved and the surface laitance not completely removed after a single application of acid or with the first mechanical preparation procedure.

Abrasive blasting removes laitance, exposing honeycombs or voids beneath the surface which must be filled with Scratch Coat 100. (Refer to separate product bulletin)

APPLICATION SPECIFICATIONS

Substrate temperature for both concrete and metal must be between 50°F and 110°F.

Relative humidity must not exceed 90%.

Substrate temperature must be 5°F above the Dew Point.

PRIMER 67/67C MIX RATIOS:

| Primer 67  | 1 gal. |
| Component A | Component B |
| Primer 67C  | 1 gal. |
| Component A | 95 fl. oz. |
| Component B |

*Pre-mix primer 67C Component A for 1-2 minutes to disperse the conductive fillers prior to adding the correct amount of Component B.

Primer 67C must be spray or roller applied. Use brush application for small touch-up or repair work only.

The pot life of the mixed Primer 67/67C will depend on the temperature. To prevent material waste and avoid damage to equipment, do not open and mix more material than can be used according to the following table:

<table>
<thead>
<tr>
<th>TEMPERATURE</th>
<th>POT LIFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>50°F</td>
<td>90 min.</td>
</tr>
<tr>
<td>75°F</td>
<td>60 min.</td>
</tr>
<tr>
<td>90°F</td>
<td>30 min.</td>
</tr>
</tbody>
</table>

At 75°F the pot life and thin film cure of Primer 67 can be decreased by the addition of Accelerator #1 as follows:

<table>
<thead>
<tr>
<th>Ozs./Accelerator #1 per mixed gal. Primer 67</th>
<th>Pot Life</th>
<th>Thin Film Cure</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-4</td>
<td>36 min.</td>
<td>4 hrs.</td>
</tr>
<tr>
<td>6-7</td>
<td>15 min.</td>
<td>2 hrs.</td>
</tr>
</tbody>
</table>

Using 7 ounces of accelerator #1 per mixed gallon of Primer 67, the thin film cure @ 40°F is reduced to 8 hours.
PRIMING

**Metal:** Mix the pre-measured units of Component A with Component B. Prime all metal surfaces to be coated with Primer 67 at 3-4 mils WFT.

**Concrete:** Mix the pre-measured units of Component A with Component B. Prime all concrete surfaces to be coated with either Primer 67 or 67C at 3-4 mils WFT. The basecoat may be applied over primer that is "tacky". Do not allow the primer to puddle.

Important - With all epoxies after priming and before each additional coat, examine the surface for amine blush (oily film). If present, remove by washing with warm water and detergent.

**Cure Cycle for Primer 67/67C:**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Minimum Recoat Time</th>
<th>Maximum Recoat Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>50°F</td>
<td>12 hrs.</td>
<td>8 Days</td>
</tr>
<tr>
<td>75°F</td>
<td>6-8 hrs.</td>
<td>5 Days</td>
</tr>
<tr>
<td>90°F</td>
<td>4-5 hrs.</td>
<td>3 Days</td>
</tr>
</tbody>
</table>

To optimize intercoat adhesion, we recommend application of the basecoat while the primer is tacky. If this is not possible, the above recoat times must be observed. Exposure of the primer to direct sunlight will considerably shorten the recoat times. If recommended recoat times are exceeded, consult a Dudick Representative; sanding or abrasive blasting may be required before the coating, lining or floor topping can be applied.

CLEANING

Use S-10 Cleaning Solvent to clean tools and equipment. DO NOT USE ACETONE.

SHIPPING

Primer 67/67C Component A's are non-regulated plastic liquids. Primer 67/67C Component B's are flammable corrosives with a flash point of 106°F (Setalash) and carry both a red warning label and a black and white warning label. S-10 Cleaning Solvent is a flammable liquid with a flash point of 52°F (PMCC) and carries a red warning label.
STORAGE

Warning: All Dudick products classified by DOT labels as either white, yellow or red labels, must not be mixed or stored together as an explosive reaction can occur. All products should be stored in a cool, dry area away from open flames, sparks or other hazards.

When properly stored in their original, unopened containers, Primer 67/67C components have a one year shelf life.

SAFETY

M.S.D.S - Sheets must always be read before using products. Primer 67/67C are intended for application by experienced, professional personnel. Dudick Inc. can supply supervision to help determine that the surface has been properly prepared, the ingredients correctly mixed, and the materials properly and safely applied.

If materials are to be applied by your own personnel or by a third party contractor, please be sure that they are aware of the following safety precautions:

• Keep open flames and sparks away from the area where materials are being mixed and applied.

• If a rash occurs, remove the individual from the work area and seek a physician's care for dermatitis.

• In case of eye contact, flush with water for at least 15 minutes and consult a physician.

• If swallowed, do not induce vomiting; call a physician immediately.

Note:
Dudick Inc. ("Dudick") warrants all goods of its manufacture to be as represented in its catalogs and that the application of its products by its employees or sub-contractors shall be performed in a workmanlike manner. Dudick's obligation under this warranty shall be the repair to and replacement of any applications which its examination shall disclose to be defective. Dudick makes no warranty concerning the suitability of its product for application to any surface, it being understood that the goods have been selected and the application ordered by the purchaser. DUDICK INC. MAKES NO WARRANTY, EXPRESS OR IMPLIED, THAT THE GOODS SHALL BE MERCHANTABLE OR THAT THE GOODS ARE FIT FOR ANY PARTICULAR PURPOSE. THE WARRANTY OF REPAIR OR REPLACEMENT SET FORTH HEREBIN IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES ARISING BY LAW OR OTHERWISE; AND DUDICK INC. SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DOWN TIME, DAMAGES TO PROPERTY OF THE PURCHASER OR OTHER PERSONS, OR DAMAGES FOR WHICH THE PURCHASER MAY BE LIABLE TO OTHER PERSONS, WHETHER OR NOT OCCASIONED BY DUDICK'S NEGLIGENCE. This warranty shall not be extended, altered or varied except by written instrument signed by Dudick and Purchaser.

Primer 67/67C 100% SOLIDS, MOISTURE-TOLERANT EPOXY PRIMER for...
Protecto-Coat 200

ELASTOMERIC, SPRAY APPLIED, ENVIRONMENTALLY SAFE, URETHANE COATING. 40-60 MILS (1-1 1/2 mm)

Protecto-Coat 200 is a high solids aromatic polyurethane coating with superior elongation. It is especially suited to bridge cracks in concrete.

RECOMMENDED APPLICATIONS

Secondary Containment Areas  
Process Floors  
Railroad Tank Cars  
Underground Pipes & Tanks - Exterior  
Thickener Tanks & Mechanisms  
Spent Liquor Storage Tanks  
Food Processing Pharmaceutical Breweries Structural Steel

CHEMICAL RESISTANCE

Protecto-Coat 200 provides a tough, durable surface and will withstand splash and spills of many inorganic and organic acids as well as alkalies. Also resistant to aliphatic solvents.

PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Protecto-Coat 200</th>
<th>40 Mil Basecoat</th>
<th>20 Mil Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength (PSI) ASTM C397</td>
<td>2,400-2,600</td>
<td>2,200-2,500</td>
</tr>
<tr>
<td>Elongation*</td>
<td>225% to 250%</td>
<td>50 to 60%</td>
</tr>
<tr>
<td>Shore D Hardness</td>
<td>40-45</td>
<td>65-70</td>
</tr>
<tr>
<td>Abrasion Resistance CS 17 wheels/1000 cycles x 1000 cm lead</td>
<td>10 mg weight loss</td>
<td>32 mg weight loss</td>
</tr>
<tr>
<td>Solids by Volume</td>
<td>80%</td>
<td>100%</td>
</tr>
</tbody>
</table>

*S tabe 60% elongation the chemical resistant topcoat begins to surface crack while the basecoat will continue to elongate to 250% extension.

SPECIFICATIONS

Coating shall be 40-60 mils thick, 60-100% solids aromatic urethane resin, consisting of 2 basecoats and a topcoat of 20 mils each, manufactured by Dudick, Inc. Materials shall be brush-, roller- or spray- applied in accordance with manufacturer's recommended practices.

THE PROTECTO-COAT 200 SYSTEM

The Protecto-Coat 200 system uses a moisture tolerant primer and two or three coats of elastomeric thersotetting urethane resins to protect concrete and steel.

Primer 67 is designed to prevent abrasive blasted steel from developing rust bloom prior to the application of a Protecto-Coat System. For maximum performance, all steel surfaces should be primed, but primer may not be needed for mild, non-immersion service. Concrete, however, must always be primed to aid in the "wetting out" required for good bonding.

Protecto-Coat 200 is applied in three coats by brush, roller or spray. The elastomeric basecoat is applied in two 25 mil applications to achieve a nominal 40 mils DFT. The chemical resistant topcoat is applied in a single 20 mil application. Total thickness shall be a nominal 60 mils.
ESTIMATING QUANTITIES AND ORDER BILL OF MATERIAL

<table>
<thead>
<tr>
<th>SQUARE FEET PER GALLON</th>
<th>CONCRETE</th>
<th>STEEL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primer 67</strong></td>
<td>150-200</td>
<td>250-300</td>
</tr>
<tr>
<td><strong>Protecto-Coat 200</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Base Coats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>35-40 mil DFT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top Coat</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-20 mil DFT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-10 Solvent</td>
<td>500</td>
<td>500</td>
</tr>
</tbody>
</table>

Quantities shown are for estimating purposes only. Actual field usage may vary.

APPLICATION INSTRUCTIONS

SURFACE PREPARATION

Metal: For immersion service, abrasive blast to a white metal finish and a 2-4 mils minimum profile according to SSPC 5 or NACE No. 1. For fume or splash service, abrasive blast to a near-white metal finish according to SSPC 10 or NACE No. 2. Atmospheric service: Commercial SSPC 6 or NACE No. 3.

Concrete: Concrete must be abrasive-blasted or etched with muriatic acid (solution of 1 part 20% HCl and 1 part water) to remove surface laitance and other contaminants. Concrete must be free of curing compounds and form release agents. Surface texture should be similar to 40-60 grit sandpaper. The prepared surface should have a tensile strength of between 250 and 300 PSI per ASTM D4541.

Additional surface preparation will be required if a 40-60 grit texture is not achieved and the surface laitance not completely removed after a single application of acid or with the first mechanical preparation procedure.

If, after abrasive blasting, honeycombs/voids appear on the concrete, these have to be filled with a suitable material. Contact a Dudick representative for this information.

Recommended application temperatures should be between 40°F and 90°F substrate temperature. Do not apply Protecto-Coat 200 over concrete exposed to direct sunlight during the warming trend of the concrete as measured by surface temperature. To do so may lead to blistering, pinholes, or wrinkling in the coating due to outgassing of air in the concrete and high substrate temperatures. Wait for a definite downturn or cooling trend within the concrete as again measured by surface temperature. If this is not possible consult a Dudick representative for alternatives such as double priming.

PRIMING

Metal: For maximum performance, prime all steel surfaces with Primer 67, mixed with appropriate amount of hardener to 3-4 mils. For mild non-immersion service, priming of steel may be omitted.

Concrete: Concrete must be primed to aid in the “wetting out” required for good bonding. Mix Component A with Component B in the premeasured units for 2-3 minutes and apply by brush, roller, or spray. We recommend the basecoat be applied over slightly tacky or tack-free primer. Do not allow the primer to puddle.

Protecto-Coat 200 Mix Ratio:

Protecto-Coat 200 Basecoat
Component A* 1 Gallon
Component B* 54 fl. oz.

*Premeasured units by weight

Protecto-Coat 200 Topcoat
Component B* 54 fl. oz.

*Premeasured quantities by weight

BASECOAT

Add appropriate amount of hardener for each gallon of Protecto-Coat Liquid and mix thoroughly until uniform color is achieved. Apply a 25 mil wet (20 mil DFT) basecoat using spray, brush or roller. Allow basecoat application to cure to at least a “firm” or slightly “tacky” feel before applying the second 25 mil wet (20 mil DFT) basecoat. Brush or roller may require several coats to achieve desired thickness.
Horizontal surfaces may be basecoated in one application by applying 50 mils wet (40 mil DFT) in a single coat.

**TOPCOAT**

Add appropriate amount of hardener for each gallon of Protecto-Coat Liquid and mix thoroughly until a uniform color is achieved. Apply a 20-mil-thick topcoat using spray, brush or roller.

**Cure Cycle for Protecto-Coat 200**

<table>
<thead>
<tr>
<th>TEMPERATURE</th>
<th>RECOAT TIME</th>
<th>CURE TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>50°</td>
<td>48 Hrs.</td>
<td>96 Hrs.</td>
</tr>
<tr>
<td>70°</td>
<td>24 Hrs.</td>
<td>48 Hrs.</td>
</tr>
<tr>
<td>90°</td>
<td>16 Hrs.</td>
<td>36 Hrs.</td>
</tr>
</tbody>
</table>

If these recoat times are exceeded, consult a Dudick representative: sanding or abrasive blasting may be required before the next coat. Recoat times are dramatically reduced when the coating is exposed to direct sunlight.

**Single Component Airless Spray Equipment** — Graco King 45-to-1 spray pump or equivalent. Use Graco Golden Mastic Gun or Graco No. 207845 Gun with airless adapter equipped with a Reverse-A-Clean tip and a tip size between .035-.041. Spray hose should be 1/2" or 3/8" ID. Available inlet pressure must be a minimum of 100 psi.

Brush or roller application may require additional coats to meet specified dry film thickness.

Pot life of the opened and mixed Protecto-Coat 200 will depend on the temperature at the work site. To prevent material waste and avoid damage to equipment, do not open and mix more material than can be used according to the following table:

<table>
<thead>
<tr>
<th>TEMPERATURE</th>
<th>POT LIFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>50°F</td>
<td>120 Min.</td>
</tr>
<tr>
<td>75°F</td>
<td>60 Min.</td>
</tr>
<tr>
<td>90°F</td>
<td>45 Min.</td>
</tr>
</tbody>
</table>

Do not attempt to store mixed material. Residual material should be properly disposed of at the end of each work period.

Where immersion service is required, spark test the coating with a 5,000 to 7,000 volt AC spark tester. Mark and repair all pinholes. Use Protecto-Coat liquid mixed with the appropriate amount of hardener. Retest only the repairs.

**CLEANING**

Use S-10 Solvent to clean tools and equipment.

**SHIPPING**

Protecto-Coat 200 Topcoat A and B and Protecto-Coat 200 Basecoat A are classified as plastic liquids and are non-regulated.

Protecto-Coat 200 Basecoat B is combustible. Primer 67 Component B is corrosive and carries a black and white warning label. Primer 67 Component A is classified as a plastic liquid and is nonregulated, while S-10 Cleaning Solvent is red label liquid with a flash point of 52°F (PMCC).

**STORAGE**

Warning: All Dudick products classified by DOT labels as either white, yellow or red labels must not be mixed or stored together as an explosive reaction may occur.

When stored in a cool and dry location, Protecto-Coat 200 ingredients have a one-year shelf life. Exposure to excessive heat may cause premature gelling and reduce working time.

**SAFETY**

M.S.D.S. - Sheets must always be read before using products. Protecto-Coat Systems are intended for application by experienced, professional personnel. Dudick Inc. can supply Protecto-Coat systems supervision to help determine that the surface has been properly prepared, the ingredients correctly mixed, and the materials properly and safely applied.
If Proteco-Coat materials are to be applied by your own personnel or by a third-party contractor, please be sure that they are aware of the following safety precautions:

- Exposure to resins and hardeners may cause severe dermatitis reactions in some people. Cleanliness of the skin and clothing is critical and must be of paramount concern.

- Safety glasses, gloves and suitable protective clothing must be worn at all times during application.

- Suitable respirators should be used.

- If contact with hardeners occurs, remove any clothing involved and wash the skin with large amounts of water. Discard the clothing. Do not attempt to wash and reuse it. Proteco-Coat liquid may be washed off with S-10 Cleaning Solvent, MEK liquid, or lacquer thinner.

- Fumes are flammable and heavier than air. Proper ventilation should be maintained to minimize breathing of concentrated fumes.

- If a rash or dermatitis occurs, remove the individual from the work area and seek a physician’s care for dermatitis.

- Keep open flames and sparks away from the area where toppings are being mixed and applied.

- In case of eye contact, wash with water for at least 15 minutes and consult a physician. If swallowed, do not induce vomiting; call a physician immediately.

Note:

Dudick Inc. ("Dudick") warrants all goods of its manufacture to be as represented in its catalogs and that the application of its products by its employees or sub-contractors shall be performed in a workmanlike manner. Dudick's obligation under this warranty shall be the repair to and replacement of any applications which its examination shall disclose to be defective. Dudick makes no warranty concerning the suitability of its product for application to any surface. It being the understood that the goods have been selected and the application ordered by the purchaser. DUDICK INC. MAKES NO WARRANTY, EXPRESS OR IMPLIED, THAT THE GOODS SHALL BE MERCHANTABILITY OR THAT THE GOODS ARE FIT FOR ANY PARTICULAR PURPOSE. THE WARRANTY OF REPAIR OR REPLACEMENT SET FORTH HEREIN IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES ARISING BY LAW OR OTHERWISE; AND DUDICK INC. SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DOWN TIME, DAMAGES TO PROPERTY OF THE PURCHASER OR OTHER PERSONS, OR DAMAGES FOR WHICH THE PURCHASER MAY BE LIABLE TO OTHER PERSONS, WHETHER OR NOT OCCASIONED BY DUDICK'S NEGLIGENCE. This warranty shall not be extended, altered or varied except by written instrument signed by Dudick and Purchaser.
Waste Analysis
ANACHEM INC.
8 Prestige Circle, Suite 104 • Allen, Texas 75002
214/727-9003 • FAX # 214/727-9666 • 1-800-966-1186

Customer Name: USPCI
Date Received: August 17, 1994 at 11:10:45
Date Reported: August 26, 1994
Submission #: 9408000203
Project: HEAT EXCHANGERS

SAMPLES The submission consisted of 1 sample with sample I.D. shown in the attached data table.

TESTS The sample listed in the attached result pages was analyzed for:
* ALKALINITY, TOTAL (EPA 310.1)
* ANION/CATION RATIO (CALCULATION)
* CALCIUM/Ca (EPA 215.1)
* CHLORIDE (EPA 300.6)
* CYANIDE, TOTAL (EPA 335.2)
* HARDNESS, TOTAL (BASED ON AAS/ICP)
* ICP SCAN (EPA 200.7)
* IRON/Fe (EPA 236.1)
* MAGNESIUM/Mg (EPA 242.1)
* MICROWAVE DIGESTION (EPA 3015)
* pH (EPA 150.1)
* POTASSIUM/K (EPA 200.7)
* SILICA (EPA 370.1)
* SODIUM/Na (EPA 273.1)
* SPECIFIC CONDUCTANCE (EPA 120.1)
* SULFATE (EPA 375.4)
* TDS-TOTAL DISSOLVED SOLIDS (EPA 160.1)
* TSS-TOTAL SUSPENDED SOLIDS (EPA 160.2)

Distribution Of Reports
2-Bruce Patterson of USPCI
Ph. (405) 697-3500 Fax (405) 697-3592

Respectfully Submitted,
Anachem, Inc.

C.E. Newton, Ph.D.
Chemist

Submission #: 9408000203 lims

NOTE: Submitted material will be retained for 60 days unless notified or consumed in analysis. Material determined to be hazardous will be returned or a $20 disposal fee will be assessed. Our letters and reports are for the exclusive use of the client to whom they are addressed. The use of our name must receive our prior written approval. Our letters and reports apply to the sample tested and/or inspected, and are not necessarily indicative of the qualities of apparently identical or similar materials.
<table>
<thead>
<tr>
<th>Analyte</th>
<th>Results (mg/l)</th>
<th>Det Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALKALINITY, TOTAL (EPA 310.1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Alkalinity</td>
<td>7800</td>
<td>1</td>
</tr>
<tr>
<td><strong>ANION/CATION RATIO (CALCULATION)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anion/Cation Ratio</td>
<td>1.00</td>
<td>0</td>
</tr>
<tr>
<td><strong>CALCIUM (EPA 215.1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>30.2</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>CHLORIDE (EPA 300.6)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>145000</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>CYANIDE, TOTAL (EPA 335.2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
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<tr>
<td>SILICA (EPA 370.1)</td>
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<td>TOTAL SUSPENDED SOLIDS (EPA 160.2)</td>
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<tr>
<td>Total Suspended Solids</td>
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Report to: USPCI  
Lab Number: 9408000203  
Page of / of

QUALITY CONTROL DATA

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<tr>
<th>ANALYTE</th>
<th>DATE ANALYZED</th>
<th>SPIKE VOL</th>
<th>STAND. DEV.</th>
<th>COEFF. OF VAR.</th>
<th>REC1%</th>
<th>REC2%</th>
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<td>Hardness, Calc.</td>
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<td>0</td>
<td>0</td>
<td>0.7</td>
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<td>Total Alkalinity</td>
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<td>0.7</td>
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<td>109</td>
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Standard Deviation = (x1-x2)/1.414
Coefficient of Variability % = (S.D./Avg.) X 100

ICP SCAN INFORMATION

Note: ICP scans are very general in nature and do not include precise calibration or quality control. The process is intended as a screening procedure to identify very high metal concentrations.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Result (mg/l)</th>
<th>Det. Limit</th>
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<td>JE, TOTAL (EPA 335.2)</td>
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<td></td>
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<td>A 150.1)</td>
<td>13</td>
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<td></td>
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<tr>
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<tr>
<td>FIC CONDUCTANCE (EPA 120.1)</td>
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<td>FIC GRAVITY (USP 841)</td>
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<td>Gravity</td>
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<td>4TE (EPA 375.4)</td>
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## QUALITY CONTROL DATA

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<tr>
<th>ANALYTE</th>
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<th>SPIKE VOL</th>
<th>STAND. DEV.</th>
<th>COEFF. OF VAR %</th>
<th>REC1/%</th>
<th>REC2%</th>
</tr>
</thead>
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<tr>
<td>Mercury</td>
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<td>99</td>
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<td>0</td>
<td>100</td>
<td>---</td>
</tr>
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<td>T.D.S.</td>
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<td>304</td>
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<td>96</td>
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<td>Silicon Dioxide/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silica</td>
<td>8/1/94</td>
<td>---</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>---</td>
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<td>Sulfate</td>
<td>8/1/94</td>
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<td>5</td>
<td>2.4</td>
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<td>99</td>
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<td>±4.2</td>
<td>1.1</td>
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<td>95</td>
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</table>

Standard Deviation = (x1-x2)/1.414

Coefficient of Variability % = (S.D./Avg.) X 100


## ICP SCAN INFORMATION

*Note:* ICP scans are very general in nature and do not include precise calibration or quality control. The process is intended as a screening procedure to identify very high metal concentrations.
Ancillary Equipment Drawings
Tank Drawings
Ancillary Equipment Drawings
SECTION EO1
SECTION 305
ASSESSMENT OF EVAPORATOR OVERFLOW TANK (EO1)
LONE MOUNTAIN HAZARDOUS WASTE FACILITY
U.S.P.C.I.
WAYNOKA, OKLAHOMA

A. TANK SYSTEM DESCRIPTION

Evaporator Overflow Tank (EO1) is an aboveground evaporator overflow storage tank. The wastewater stored in this tank is treated or neutralized wastewater according to USPCI. The tank is horizontal in position and cylindrical in shape. This tank and a portion of the ancillary piping is located together inside a concrete containment area.

B. PRIMARY TANK VESSEL

1. General Description

Evaporator Overflow Tank (EO1) consists of a circular steel tank placed in the horizontal position supported by a steel plate support system. The actual steel specifications to which the tank is constructed of is not known. The tank was inspected prior to the placement of interior coatings. Influent piping is located from the wastewater treatment building. This tank receives water from roof drains. Water from rains or an overflow of the flash tank will be collected in the gutter system and deposited into this tank.

2. Design Standards.

Structure calculations were performed to compare the existing tank and supports to those sections that are applicable in the American Petroleum Institute Standard 650 - 1988 edition (API-650) and the American Institute of Steel Construction (AISC) Manual of Steel Construction (8th Edition). These calculations can be found in Appendix B and C of this report. The actual steel specifications to which the tank is constructed are not known. Appendix A of API-650 was utilized in the analysis of this vessel due to the small diameter of the vessel.

3. Hazardous Characteristics of Wastes Stored

The wastes which are treated in this tank have the following characteristics:

Neutralized wastewater with a pH level between 4-10
N < 6
Temperature = Ambient

The hazardous characteristics of the waste treated in this tank were examined. It was determined that the pH and normality levels of the waste are the primary areas of concern. This is to determine the applicability of a corrosion allowance for the tank material type and thickness.
4. Existing Corrosion Protection

The interior of the tank is coated with a coal tar epoxy coating. This coating was applied in May of 1992 and is in excellent condition. The exterior of the tank is painted with an epoxy paint as corrosion protection.

5. Documented Age of Tank

This tank was purchased as a used tank and the actual documented age is unknown. This tank was installed in July of 1987. The estimated age of the tank is 5 years old. This age was determined by using a 20 year design life less the estimated useful life of 15 years. A 20 year design life is assumed from the time of installation at USPCI.

6. Result of Leak Tests

No leak tests have been performed, however, the vessel is in service and a visual leak inspection was performed. In the visual leak test items such as welds, seams, flange connections, valves and threaded connections were examined to verify that no leaks were present. From this visual analysis it was determined that the primary tank is not leaking.

7. Existing Data Obtained

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
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<td>Diameter of Tank</td>
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<tr>
<td>Height</td>
<td>20'-6&quot;</td>
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<tr>
<td>Material</td>
<td>Carbon Steel.</td>
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<tr>
<td>* Thickness</td>
<td>0.70&quot;</td>
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<tr>
<td>Specific Gravity</td>
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<tr>
<td>Operating Temperature</td>
<td>&lt; 230°</td>
</tr>
<tr>
<td>Maximum Volume</td>
<td>5514 Gal.</td>
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<tr>
<td>Seismic Zone</td>
<td>1</td>
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</table>

* A complete and exhaustive ultrasonic thickness corrosion survey has been completed, the results of which can be found in Appendix F of this assessment.

8. Calculation of Foundation Loading

Total Weight of Tank and Contents = 37.07 tons

Detailed calculations reflecting the volume and weight of the tank along with the minimum required foundation thickness and steel reinforcement are included in Appendix A and E of this assessment.

9. Required Structural Calculation

The calculated required wall thickness for this tank is 0.066 inches. 0.0625 inches is added for corrosion allowance. This corrosion allowance is based on a best engineering estimate taking into account the materials being treated and a 20 year design life. (See Appendix B of this assessment for detailed calculations or required wall thickness and structural analysis of the tank support system).
10. Comparison of Actual Structure to Theoretical Values

Wall Thickness Comparison

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<tr>
<th>Calculated Required Thickness</th>
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</thead>
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<tr>
<td>Minimum Required Wall Thickness By API 650-88</td>
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<tr>
<td>Measured Wall Thickness</td>
<td>0.70&quot;</td>
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</table>

C. SECONDARY CONTAINMENT SYSTEM

1. General Description of Secondary Containment

The secondary containment system is designed and operated to prevent any migration of wastes or liquids out of the system. (See Appendix G of this assessment for layout of secondary containment area.) The Evaporator Overflow Tank (EO1) #1 is located in a 12' x 24.5' x 3' high concrete containment area.

The containment area and tanks are routinely visually monitored on a daily basis for leaks. A sump pump and drain are located in the containment area. The floor is sloped to the sump to collect any drainage or spills. Any released tank contents or surface runoff will drain on top of the sloped concrete to the sump area. The accumulated liquids are then removed and pumped to the wastewater pretreatment area within a maximum of 24 hours, as a permit condition.

2. Design Standards

The structural capacity of the foundation and walls were compared to those sections that are applicable in the API 650-88 and the American Concrete Institute (ACI 318-89/318r-89) and these calculations were used as a guide in verifying the ability of the system to contain hazardous waste.

3. Hazardous Characteristics of Wastes Treated

The wastes which are treated in the primary tank have the following characteristics:

- Treated Wastes
- pH Level (4-10)
- N < 6
- Temperature = Ambient

The hazardous characteristics of the waste treated in the primary tank were examined. It was determined that the pH and normality levels of the waste are the primary areas of concern. This is to determine the applicability of a corrosion allowance for the containment system material type and thickness.
4. Existing Corrosion Protection

The entire secondary containment area floor and walls are coated with an impermeable coating by (Overcrete Plus by Concrete Protection Systems, Inc.) installed by Mid-America Painters of Woodward, Oklahoma. See Appendix H of this report for detailed information on this coating.

5. Documented Age of the Containment Area

The secondary containment system was constructed and installed in 1992 thus making the containment system less than 1 year old.

6. Result of Leak Tests

A visual inspection of the containment area was performed and from this inspection there were no cracks or breaks in the impermeable coating, therefore it appears to be adequate to contain any leaks or spills.

7. Existing Data Obtained

<table>
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<tr>
<th>Area</th>
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<tr>
<td>Wall Height</td>
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<tr>
<td>Material</td>
<td>Concrete</td>
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<tr>
<td>Gross Volume</td>
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</tr>
</tbody>
</table>

8. Calculation of Existing Capacity

Containment Capacity Available (CCA)

CCA = Gross Volume - Volume of items in the containment - Volume of rainfall.

See the appendix of this report for detailed calculations of the available containment volume. The containment capacity available = 749.13 c.f.

9. Required Volume

Containment Capacity Required (CCR)

CCR = Volume of Largest Tank in the secondary containment

Volume of Largest Tank = 737.29 c.f.

10. Comparison of Available Volume to Required Volume

Containment Capacity Comparison

Containment Capacity Required = 737.29 c.f.
Secondary Containment Volume Available = 749.13 c.f.
Excess Containment Volume = 11.84 c.f.

CCA > CCR Adequate Capacity (under normal operating conditions) is available.
D. CONCLUSIONS

1. Primary Tank Vessel

The tank vessel at the time of inspection was fit for use with the present waste stream at given densities, chemical and physical characteristics as verified by USPCI.

2. Secondary Containment System

The secondary containment area at the time of inspection was fit for use, if the present waste stream at given densities and chemical and physical characteristics as verified by USPCI were released from the primary tank. The useful life of the concrete containment area is estimated at 15 years. This useful life was determined by using a design life of 20 years less the period that the tank has been in use at the USPCI Lone Mountain Facility. There did not seem to be any extensive corrosion or deterioration of the secondary containment area.

E. RECOMMENDATIONS

The following repairs or modifications should be made:

1) Primary Tank

The tank should be checked periodically with ultrasonic testing procedures to establish a verified limit of corrosion. USPCI should continually insure compatibility with the waste and densities stored. Daily inspections should be continued to detect any visual corrosion or defects.

2) Secondary Containment System

The secondary containment should be checked periodically for any deterioration and structural integrity.

3) Routine Inspections

When routine and preventative measures are to be completed, the tank should be cleaned and internally inspected to determine any interior defects or corrosion. Continued routine painting and coating of tanks on the interior and exterior, and routine inspection is recommended.
F. CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted, is to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment from knowing violations.

E. E. Myers
Date: 1/20/97

OKLA
APPENDIX A

Primary Tank Volume Calculations
SECTION 305 - APPENDIX A

EO1, Evaporator Overflow Tank

PRIMARY TANK VOLUME CALCULATIONS

DIMENSIONS:

Geometry: CYLINDRICAL
Diameter: 6.87 FEET
Height = 17.50 FEET
Top = Std. Umbrella =
Bottom = Std. Umbrella =

TANK VOLUME:

Top = approx. Std. Umbrella volume = 0.05539*D^3
Bottom = Std. approx. Umbrella volume = 0.05539*D^3
Tank Cylinder =

TOTAL PRIMARY TANK VOLUME = 737.29 C.F.
OR 5,514.93 CAL

WEIGHT ON FOUNDATION

CONTENTS S.G.: 1.50
DENSITY: 93.60 LB/C.F.

SURFACE AREA CALCULATION

Tank Top = 0.8418*D^2 = 39.73 S.F.
Tank Bottom = 0.8418*D^2 = 39.73 S.F.
Tank Wall = Cîr*h = 379.86 S.F.

TOTAL SURFACE AREA = 459.32 S.F.

Steel Thickness =
Sidewalls 0.26 INCHES
Top and bottom Dish 0.34 INCHES

Volume of Steel =
Sidewalls 8.23 C.F.
Top and bottom dish 2.22 C.F.

Density of Steel = 490.00 LB/C.F.
Weight of Steel = 2.56 TONS

WEIGHT OF TANK CONTENTS = 34.51 TONS

TOTAL WEIGHT OF TANK AND CONTENTS = 37.07 TONS
APPENDIX B

Primary Tank Wall Thickness Calculations
**SECTION 305 - APPENDIX B**

**EO1, Evaporator Overflow Tank**

**PRIMARY TANK WALL THICKNESS**

<table>
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<td>DIAMETER:</td>
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</tr>
<tr>
<td>LENGTH:</td>
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<td>TANK VOLUME:</td>
<td>737.29 C.F.</td>
</tr>
<tr>
<td>CONTENTS S.G.:</td>
<td>1.30</td>
</tr>
<tr>
<td>DENSITY:</td>
<td>81.12 LB/C.F.</td>
</tr>
<tr>
<td>TOTAL WEIGHT OF TANK AND CONTENTS =</td>
<td>37.14 TONS</td>
</tr>
<tr>
<td>STEEL THICKNESS =</td>
<td>0.740 INCHES</td>
</tr>
</tbody>
</table>

**THIS TANK IS LYING ON ITS SIDE THEREFORE TREAT TANK AS A CONTINUOUS BEAM**

Allowable Stress API-650-88

\[
I = \frac{23,200.00}{162,819.18} = 0.0014 \text{ in}^4
\]

\[
S (\text{provided}) = 3950.00 \text{ in}^3
\]

\[
w = 4.22 \text{ K/LF}
\]

Length Between Supports = 8.80 feet

\[
M = wi^2/28 = 40.85 \text{ K-FT}
\]

\[
490.25 \text{ K-IN}
\]

\[
S \text{ required} = 21.13 \text{ in}^3
\]

\[
\text{Thickness Required} = 0.004 \text{ in}
\]

\[
\text{Corrosion Allowance} = 0.0625 \text{ in}
\]

**Thickness Required = 0.086 in**
APPENDIX C

Structural Support Calculations
SECTION 305 - APPENDIX C

EO1, Evaporator Overflow Tank

STRUCTURAL SUPPORT CALCULATIONS

<table>
<thead>
<tr>
<th>GIVEN:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank Diameter =</td>
<td>6.87 feet</td>
</tr>
<tr>
<td>Total Height =</td>
<td>17.50 feet</td>
</tr>
<tr>
<td>Weight of Tank (Steel) =</td>
<td>5120.00 lbs</td>
</tr>
<tr>
<td>Weight of Max. Contents =</td>
<td>69020.00 lbs</td>
</tr>
<tr>
<td>Tank Nominal Thickness =</td>
<td>0.25 in</td>
</tr>
</tbody>
</table>

---SEISMIC DESIGN CHECK---

ZONE COEFFICIENT (Z): 0.1875

ESSENTIAL FACILITIES FACTOR (I): 1.000

LATERAL EARTHQUAKE FORCE COEFF. (C1): 0.240

D/H: 0.390

k Factor: 0.550

SITE AMPLIFICATION FACTOR (S): 1.500

NATURAL PERIOD OF FIRST SLOSHING (T): 1.442

LATERAL EARTHQUAKE FORCE COEFF. (C2): 0.312

WEIGHT OF TANK SHELL (W0): 5120.00 LBS

TOTAL WEIGHT OF TANK CONTENTS (W): 69020.00 LBS

W1/Wt: 0.900

W2/Wt: 0.100

WEIGHT OF EFFECTIVE MASS OF CONTENTS THAT MOVES IN UNISON WITH THE TANK SHELL (W1): 62118.000 LBS

WEIGHT OF EFFECTIVE MASS IN FIRST SLOSHING (W2): 6902.000 LBS

HT FROM BTM OF SHELL TO CENT. OF SHELL (Xa): 8.800 FEET

X1/H: 0.480

HT FROM BTM TO CENT. OF LAT. SEISMIC FORCE (X1): 8.448 FEET

X2/H: 0.800

HT FROM BTM TO CENT. OF LAT. SEISMIC FORCE (X2): 14.080 FEET

OVERTURNING MOMENT (M) = Z*(C1*W0*Xa + C1*W1*X1 + C2*W2*X2)

OVERTURNING MOMENT (M): 31330.178 FT-LBS
Note: All of the above calculations are based on API-650-88 Seismic Design Procedure (Appendix E).

CHECK STRESS IN TANK SHELL FROM SEISMIC FORCES:

\[ W_i = \text{MAXIMUM WEIGHT OF TANK CONTENTS THAT MAY BE USED TO RESIST THE SHELL OVERTURNING MOMENT} \]

\[ W_i = 7.9 \times \text{tb}^* (F_{by}*G^*H)^{.5} \]

\[ W_i \text{ must be less than } 1.25\times G^*H^*D : \]

\[ \text{tb} = \text{THK. OF BTM. PLATE UNDER SHELL:} \]

\[ F_{by} = \text{MINIMUM YIELD STRENGTH OF BOTTOM PLATE:} \]

\[ G = \text{DESIGN SPECIFIC GRAV. OF LIQUID:} \]

\[ W_i = \]

\[ 1925.40 \text{ LBS/FT OF SHELL CIRCUMFERENCE} \]

DENSITY OF TANK SHELL MATERIAL:

\[ \text{WT} = \text{WEIGHT OF TANK SHELL AND THE PORTION OF FIXED ROOF SUPPORTED BY TANK SHELL:} \]

\[ M/(D^2 \times (WT+W_i)) ; \]

\[ b = \text{MAXIMUM LONGITUDINAL COMPRESSIVE FORCE AT THE BTM. OF TANK SHELL} \]

\[ b = \text{WT} + 1.273\times M/D^2 \]

\[ b ; \]

\[ 1024.71 \text{ LBS/FT OF SHELL} \]

\[ G^*H^*D^2/2A^2; \]

\[ F_a = \text{MINIMUM OF } 10^{-6}\times 12.5^*D + 600^*G^*H^{.5} \text{ or } .5^*F_{by} \]

\[ F_{by} = \text{MINIMUM YIELD STRENGTH OF BTM. SHELL COURSE:} \]

\[ \text{MAX. LONGITUDINAL COMPRESSIVE STRESS IN THE TANK SHELL} = \]

\[ b/12t = \]

\[ 36000.00 \text{ PSI} \]

\[ 341.57 \text{ PSI} \]

CHECK OVERTURNING MOMENT FROM WIND PRESSURE

\[ M_{\text{max}} \text{ must be Less Than or Equal To } .66^* (WD)/2 \]

Where:

\[ W = \text{Shell Weight Available To Resist Uplift (lbs)} \]

\[ D = \text{Tank Diameter (feet)} \]

\[ M = \text{Overturning Moment} \]
\[ M = P_w \cdot \text{Projected Area} \cdot H_1 \]

\[ H_1 = \text{Height from ground to centroid of tank shell} \]

\[ P_w = \text{Wind Pressure (18 psf for 100 MPH Wind on cylinders)} \]

\[ M_{\text{max}}: \quad 11607.55 \text{ FT-LBS} \]

\[ M: \quad 19152.46 \text{ FT-LBS} \]
APPENDIX D

Containment Area Volume Calculations
## SECTION 305 APPENDIX D

### EO1, Evaporation Overflow Tank

### SECONDARY CONTAINMENT CALCULATIONS

<table>
<thead>
<tr>
<th>Area No.1</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Length =</td>
<td>24.50 ft</td>
</tr>
<tr>
<td>Width =</td>
<td>12.05 ft</td>
</tr>
<tr>
<td>Height =</td>
<td>3.05 ft</td>
</tr>
<tr>
<td>Surface Area =</td>
<td>295.23 S.F.</td>
</tr>
<tr>
<td>Volume =</td>
<td>900.44 C.F.</td>
</tr>
</tbody>
</table>

Gross Area = Area 1  
Gross Volume = Vol. 1  

Volumes of Items of Displacement **

There are no items in secondary containment except tank EO1

Total volume to deduct for items in containment area = 0.00 C.F.

Subtraction for volume of rainfall

<table>
<thead>
<tr>
<th>Volume of rain = Area x depth of rainfall</th>
<th>6.15 in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth of rainfall =</td>
<td>295.23 S.F.</td>
</tr>
<tr>
<td>Area =</td>
<td>151.30 C.F.</td>
</tr>
<tr>
<td>Volume =</td>
<td></td>
</tr>
</tbody>
</table>

TOTAL AVAILABLE VOLUME = Gross Volume - Subtractions =

<table>
<thead>
<tr>
<th>Items of displacement</th>
<th>900.44 C.F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of rainfall</td>
<td>-151.30 C.F.</td>
</tr>
</tbody>
</table>

TOTAL AVAILABLE VOLUME =

| OR | 5603.52 Gal. |

---

Section 305 - Appendix D - Page 1
APPENDIX E

Foundation Design Analysis
SECTION 305 - APPENDIX E

EO1, Evaporator Overflow Tank

FOUNDATION DESIGN ANALYSIS

ASSUMPTIONS:

\( f_c = \) 3.50 KSI
\( f_y = \) 60.00 KSI
Allowable Soil Press. = 2.00 KSI
Structural Steel = A36

GIVEN:

Tank Diameter = 6.87 feet
Sidewall Height = 17.60 feet
Weight of Tank (Shell) = 5120.00 lbs
Weight of Max. Contents = 69020.00 lbs

Tank is Resting on a concrete foundation.

CHECK CONCRETE FOUNDATION DESIGN:

Assume Footing Depth = 6.00 inches
Assume Footing Width = 12.00 inches
Assumed Effective Soil Press. = 1925.00 psf

Look at what is resisting overturning moment from seismic load:

\[ b = 1024.71 \text{ lb/ft of circ.} \]

Where \( b \) is the maximum shell compression at the bottom of the shell.

If the footing is 12.00 inches wide
then the actual applied pressure to the subgrade is 1024.71 lb/ef

This is less than the effective soil pressure.
APPENDIX F

Ultrasonic Thickness Testing Results
REPORT OF UT THICKNESS INSPECTION

TESTED FOR: US PCI  
LONE MOUNTAIN  

PROJECT: CORROSION SURVEY  

DATE: **8-3-92**  
OUR REPORT NO.: 53  

<table>
<thead>
<tr>
<th>Client Order Number:</th>
<th>Lab Number:</th>
<th>Location:</th>
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<tbody>
<tr>
<td></td>
<td>UT #1</td>
<td>EO-1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test Method Standard:</th>
<th>Acceptance Standard:</th>
<th>Scanning Method:</th>
</tr>
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<tbody>
<tr>
<td>QC UT 5</td>
<td>QC UT 5</td>
<td>RANDOM / 2'</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UT UNIT</th>
<th>A-Scan</th>
<th>Direct Readout</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Serial No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>KBA</td>
<td>PME</td>
<td>103162</td>
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</table>

<table>
<thead>
<tr>
<th>CALIBRATION</th>
<th>BLOCK ID Number:</th>
<th>Size</th>
<th>Material Type:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>01</td>
<td>.100'' - .500'' STEP</td>
<td>STEEL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEARCH UNIT</th>
<th>Single Element</th>
<th>Size</th>
<th>Frequency</th>
<th>Serial No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dual Element</td>
<td>.625''</td>
<td>5 MHZ</td>
<td>E08 931</td>
</tr>
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</table>

Measurements:

```
1  18  35  52
2  19  36  53
3  20  37  54
4  21  38  55
5  22  39  56
6  23  40  57
7  24  41  58
8  25  42  59
9  26  43  60
10 27  44  61
11 28  45  62
12 29  46  63
13 30  47  64
14 31  48  65
15 32  49  66
16 33  50  67
17 34  51  68
```

*NOTE:* SEE DRAW. # EO-1 AND ATTACHMENTS FOR READINGS AND LOCATIONS.

*NOTE:* BLANK AREAS ON DRAWING DENOTE AREAS UNINSPECTABLE DUE TO INACCESSIBILITY.

**TECHNICIANS:** J. Brooks  
Level: II  

**TECHNICIANS:** J. Brooks  
Level: II  

**REMARKS:** READINGS TAKEN AT 2 FOOT GRID.
<table>
<thead>
<tr>
<th>PSI</th>
<th>Tank Number</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>124</td>
<td>E0-1</td>
<td>8-3-92</td>
</tr>
<tr>
<td>0.951</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.953</td>
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</tr>
<tr>
<td>0.706</td>
<td>0.696</td>
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<tr>
<td>0.973</td>
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<td></td>
</tr>
<tr>
<td>0.918</td>
<td>0.718</td>
<td></td>
</tr>
<tr>
<td>0.970</td>
<td>0.970</td>
<td></td>
</tr>
<tr>
<td>0.973</td>
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<td>0.963</td>
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<td>0.700</td>
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<td>0.955</td>
<td>0.747</td>
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</tr>
<tr>
<td>0.923</td>
<td>0.740</td>
<td></td>
</tr>
<tr>
<td>0.911</td>
<td>0.730</td>
<td></td>
</tr>
<tr>
<td>0.949</td>
<td>0.765</td>
<td></td>
</tr>
<tr>
<td>0.993</td>
<td>0.720</td>
<td></td>
</tr>
<tr>
<td>0.928</td>
<td>0.746</td>
<td></td>
</tr>
<tr>
<td>0.915</td>
<td>0.714</td>
<td></td>
</tr>
<tr>
<td>0.908</td>
<td>0.711</td>
<td></td>
</tr>
<tr>
<td>0.950</td>
<td>0.711</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX G

Drawings
SECTION FT1
ASSESSMENT
OF
EVAPORATOR FLASH TANK NO. 1
(FT 1)
Located At The
LONE MOUNTAIN HAZARDOUS WASTE
FACILITY
WAYNOKA, OKLAHOMA

PREPARED FOR

safety-kleen ®

July 2002
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APPENDIX B. WELDING PROCEDURES AND INSPECTIONS
APPENDIX C. HYDROSTATIC LEAK TESTS
APPENDIX D. CALCULATIONS
APPENDIX E. METALLURGICAL INFORMATION
APPENDIX F. SUPPORT STRUCTURE CALCULATIONS
APPENDIX G. FOUNDATION ANALYSIS
APPENDIX H. CONCRETE COATING INFORMATION FOR SECONDARY CONTAINMENT
APPENDIX I. SECONDARY CONTAINMENT
ASSESSMENT
Of
EVAPORATOR FLASH TANK NO. 1 (FT 1)
Located At The
LONE MOUNTAIN HAZARDOUS WASTE FACILITY
WAYNOKA, OKLAHOMA
Prepared For
SAFETY-KLEEN, INC.

1. TANK SYSTEM DESCRIPTION

Evaporator Flash Tank No. 1 (FT 1) is a welded, above-ground wastewater treatment and storage tank to be installed as part of the final wastewater treatment plant at the Lone Mountain Facility in Waynoka, Oklahoma. This tank is a replacement for an existing tank which is constructed of carbon steel. The new tank, which is constructed of stainless steel, is exactly the same size as the original tank. The top of the tank is completely open to the atmosphere for evaporation purposes. Evaporator Flash Tank No. 1 (FT 1) is located within the Wastewater Final Treatment building on the first mezzanine level of the support structure. The complete tank system consists of Evaporator Flash Tank No. 1 (FT 1), Circulating Pump (P 78), Heat Exchanger (EU 1), Pump (P 80), Filter Press (FP 1), and associated piping and instruments.

2. PRIMARY TANK VESSEL

2.1 General Description. Evaporator Flash Tank No. 1 (FT 1) is a circular steel tank with an outside diameter of 6-ft. 4-in. and a height of 31-ft. The tank proper's skirt is anchored to the support structure, and the bottom of the tank is dished and welded to the shell. A self-supporting flue is attached to the top of the tank. Evaporator Flash Tank No. 1 (FT 1) is being assessed to determine if the unit is adequately designed with sufficient structural strength and compatibility with the waste to be stored.

2.2 Design Standards. The tank is designed and constructed to those sections that are applicable in the American Petroleum Institute Standard 650, 10th Edition (API-550). The manufacturer's certification is included in Appendix A.

2.3 Hazardous Characteristics of Waste Stored. The waste stored in this tank is treated and untreated brine solutions. The following parameters are characteristics of the waste treated:

Ignitability: Flash Point > 240° F

Corrosiveness:

\[ 6 < \text{pH} < 13 \]
\[ 0 < \text{N} < 7 \]

Reactivity: None

Temperature: < 240° F

Based on the results of the examination of the hazardous characteristics of the waste to be stored in this tank, it was determined that the pH, normality levels, and salinity (corrosiveness) of the waste are the primary areas of concern. These levels are used to determine the applicability of a corrosion allowance for the tank material type and thickness.
2.4 **Welding Specifications and Inspection.** The welding procedures utilized in the tank construction and the Radiographic Examination Report are included in Appendix B.

2.5 **Corrosion Protection.** The tank shell is constructed of 316L stainless steel for corrosion protection.

2.6 **Documented Age of Tank.** This tank was manufactured by Lide Industries of Mexia, Texas, in January 2002, and installed in July 2002.

2.7 **Results of Leak Tests.** The manufacturer conducted a hydrostatic leak test of the tank prior to shipping. A description of this test is included in Appendix C of this assessment. In addition, a visual inspection was performed of the tank's interior and exterior subsequent to installation. This inspection was conducted specifically to detect the presence, if any, of the following defects:

(a) Weld break  
(b) Punctures  
(c) Cracks  
(d) Corrosion  
(e) Other structural damage or inadequacies of construction and/or installation

The tank was again hydrostatically tested subsequent to installation. A description of this procedure is summarized in Appendix C of this assessment. Based on the results of these tests, it was determined that the primary tank was not leaking.

2.8 **Existing Data Obtained.**

- Tank Diameter ............................................ 6-ft. 4-in.
- Nominal Height of Tank ..................................... 31-ft.
- Maximum Capacity ........................................ 3,785-gal.*
- Overflow Liquid Level ..................................... 9-ft. 1-in.
- Overflow Volume ......................................... 1,137-gal.
- Design Specific Gravity .................................... 1.5
- Maximum Bottom Pressure ................................ 10.8-psi
- Maximum Operating Temperature .......................... 300°F

**Construction Material:**

- Flue .................................................. ASTM A36
- Shell .................................................. ASTM 316L
- Bottom ............................................... ASTM 316L
- Skirt ................................................. ASTM A36
- Flanges, Blinds, Coupler and Plugs ..................... ASTM 316L
- Bolts ................................................ SA 193-B7/SA 194-2H

- Wall Thickness (Shell and Bottom) ....................... 0.250-in.
- Operating Pressure .................................... Atmospheric
- Seismic Zone ......................................... 1

* The maximum capacity of the assessed tank is the same as the original tank, however the original tank assessment indicates otherwise. There appears to have been an error in the original assessment's volume calculations.

2.9 **Calculation of Existing Foundation Loading.**

- Total Weight of Tank and Contents (maximum volume) ............. 59,406-lb.

Detailed calculations reflecting the volume and weight of the tank are included in Appendix D of this assessment.
2.10 **Required Structural Calculation.** Calculations for the required wall thickness for this tank are presented in Appendix D of this assessment. Metallurgical information on the materials used is included in Appendix E of this assessment. The minimum required thickness in accordance with API 650 is 0.1875-in. A corrosion allowance of 0.125 is provided for. The measured wall thickness is 0.250-in.

Design calculations for the support structure are included in Appendix F of this assessment. These calculations were completed in accordance with the BOCA National Building Code 1990 Edition and were part of a previous tank assessment prepared by Black and Veach. The structural support was inspected and no changes have been made since the date of the Black and Veach assessment.

Structural analysis of the foundation is included in Appendix G of this assessment.

2.11 **Comparison of Actual to Theoretical Structural Values.**

(a) **Wall Thickness Comparison:**

- Calculated Required Wall Thickness (includes corrosion allowance) ............... 0.156-in.
- Minimum Required Wall Thickness by API 650 ........................................... 0.1875-in.
- Measured Wall Thickness ................................................................. 0.250-in.

(b) **Bottom Thickness Comparison:**

- Calculated Required Bottom Thickness .................................................. 0.151-in.
- Minimum Required Bottom Thickness by API 650 ........................................ 0.250-in.
- Measured Bottom Thickness ................................................................. 0.250-in.

(c) **Foundation Integrity Comparison:**

- Maximum Calculated Load (6-in. Slab) ................................................... 17.6 Kips
- Calculated Foundation Support (6-in. Slab) ........................................... 26.7 Kips
- Maximum Calculated Load (17-in. Slab) ................................................... 62.9 Kips
- Calculated Foundation Support (17-in. Slab) ........................................... 127.7 Kips

2.12 **Ancillary Equipment.** The ancillary equipment for the Evaporator Flash Tank No. 1 (FT 1) system includes the following:

(a) **Circulating Pump (P 78).** A centrifugal pump designed to pump 800-GPM at 150-ft. of discharge head with a suction head of 11-ft.

(b) **Heat Exchanger (EU 1).** A plate and frame unit of stainless steel construction designed to operate at a pressure of 150-PSIG and a temperature of 300° F.

(c) **Pump (P 80).** A pneumatically-operated, double-diaphragm pump designed to pump from 100- to 0-GPM at head pressures varying from 0- to 100-PSIG, pumping fluid at a temperature up to 212° F.

(d) **Filter Press (FP 1).** A gasketed unit employing glass-filled polypropylene plates designed to operate at a temperature/pressure limit of 100-psi at 212° F.

(e) **Associated Piping, Valves, and Instruments.** All piping is Schedule 40 carbon steel fitted with 150-psi flanges. All piping with an inside diameter of 2-in. or smaller is socket-welded using, at minimum, 3,000-lb. connections. All piping with an inside diameter greater than 2-in. is butt-welded. All valves, fittings, and instruments are rated for 150-psi or higher.
**Note:** Items (a) - (c) are part of the tank system. However, no changes were made to them during the installation of the new FT 1 tank.

### 3. SECONDARY CONTAINMENT SYSTEM

#### 3.1 General Description of Secondary Containment

The secondary containment system is designed and operated to prevent migration of wastes or liquids out of the system. Evaporator Flash Tank Nos. 1, 2 and 3, Evaporator Blowdown Tank No. 2, and Evaporator Feed Tank No. 4 are located on a reinforced concrete base floor area with vertical concrete sidewalls. This area is inspected daily on a routine basis.

At the time of inspection, the concrete area was withstanding daily operations and routine climatic conditions. No cracks from compression or uplift were visually apparent.

Any released tank contents are removed and pumped to an appropriate storage area within the maximum time allowed as a permit condition.

#### 3.2 Corrosion Protection

There is an impermeable coating applied to the entire concrete floor and curbs. Detailed information on the coatings employed is included in Appendix H of this assessment.

#### 3.3 Documented Age of the Containment Area

The concrete secondary containment system was constructed and installed in 1987.

#### 3.4 Results of Leak Tests

A visual inspection of the containment area was conducted and no cracks or breaks in the impermeable coating were observed. Therefore, it appears to be adequate to contain any leaks or spills.

#### 3.5 Calculation of Capacity Available (CCA).

| Area                                      | 2,739-sf |
| Curb Height                               | 0.25-ft. |
| Material                                  | Concrete |
| Gross Volume                              | 685-cf   |

**Note:** See Appendix I for secondary containment.

#### 3.6 Required Volume

(a) Containment Capacity Required (CCR):

\[
\text{CCR} = \text{Volume of Largest Tank (Overflow Volume) in the Secondary Containment}
\]

Volume of Largest Tank = (FT1) ................................. 506-cf

#### 3.7 Comparison of Available Volume to Required Volume

(a) Containment Capacity Available (CCA):

- Containment Capacity Required (CCR) .......................... 506-cf
- Secondary Containment Volume Available ....................... 685-cf
- Excess Containment Volume ..................................... 179-cf

CCA > CCR Adequate Capacity (under normal operating conditions is available.)

**Note:** See Appendix I for secondary containment calculations.
4. CONCLUSIONS

The foundation and structural support for the Evaporator Flash Tank No. 1 (FT1) system have been previously analyzed, reviewed, and deemed to be adequately designed.

The Evaporator Flash Tank No. 1 (FT 1) system has sufficient structural strength, is compatible with the waste to be stored and treated, and has adequate corrosion protection to ensure that it will not collapse, rupture, or fail.

The Evaporator Flash Tank No. 1 (FT 1) system was inspected on July 18, 2002, for weld breaks, punctures, scrapes of protective coating, cracks, leaks, corrosion, and other structural damage or inadequacies of construction/installation.

The Evaporator Flash Tank No. 1 (FT 1) equipment was hydrostatically tested on July 18, 2002, and it was determined that the tank does not leak.

The Secondary Containment for the Evaporator Flash Tank No. 1 (FT 1) system is of sufficient structural strength and volume to meet the requirements set forth in 40 CFR 264.193.

5. RECOMMENDATIONS

Due to a previous history with interior deterioration of the Evaporator Flash Tank No. 1 (FT 1), the following recommendations are suggested:

☐ Visual inspections of the tank interior subsequent to the initial 6-mo. of operation.

☐ Annual visual inspections of the tank interior subsequent to the initial 6-mo. inspection.

☐ Perform an ultrasonic survey of the tank shell subsequent to 5-yr. of operation to determine the average shell thickness.

6. CERTIFICATION

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision, in accordance with a system designed to ensure that qualified personnel properly collect and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for collecting the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Rob L. Stallings, P.E.
Envirotech Engineering & Consulting, Inc.

CA. 1960 - Expiration Date 06/30/03
APPENDIX A.

PRIMARY TANK VOLUME CALCULATIONS
APPENDIX A.

PRIMARY TANK VOLUME CALCULATIONS
For
EVAPORATOR FEED TANK NO. 2 (EF2)

- DIMENSIONS:
  - Geometry: Cylindrical
  - Diameter: 60.00-ft.
  - Height: 16.90-ft.
  - Operating Height: 15.50-ft.
  - Bottom: Flat

- TANK VOLUME:
  - Operating Volume = 43,826.72-ft³ = 327,846.63-gal.
  - Total Primary Tank Volume = 47,785.26-ft³ = 357,458.57-gal.

- WEIGHT ON FOUNDATION:
  - Contents S.G.: 1.3
  - Density: 81.12-lb/ft³

- SURFACE AREA CALCULATION:
  - Tank Top = n/a
  - Tank Bottom = 2,827.53-sf
  - Tank Wall = 3,185.68-sf
  - Total Surface Area = 6,013.21-sf
  - Steel Thickness:
    - Sidewalls = 0.250-in.
    - Bottom = 0.240-in.
  - Volume of Steel:
    - Sidewalls = 66.37-cf
    - Bottom = 56.55-cf
  - Density of Steel = 490-lb/ft³
  - Weight of Steel (Tank): = 30.12-ton = 60,230.32-lb.
  - Weight of Tank Contents = 1,938-ton = 3,876,340-lb.
  - Total Weight of Tank and Contents = 1,968-ton = 3,936,570-lb.
APPENDIX B.

PRIMARY TANK WALL THICKNESS
APPENDIX B.

PRIMARY TANK WALL THICKNESS
For
EVAPORATOR FEED TANK NO. 2 (EF2)

□ DIMENSIONS:

Geometry: Cylindrical
Diameter: 60.00-ft
Height: 16.90-ft
Specific Gravity: 1.30
Normal Operating Temperature: Ambient

□ STEEL THICKNESS CALCULATIONS:

Thickness (t) = \((2.6 \times H \times D \times S.G.) / (s \times E) + CA\)

\[\begin{align*}
\text{s} & = \text{Allowable Design Stress} \quad = 23,200.00\text{-psi} \\
E & = \text{Joint Efficiency} \quad = 85.00\% \\
\text{Thickness (t)} & \quad = 0.1738\text{-in.} \\
\text{Corrosion Allowance} & \quad = 0.0625\text{-in.} \\
\text{Calculated Minimum Wall Thickness} & \quad = 0.2363\text{-in.}
\end{align*}\]
APPENDIX C.

SEISMIC CALCULATIONS
APPENDIX C.

SEISMIC CALCULATIONS
For
EVAPORATOR FEED TANK NO. 2 (EF2)

DIMENSIONS:

- Diameter: 60.00-ft.
- Height: 16.90-ft.
- Weight of Tank (Steel): 60,230.32-lb.
- Weight of Maximum Contents: 3,876,340.00-lb.
- Tank Shell Thickness: 0.25-in.
- Tank Bottom Thickness: 0.240-in.

STRESS IN TANK SHELL FROM SEISMIC FORCES:

Maximum weight of tank contents that may be used to resist shell overturning moment:

\[ W_I = 7.9 \times t_b \times (F_{by} \times G \times H)^{0.5} \]

- \[ F_{by} = \text{Minimum Yield Strength in Bottom Plate} \]
- \[ t_b = \text{Thickness of Tank Bottom} \]
- \[ G = \text{Design Specific Gravity of Liquid} \]
- \[ W_I = \text{Weight of Tank Shell} \]

Note: \[ W_I \text{ Shall Not Exceed } 1.25 \times G \times H \times D \]

- Density of Tank Shell Material: 490.00-lb/ft³
- \[ WT = \text{Weight of Tank Shell} \]
- \[ M/(D^2(WT+W_I)) = 0.1071 \]
- \[ b = \text{Maximum Longitudinal Compressive Force at the Bottom of Tank Shell} \]
- \[ b = WT + 1.273 \times W/D^2 \]
- \[ G \times H \times D^2/A^2 = 1,265,472 \]
- \[ Fa = 10^6/t/D = 4,167-\text{psi} \]
- OR
- \[ Fa = 0.5 \times F_{by} = 18,000-\text{psi} \]
- Use Minimum Value for \[ Fa = 4,167-\text{psi} \]
- \[ b/12 \times t = 140.21-\text{psi} \]

Note: \[ b/12t \text{ Cannot Exceed } Fa \text{ for a Stable Tank} \]
OVERTURNING MOMENT:

Overturning Moment (M) = \( Z^* I'^*(C1 \cdot Ws \cdot Xs + C1 \cdot W1 \cdot X1 + C2 \cdot W2 \cdot X2) \)

Zone Coefficient (Z) = 0.1875

Essential Facilities Factor (I) = 1.000

Lateral Earthquake Force Coefficient (C1) = 0.240

D/H = 3.55

k Factor (@ D/H = 3.55) = 0.680

Site Amplification Factor (S) = 1.5

Natural Period of First Sloshing Mode (T) = 5.11

Lateral Earthquake Force Coefficient (C2) = 0.07755

Weight of Tank (Ws) = 60,230.32

Weight of Tank Contents (Wt) = 3,876,340.00

\( W1 / Wt \) (@ D/H = 3.55) = 0.32

\( W2 / Wt \) (@ D/H = 3.55) = 0.60

Weight of Effective Mass (W1) = 1,240,428.80

Weight of Effective Mass (W2) = 2,325,804.00

Ht from Btm of Shell to Cent. of Shell (Xs) = 8.45

\( X1/H \) = 0.38

Ht from Btm of Cent. of Lat. Seismic Force (X1) = 6.422

\( X2/H \) = 0.55

Ht from Btm of Ccnt. of Lat. Scismic Force (X2) = 9.295

Overturning Moment \( M \) = 695,718-ft/lb.

Opposing Moment \( M^* \) = 118,097,110-ft/lb.
APPENDIX D.

WIND LOAD CALCULATIONS
APPENDIX D.

WIND LOAD CALCULATIONS
For
EVAPORATOR FEED TANK NO. 2 (EF2)

DIMENSIONS:

Diameter: 60.00-ft.
Height: 16.90-ft.
Weight of Tank (Steel): 60,230.32-lb.
Weight of Max. Contents: 3,876,340.00-lb.
Tank Shell Thickness: 0.25-in.
Tank Bottom Thickness: 0.240-in.

OVERTURNING MOMENT FROM WIND LOADS:

\[ M = \text{Overturing Moment Due to Wind Loading} \]
\[ M = P_w \times A_p \times H_c \]

\[ P_w = \text{Wind Pressure} \]
\[ \text{(Assume 18-psi for 100-MPH Wind on Cylinders)} = 18.00-\text{psi} \]

\[ A_p = \text{Projected Frontal Area of Tank (H*D)} = 1,014-\text{ft}^2 \]

\[ H_1 = \text{Height from Ground to Centroid of Tank} = 8.45-\text{ft.} \]

\[ M = \text{Overturing Moment} = 154,229.40-\text{ft-lb.} \]

\[ M_{\text{Max}} = \text{Returning Moment} = .66*(W/D)/2 \]

\[ W = \text{Wt of Tank} = 60,230.32-\text{lb.} \]

\[ M_{\text{Max}} = 1,192,560-\text{ft-lb.} \]

\[ M \text{ Must Be Less Than } M_{\text{Max}} \]
APPENDIX E.

FOUNDATION INTEGRITY
MONITORING
DOCUMENTS
Annual Tank In-Service Inspection Checklist

Tank Name: EF-2
Tank Location: W10PT
Inspected By: Terry L. Phillips
Date of Last Inspection: 03-07-01

Tank Number: #2
Date: 06-11-01
Signature: [Signature]

L. Foundation

A. Measure foundation levelness and bottom elevations (8 points for EF-1 and 9 points for EF-2).
   Note: No other tanks require foundation levelness and elevation survey.

   EF-1:
   37 ______ 47 ______ 55 ______ 263 ______
   271 ______ 279 ______ 293 ______ 303 ______

   EF-2:
   85 [1425.94] 73 [1425.74] 81 [1425.98] 89 [1425.86] 191 [1425.71]
   205 [1425.63] 211 [1425.70] 219 [1425.77] 227 [1425.78]

B. Has the yearly maximum settlement exceeded 1 inch? (EF-1 and EF-2 only)
   EF-1: Yes _____ No _____
   EF-2: Yes _____ No _____

C. Check 8 inch annular channel for deflection of more than 2 degrees from its correct position. (EF-1 only)
   Deflection

Comments:

________________________________________________________

________________________________________________________
Annual Tank In-Service Inspection Checklist

Tank Name: **EF-2**
Tank Location: **UWPT**
Inspected By: ____________________
Date of Last Inspection: ____________________

**Tank Number:** 2  
**Date:** 4-17-02  
**Signature:** ____________________

I. Foundation

A. Measure foundation levelness and bottom elevations (8 points for EF-1 and 9 points for EF-2). Note: No other tanks require foundation levelness and elevation survey.

**EF-1:**

<table>
<thead>
<tr>
<th>37</th>
<th>47</th>
<th>55</th>
<th>263</th>
</tr>
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<tr>
<td>271</td>
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<td>293</td>
<td>303</td>
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**EF-2:**

<table>
<thead>
<tr>
<th>65</th>
<th>73</th>
<th>81</th>
<th>89</th>
<th>191</th>
</tr>
</thead>
<tbody>
<tr>
<td>1425.80</td>
<td>1425.92</td>
<td>1425.98</td>
<td>1425.84</td>
<td>1425.66</td>
</tr>
<tr>
<td>205</td>
<td>211</td>
<td>219</td>
<td>227</td>
<td>1425.75</td>
</tr>
</tbody>
</table>

B. Has the yearly maximum settlement exceeded 1 inch? (EF-1 and EF-2 only)

**EF-1:** Yes [ ] No [ ]  
**EF-2:** Yes [ ] No [x]

C. Check 8 inch annular channel for deflection of more than 2 degrees from its correct position. (EF-1 only)

**Deflection:**

Comments: ________________________________________________

_________________________________________________________

_________________________________________________________
Annual Tank In-Service Inspection Checklist

Tank Name: EF-2
Tank Location: UWIPT
Inspected By: 

Date: 4-14-04
Signature: 

Date of Last Inspection: 

I. Foundation
A. Measure foundation levelness and bottom elevations (8 points for EF-1 and 9 points for EF-2). Note: No other tanks require foundation levelness and elevation survey.

EF-1:
37 ______ 47 ______ 55 ______ 263 ______
271 ______ 279 ______ 293 ______ 303 ______

EF-2:
55 1425.82 73 1425.94 81 1425.99 89 1425.86 191 1425.69
205 1425.61 211 1425.67 219 1425.76 227 1425.76

B. Has the yearly maximum settlement exceeded 1 inch? (EF-1 and EF-2 only)

EF-1: Yes ______ No ______
EF-2: Yes ______ No X

C. Check 8 inch annular channel for deflection of more than 2 degrees from its correct position. (EF-1 only)

Deflection: 

Comments: 

__________________________________________
__________________________________________
__________________________________________
__________________________________________
Annual Tank In-Service Inspection Checklist

Tank Name: EF-2
Tank Location: WUPT
Inspected By: 
Date of Last Inspection: 4/24/08

Tank Number: 
Date: 4/24/08
Signature: 

1. Foundation
A. Measure foundation levelness and bottom elevations (8 points for EF-1 and 9 points for EF-2)
   Note: No other tanks require foundation levelness and elevation survey.

   EF-1:
   37 _______ 47 _______ 55 _______ 263 _______
   271 _______ 279 _______ 293 _______ 303 _______

   EF-2:
   65 1425.78 73 1425.90 81 1425.93 89 1425.80 191 1425.67
   205 1425.58 211 1425.67 219 1425.73 227 1425.72

B. Has the yearly maximum settlement exceeded 1 inch? (EF-1 and EF-2 only)
   EF-1: 
   Yes _______ No _______
   EF-2: 
   Yes _______ No _______

C. Check 8 inch annular channel for deflection of more than 2 degrees from its correct position. (EF-1 only)

   Deflection ________________

Comments: __________________________
______________________________
______________________________

Page 1 of 4
APPENDIX F.

LAW ENGINEERING
GEOTECHNICAL REPORT
November 22, 1993

Mr. Walter Sonne, P.E.
USPCI, Inc.
515 West Greens Road, Suite 500
Houston, Texas 77067

SUBJECT: REVISED REPORT OF GEOTECHNICAL EXPLORATION
Expansion of Wastewater Treatment Facilities--
Lone Mountain Facility, Major County, Oklahoma
Law Engineering Projects No. 392-01406-01

Law Engineering, Inc. has completed the geotechnical exploration at the subject site. Our services were provided in accordance with our Revised Proposal for Geotechnical Exploration Services No. HP-8173-83G, dated September 22, 1993; and a Request for Change Order letter dated October 12, 1993. This report briefly discusses our understanding of the project information, describes our exploratory procedures and findings, and presents our recommendations and conclusions. The data obtained during the field exploration and from the laboratory testing program is presented in the appendices.

We will be happy to discuss our recommendations with you and would welcome the opportunity to provide the additional studies or construction testing services necessary to complete this project. We look forward to serving as your geotechnical engineer on the remainder of this project and on future projects.

If you have any questions, or if you require additional information, please do not hesitate to contact us.

Sincerely,

LAW ENGINEERING, INC.

Fernando Pons, E.I.
Project Geotechnical Engineer

Distribution Copies:
Walter Sonne (2) - USPCI
Larry Marr (1) - USPCI

Michael W. Palmer, P.E.
Principal Geotechnical Engineer
USPCI - Client Manager

Michael H. Homan, P.E.
Principal Geotechnical Engineer
Oklahoma Registration No. 15777
REVISED REPORT OF GEOTECHNICAL EXPLORATION

EXPANSION
OF WASTEWATER TREATMENT FACILITIES

LONE MOUNTAIN FACILITY
MAJOR COUNTY, OKLAHOMA

prepared for
USPCI, Inc.
HOUSTON, TEXAS

LAW ENGINEERING PROJECT NO. 392-1406-01

NOVEMBER 1993
1.0 PURPOSE OF EXPLORATION

The purpose of this exploration was to obtain specific subsurface data at the site and to provide recommendations and opinions for:

- General geotechnical design and construction criteria for the Expansion of Wastewater Final Treatment Facilities (WWFT): Phase I (Expansion of the WWFT Building) and Phase II (Leachate Storage Tanks).

- Site preparation and construction of compacted fills for the WWFT Phase I, and the WWFT Phase II.

- Soil stratigraphy at the Wastewater Pretreatment Facilities (WWPT): Phase III tanks.

It should be noted that it was not the purpose of this study to directly assess or to address any environmental conditions at the site, i.e., the presence of contaminants or substances in the soil, rock, or ground water. An additional study should be undertaken if USPCI decides to specifically address environmental conditions.
2.2 LEACHATE STORAGE TANKS

We understand that USPCI plans to construct three tanks within a containment area. The proposed site of construction is south of Cell 4. The proposed tanks will include a 60-foot diameter, 16-feet tall, 300,000 gallon tank; and two 33-foot diameter, 16-feet tall, 100,000 gallon tanks.

The proposed tanks, containing leachate with a specific gravity of 1.3, will be located within a concrete containment structure with walls on the order of 7 feet in height.

We understand that the preferred foundation system at the present time is a drilled pier underground system, 18-inch diameter, straight-sided drilled piers founded at 8-feet on centers. In turn, these drilled piers will support the containment wall and a 10-inch thick concrete slab on 6 inches of sand and 24 inches of structural fill.

2.3 WASTEWATER PRETREATMENT (WWPT) BUILDING

We understand that two existing on-line 300,000 storage tanks structures within the Wastewater Pretreatment (WWPT) Building are experiencing foundation distress. We further understand that these two tanks and the containment area are supported on shallow footings.
4.1.3 Wastewater Pretreatment (WWPT) Building

Exploration borings L-5, L-6, L-6A, and L-7 were drilled in this area. The measured surface elevation of these borings were 1418.35, 1428.62, 1428.48, and 1430.23 feet MSL, respectively, as provided by USPCI. The subsurface conditions for this area are generalized as follows:

AREA C

WASTEWATER PRETREATMENT BUILDING

(Borings L-5, L-6, L-6A, and L-7)

| STRATUM | DEPTH (ft) | DESCRIPTION | USCS CLASSIFICATION
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I C</td>
<td>0 to 2</td>
<td>FILLY GRAVEL</td>
<td>Unclassified</td>
</tr>
<tr>
<td>II C</td>
<td>1 to 22.5</td>
<td>FILL: Soft to hard, reddish brown with gray, silty CLAY, with gypsum fragments and gravel.</td>
<td>CL</td>
</tr>
<tr>
<td>III C</td>
<td>15.5 to 20.5</td>
<td>Very stiff to hard, reddish brown with gray, silty CLAY, with gypsum fragments and gray silt streaks.</td>
<td>CL</td>
</tr>
<tr>
<td>IV C</td>
<td>18.5 to TOB</td>
<td>Gray silty CLAYSTONE to reddish brown silty CLAYSTONE</td>
<td>Unclassified</td>
</tr>
</tbody>
</table>

Termination of Boring
Unified Soil Classification System
With reference to the Soil Stratum Summary, the TEST BORING RECORDS, Soil Profiles and the Laboratory Test Results, our discussion of the soil conditions for Area C is as follows:

Stratum IC consists of GRAVEL to gravelly fill soils encountered in all borings from a existing surface to approximately 2 feet below existing grade.

Stratum IIC consists of fill soils of soft to hard, reddish brown with gray, silty CLAY with gypsum fragments and gravel. Law personnel performed continuous sampling with Shelby tubes, and utilized on-site extruding techniques to better identify the extent of this fill stratum. These fill soils were encountered from a depth of 1 foot from existing surface to 22.5 feet below grade. Organic odor and wet seams were identified in the lower two feet of this formation in Borings L-6 and L-7. Plasticity for this stratum was medium with plasticity index values ranging from 17 to 21. Liquid limit values range from 43 to 45 percent and plastic limit values range from 24 percent to 26 percent. Stratum IIC soils were generally moist with occasional wet seams. Natural moisture contents ranged from 14 to 30 percent, and were from 0 to 2 percent above corresponding PL values.

Pocket penetrometer tests and laboratory unconfined compression tests, on relatively undisturbed samples, indicated shear strength values that varied erratically throughout the fill depth in Boring L-5 (easternmost boring). Shear strength values in Borings L-6 and L-7 were similar throughout the same depths of the fill stratum. There was a similar uniform decrease of shear strength values with depth in Borings L-6 and L-7 to a depth of approximately 12.5 feet. (See TEST BORING RECORDS L-6 and L-7).

Stratum IIC consists of very stiff to hard, reddish brown with gray, silty CLAY with gypsum fragments and gray silt-streaks. These soils were encountered in all borings, except Boring L-5, from 15.5 feet from existing surface to a depth of 20.5 feet below grade. One Standard Penetration Test N-value was 40 blows per foot (bpf) at a depth of 17 feet in Boring L-6A. Plasticity for this stratum was medium with a plasticity index value of 13, a LL value of 32 percent, and a PL value of 19 percent. One natural moisture content was 24 percent. Based on this natural moisture content and corresponding Atterberg Limit tests, the soil was very moist with a moisture content 5 percent above the corresponding PL value. Pocket penetrometer tests resulted in cohesion values ranging from 3,750 psf to an excess of 4,500 psf.
Stratum IVC consists of gray silty CLAYSTONE to reddish brown silty CLAYSTONE. This formation was encountered from a depth of 18.5 feet below existing surface to termination depth. Standard Penetration Test N-values resulted in refusal values ranging from 6 inches per 50 blows to 4.5 inches per 50 blows. One natural moisture content was 21 percent. All pocket penetrometer tests resulted in cohesion values in excess of 4,500 psf.

4.2 WATER LEVEL CONDITIONS

Water level observations were made in the boreholes during drilling operations and 24 hours after completion of drilling to investigate the short term ground water levels.

Ground water was identified during our subsurface exploration at depths of 7 feet and 5.5 feet in Borings L-1 and L-2A, respectively (24 hour readings). Ground water was encountered 1.5-feet to 1-foot above the top of the claystone formation in these borings. Borings L-3 and L-4 were dry at the time of drilling and 24 hours thereafter.

Water was identified during drilling at a depth of 24 feet below existing ground surface in Boring L-5. Boring L-6 was dry to termination depth during drilling operations and 24 hours thereafter. Ground water was not identified in Borings L-6A and L-7 during and immediately following drilling operations. Law personnel could not obtain 24 hour water level readings at L-5, L-6A, or L-7, due to caving soils in L-5 at 15.8 feet, and surficial cuttings that obstructing the boreholes at L-6A and L-7.

Fluctuations in rainfall, evaporation, construction activity, surface runoff, and other site specific factors could cause ground water conditions at the time of construction to vary from that observed during our field exploration.
5.4.3 Settlement

Predicted settlements for the drilled piers will be relatively small and are expected to be limited to the elastic compression of the founding claystone formation. The maximum total settlement of any drilled shaft under the anticipated sustained loading conditions is predicted to be less than 0.25 inch.

5.5 CONSTRUCTION CONSIDERATIONS

Once a foundation excavation is completed, the setting of reinforcing steel and placement of concrete should proceed expeditiously to reduce exposure of the bearing stratum and possible disturbance of the material. Should the bottom of an excavation become disturbed due to ponding of water or desiccation, the disturbed soils should be removed before concrete is placed.

Recommend that the geotechnical engineer, or their representative, observe the ongoing excavations immediately prior to placing concrete. The engineer should compare the soils exposed with those encountered in the soil test borings and document the results. Any significant differences should be brought to the attention of the Owner’s representatives along with appropriate recommendations. The foundation bearing area should be level or suitably benched. It should also be free of loose soil, ponded water, and debris prior to the inspection.

5.6 WASTEWATER PRETREATMENT BUILDING STRATIGRAPHY

We understand that two existing on-line 300,000 storage tank structures within the Wastewater Pretreatment (WWPT) Building are experiencing foundation distress. We further understand that these two tanks and the containment area are supported on shallow footings, which are currently bearing in fill soils consisting of soft to hard, reddish brown with gray, silty CLAY with gypsum fragments and gravel (Stratum IIC).
As discussed previously in this report, the soil stratigraphy encountered in the WWPT area generally consists of silty fill soils to a maximum depth of 22.5 feet underlain by silty clay soils which grade into claystone. Law personnel performed continuous sampling in Borings L-5, L-6, and L-7 and utilized Shelby tubes and on-site extruding techniques to better identify the extent of this fill stratum.

The properties of the soils, deemed significant in the evaluation of distress of the structures, are the following:

(a) the moist condition of the silty clay fill soils (Stratum II C) at the site;
(b) the medium shrink-swell potential of the silty clay matrix within the zone of major seasonal moisture change;
(c) the erratic variation in consistency of the fill soils encountered in Boring L-5;
(d) the similar uniform decrease in shear strength in Borings L-6 and L-7 to a minimum at approximately 13 feet from existing ground level;
(e) the presence of wet seams, organics, and organic odor in the fill soils of Boring L-6 and Boring L-5;
(f) the presence of ground water in Boring L-5 at a depth of 24.5 feet;
FIGURE 3
Boring Location Plan—Phase III
Expansion of Wastewater Treatment Facilities
Lone Mountain Facility
USPCI
Major County, OK
Law Engineering
#392-01406-01

Bore Location
No Scale
## Description of Material

**Surface EL:** 1423.48 ft. MSL

- **Loam** to soft, reddish brown, silty clay with gypsum fragments and gravel
- **Silt with some gray, silty clay with silt streaks**
- **Claystone**
- **Silty claystone**

**Boring terminated at 25 feet**

---

### Test Boring Record

**Boring Number:** L-6A

**Dates Drilled:**
- **Start:** October 1, 1993
- **Completion:** October 1, 1993

**Project Number:** 392-01406-01

**Project:** Expansion of WWT Facilities

---

### Sample / Test Data

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample</th>
<th>Test</th>
<th>Dry Density (pcf)</th>
<th>Fines</th>
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</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Cohesion (100 psi):**
  - **Penetration (in):**

---

**See key sheet for explanation of symbols and abbreviations used above**
**DESCRIPTION OF MATERIAL**

SURF. EL: 1423.82 ft. MSL

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DEPTH</th>
<th>ELEV.</th>
<th>SAMPLES / TESTS</th>
<th>Plastic Limit (%)</th>
<th>ML (%)</th>
<th>Liquid Limit (%)</th>
</tr>
</thead>
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<tr>
<td><strong>GRAVEL</strong></td>
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<td>0</td>
<td>1</td>
<td>3.0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Soft to hard, reddish brown, silty CLAY</td>
<td>5</td>
<td>1423.6</td>
<td>2</td>
<td>5.0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>wavy fragments and gravel</td>
<td>10</td>
<td>1418.6</td>
<td>3</td>
<td>7.0</td>
<td>4</td>
<td>99.0</td>
</tr>
<tr>
<td>Some gray at 4'-6'</td>
<td>15</td>
<td>1412.6</td>
<td>4</td>
<td>9.0</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Wet seams at 8'-10'</td>
<td></td>
<td></td>
<td>5</td>
<td>11.0</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Some paper or plastic debris</td>
<td></td>
<td></td>
<td>6</td>
<td>13.0</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Deg moist at 8'</td>
<td></td>
<td></td>
<td>7</td>
<td>15.0</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Wet seams and organic at 10'-12'</td>
<td></td>
<td></td>
<td>8</td>
<td>17.0</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Organic odor and 1&quot; to 2&quot; thick wet seam</td>
<td></td>
<td></td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stench, wet seams and organic</td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4'-2'-5'</td>
<td></td>
<td></td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bored with some gray, silty CLAY with</td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gray silty streaks</td>
<td></td>
<td></td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silty mud from 16'-18'</td>
<td></td>
<td></td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
- Arnold Casper, P.A., P.E.
- See key sheet for explanation of symbols and abbreviations used above.

**TEST/BORING RECORD**

**BORING NUMBER**: L-6
**DATES DRILLED**: Start: October 1, 1993
**PROJECT NUMBER**: 392-01406-01
**PROJECT**: Expansion of WWT Facilities
**PAGE 1 OF 1**
**DESCRIPTION OF MATERIAL**

SURF. EL: 1418.35 ft. MSL

**GRAVEL**
- Soft to hard, reddish brown with gray, silty with some gravel

**BROWN Silty CLAYSTONE**
- Some refusal at 23 feet
- "Boring terminated at 23 feet"

**TEST BORING RECORD**

<table>
<thead>
<tr>
<th>BORING NUMBER</th>
<th>L-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATES DRILLED</td>
<td>Start: October 1, 1993</td>
</tr>
<tr>
<td></td>
<td>Complete: October 1, 1993</td>
</tr>
<tr>
<td>PROJECT NUMBER</td>
<td>392-01406-01</td>
</tr>
<tr>
<td>PROJECT</td>
<td>Expansion of WWT Facilities</td>
</tr>
</tbody>
</table>

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE
APPENDIX G.

FOUNDATION DESIGN ANALYSIS
APPENDIX G.

FOUNDATION DESIGN ANALYSIS
For
EVAPORATOR FEED TANK NO. 2 (EF2)

DIMENSIONS:

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>60.00-ft.</td>
</tr>
<tr>
<td>Height</td>
<td>16.90-ft.</td>
</tr>
<tr>
<td>Weight of Tank (Steel)</td>
<td>60,230.32-lb.</td>
</tr>
<tr>
<td>Weight of Max. Contents</td>
<td>3,876,340.00-lb.</td>
</tr>
<tr>
<td>Tank Shell Thickness</td>
<td>0.25-in.</td>
</tr>
<tr>
<td>Tank Bottom Thickness</td>
<td>0.240-in.</td>
</tr>
</tbody>
</table>

CONCRETE FOUNDATION DESIGN:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assumed Footing Depth</td>
<td>48-in.</td>
</tr>
<tr>
<td>Assumed Footing Width</td>
<td>12-in.</td>
</tr>
<tr>
<td>Assumed Effective Soil Pressure</td>
<td>1,500-psf</td>
</tr>
<tr>
<td>(Based on Law Engineering Investigation)</td>
<td></td>
</tr>
<tr>
<td>Maximum Shell Compression at Bottom of Shell</td>
<td>420.63-lb/ft. of circ.</td>
</tr>
<tr>
<td>(Based on Seismic Analysis)</td>
<td></td>
</tr>
<tr>
<td>Footing Width</td>
<td>1.00-ft.</td>
</tr>
<tr>
<td>Actual Applied Loading</td>
<td>420.63-psf</td>
</tr>
</tbody>
</table>

The actual applied loading is significantly less than the assumed effective soil pressure and therefore, the foundation should be stable.
APPENDIX H.

DUDICK, INC.
PROTECTO-COAT 200
DATA
Protecto-Coat 200

ELASTOMERIC, SPRAY APPLIED, ENVIRONMENTALLY SAFE, URETHANE COATING. 40-60 MILS (1-1 1/2 mm)

Protecto-Coat 200 is a high solids aromatic polyurethane coating with superior elongation. It is especially suited to bridge cracks in concrete.

RECOMMENDED APPLICATIONS

Secondary Containment Areas
Process Floors
Railroad Tank Cars
Underground Pipes & Tanks - Exterior
Thickener Tanks & Mechanisms
Spent Liquor Storage Tanks
Food Processing Pharmaceutical Breweries Structural Steel

CHEMICAL RESISTANCE

Protecto-Coat 200 provides a tough, durable surface and will withstand splash and spills of many inorganic and organic acids as well as alkalies. Also resistant to aliphatic solvents.

PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Protecto-Coat 200</th>
<th>40 Mil Bascoait</th>
<th>20 Mil Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength  (FSL ASTM C237)</td>
<td>2,400-2,600</td>
<td>2,200-2,500</td>
</tr>
<tr>
<td>Elongation*</td>
<td>225% to 250%</td>
<td>50 to 60%</td>
</tr>
<tr>
<td>Shore D Hardness</td>
<td>40-45</td>
<td>65-70</td>
</tr>
<tr>
<td>Abrasion Resistance</td>
<td>10 mg</td>
<td>32 mg</td>
</tr>
<tr>
<td>CS 17 wheels/1000 cycles x 1000 gm load weight loss</td>
<td>weight loss</td>
<td></td>
</tr>
<tr>
<td>Solids by Volume</td>
<td>80%</td>
<td>100%</td>
</tr>
</tbody>
</table>

*At 60% elongation the chemical resistant topcoat begins to surface crack while the basecoat will continue to elongate to 250% extension.

SPECIFICATIONS

Coating shall be 40-60 mils thick, 80-100% solids aromatic urethane resin, consisting of 2 basecoats and a topcoat of 20 mils each, manufactured by Dudick, Inc. Materials shall be brush-, roller- or spray-applied in accordance with manufacturer's recommended practices.

THE PROTECTO-COAT 200 SYSTEM

The Protecto-Coat 200 system uses a moisture tolerant primer and two or three coats of elastomeric thermosetting urethane resins to protect concrete and steel.

Primer 67 is designed to prevent abrasive-blasted steel from developing rust bloom prior to the application of a Protecto-Coat System. For maximum performance, all steel surfaces should be primed, but primer may not be needed for mild, non-immersion service. Concrete, however, must always be primed to aid in the "wetting out" required for good bonding.

Protecto-Coat 200 is applied in three coats by brush, roller or spray. The elastomeric basecoat is applied in two 25 mil applications to achieve a nominal 40 mils DFT. The chemical resistant topcoat is applied in a single 20 mil application. Total thickness shall be a nominal 60 mils.
ESTIMATING QUANTITIES AND ORDER BILL OF MATERIAL

<table>
<thead>
<tr>
<th>SQUARE FEET PER GALLON</th>
<th>CONCRETE STEEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primer 67</td>
<td>150-200 250-300</td>
</tr>
<tr>
<td>Protecto-Coat 200</td>
<td>2 Base Coats</td>
</tr>
<tr>
<td>Actual</td>
<td>Actual</td>
</tr>
<tr>
<td>35-40 mil DFT</td>
<td>25 25</td>
</tr>
<tr>
<td>Top Coat</td>
<td>60 60</td>
</tr>
<tr>
<td>15-20 mil DFT</td>
<td>S-10 Solvent</td>
</tr>
<tr>
<td>500 500</td>
<td></td>
</tr>
</tbody>
</table>

Quantities shown are for estimating purposes only. Actual field usage may vary.

APPLICATION INSTRUCTIONS

SURFACE PREPARATION

**Metal:** For immersion service, abrasive blast to a white metal finish and a 2-4 mil thickness profile according to SSPC 5 or NACE No. 1. For fume or splash service, abrasive blast to a near-white metal finish according to SSPC 10 or NACE No. 2. For atmospheric service, Commercial SSPC 6 or NACE No. 3.

**Concrete:** Concrete must be abrasively blasted or etched with muratic acid (solution of 1 part 20% De ICl and 1 part water) to remove surface laitance and other contaminants. Concrete must be free of curing compounds and form release agents. Surface texture should be similar to 40-60 grit sandpaper. The prepared surface should have a tensile strength of between 250 and 300 PSI per ASTM D4541.

Additional surface preparation will be required if a 40-60 grit texture is not achieved and the surface laitance not completely removed after a single application of acid or with the first mechanical preparation procedure.

If, after abrasive blasting, honeycombs/voids appear on the concrete, these have to be filled with a suitable material. Contact a Dudick representative for this information.

Recommended application temperatures should be between 40°F and 90°F substrate temperature. Do not apply Protecto-Coat 200 over concrete exposed to direct sunlight during the warming trend of the concrete as measured by surface temperature. To do so may lead to blistering, pinholes, or wrinkling in the coating due to outgassing of air in the concrete and high substrate temperatures. Wait for a definite downturn or cooling trend within the concrete as again measured by surface temperature. If this is not possible consult a Dudick representative for alternatives such as double priming.

**PRIMING**

**Metal:** For maximum performance, prime all steel surfaces with Primer 67, mixed with an appropriate amount of hardener to 3-4 mils. For mild non-immersion service, priming of steel may be omitted.

**Concrete:** Concrete must be primed to aid in the “wetting out” required for good bonding. Mix Component A with Component B in the premeasured units for 2-3 minutes and apply by brush, roller, or spray. We recommend the basecoat be applied over slightly tacky or tack-free primer. Do not allow the primer to puddle.

**Protecto-Coat 200 Mix Ratios**

- **Protecto-Coat 200 Basecoat**
  - Component B* 4 Gal.

*Premeasured quantities by weight

- **Protecto-Coat 200 Topcoat**
  - Protecto-Coat 200 Top Coat Comp. A* 1 Gal.
  - Component B* 54 fl. oz.

*Premeasured quantities by weight

**BASECOAT**

Add appropriate amount of hardener for each gallon of Protecto-Coat Liquid and mix thoroughly until uniform color is achieved. Apply a 25 mil wet (20 mil DFT) basecoat using spray, brush or roller. Allow basecoat application to cure to at least a “firm” or slightly “tacky” feel before applying the second 25 mil wet (20 mil DFT) basecoat. Brush or roller may require several coats to achieve desired thickness.

---

**Protecto-Coat 200**

Elastomeric, Spray Applied, Environmentally Safe, Urethane Coating (1.1 mm)
Horizontal surfaces may be basecoated in one application by applying 50 mils wet (40 mils DFT) in a single coat.

**TOPCOAT**
Add appropriate amount of hardener for each gallon of Protecto-Coat Liquid and mix thoroughly until a uniform color is achieved. Apply a 20-mil-thick topcoat using spray, brush or roller.

** Cure Cycle for Protecto-Coat 200**

<table>
<thead>
<tr>
<th>TEMPERATURE</th>
<th>RECOAT TIME</th>
<th>CURE TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>50°F</td>
<td>48 Hrs.</td>
<td>96 Hrs.</td>
</tr>
<tr>
<td>70°F</td>
<td>24 Hrs.</td>
<td>48 Hrs.</td>
</tr>
<tr>
<td>90°F</td>
<td>16 Hrs.</td>
<td>36 Hrs.</td>
</tr>
</tbody>
</table>

If these recoat times are exceeded, consult a Dudick representative; sanding or abrasive blasting may be required before the next coat. Recoat times are dramatically reduced when the coating is exposed to direct sunlight.

**Single Component Airless Spray Equipment** — Graco King 45-to-1 spray pump or equivalent. Use Graco Golden Mastic Gun or Graco No. 207945 Gun with airless adapter equipped with a Reverse-A-Clean tip and a tip size between .035-.041. Spray hose should be 1/2" or 3/8" ID. Available inlet pressure must be a minimum of 100 psi.

Brush or roller application may require additional coats to meet specified dry film thickness.

Pot life of the opened and mixed Protecto-Coat 200 will depend on the temperature at the work site. To prevent material waste and avoid damage to equipment, do not open and mix more material than can be used according to the following table:

<table>
<thead>
<tr>
<th>TEMPERATURE</th>
<th>POT LIFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>50°F</td>
<td>120 Min.</td>
</tr>
<tr>
<td>75°F</td>
<td>60 Min.</td>
</tr>
<tr>
<td>90°F</td>
<td>45 Min.</td>
</tr>
</tbody>
</table>

Do not attempt to store mixed material. Residual material should be properly disposed of at the end of each work period.

Where immersion service is required, spark test the coating with a 5,000 to 7,000 volt AC spark tester. Mark and repair all pinholes. Use Protecto-Coat liquid mixed with the appropriate amount of hardener. Retest only the repairs.

**CLEANING**

Use S-10 Solvent to clean tools and equipment.

**SHIPPING**

Protecto-Coat 200 Topcoat A and B and Protecto-Coat 200 Basecoat A are classified as plastic liquids and are non-regulated.

Protecto-Coat 200 Basecoat B is combustible. Primer 67 Component B is corrosive and carries a black and white warning label. Primer 67 Component A is classified as a plastic liquid and is nonregulated, while S-10 Cleaning Solvent is red label liquid with a flash point of 52°F (PMCC).

**STORAGE**

**Warning:** All Dudick products classified by DOT labels as either white, yellow or red labels must not be mixed or stored together as an explosive reaction may occur.

When stored in a cool and dry location, Protecto-Coat 200 ingredients have a one-year shelf life. Exposure to excessive heat may cause premature gelling and reduce working time.

**SAFETY**

M.S.D.S. - Sheets must always be read before using products. Protecto-Coat Systems are intended for application by experienced, professional personnel. Dudick Inc. can supply Protecto-Coat systems supervision to help determine that the surface has been properly prepared, the ingredients correctly mixed, and the materials properly and safely applied.
If Proteco-Coat materials are to be applied by your own personnel or by a third-party contractor, please be sure that they are aware of the following safety precautions:

- Exposure to resins and hardeners may cause severe dermatitis reactions in some people. Cleanliness of the skin and clothing is critical and must be of paramount concern.

- Safety glasses, gloves, and suitable protective clothing must be worn at all times during application.

- Suitable respirators should be used.

- If contact with hardeners occurs, remove any clothing involved and wash the skin with large amounts of water. Discard the clothing. Do not attempt to wash and reuse it. Proteco-Coat liquid may be washed off with 8-10 Cleaning Solvent, MEK liquid, or lacquer thinner.

- Flumes are flammable and heavier than air. Proper ventilation should be maintained to minimize breathing of concentrated fumes.

- If a rash or dermatitis occurs, remove the individual from the work area and seek a physician’s care for dermatitis.

- Keep open flames and sparks away from the area where toppings are being mixed and applied.

- In case of eye contact, wash with water for at least 15 minutes and consult a physician. If swallowed, do not induce vomiting; call a physician immediately.

Note:

Dudick Inc. ("Dudick") warrants all goods of its manufacture to be as represented in its catalogs and that the application of its products by its employees or sub-contractors shall be performed in a workmanlike manner. Dudick’s obligation under this warranty shall be the repair and replacement of any applications which its examination shall disclose to be defective. Dudick makes no warranty concerning the suitability of its product for application to any surface, it being understood that the goods have been selected and the application ordered by the purchaser. DUDICK INC. MAKES NO WARRANTY, EXPRESS OR IMPLIED, THAT THE GOODS SHALL BE MERCHANTABILITY OR THAT THE GOODS ARE FIT FOR ANY PARTICULAR PURPOSE. THE WARRANTY OF REPAIR OR REPLACEMENT SET FORTH HEREIN IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES ARISING BY LAW OR OTHERWISE; AND DUDICK INC. SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DOWN TIME, DAMAGES TO PROPERTY OF THE PURCHASER OR OTHER PERSONS, OR DAMAGES FOR WHICH THE PURCHASER MAY BE LIABLE TO OTHER PERSONS, WHETHER OR NOT OCCASIONED BY DUDICK’S NEGLIGENCE. This warranty shall not be extended, altered or varied except by written instrument signed by Dudick and Purchaser.
APPENDIX 1.

SECONDARY
CONTAINMENT
CALCULATIONS
APPENDIX I.

SECONDARY CONTAINMENT CALCULATIONS
For
EVAPORATOR FEED TANK NO. 2 (EF2)

DIMENSIONS:

EF Tank Diameter: 60.00-ft.
PCL Tank Diameter: 12.00-ft.
Secondary Containment Height - Hsc: 5.50
Secondary Containment Surface Area - Asc: 14,589.00-sf
Gross Volume of Secondary Containment: 80,239.50-cf

DISPLACEMENT VOLUMES:

EF Tank Base \( \pi D^2/4 \times Hsc \): 15,551.42-cf
PCL Tank Base \( \pi D^2/4 \times Hsc \): 622.06-cf

Note: Displacement volumes include only one of the EF tanks. It is assumed that a failed tank would not displace available secondary containment.

Displacement Volume: 16,173.47-cf

RAINFALL VOLUMES:

Depth of Rainfall: 6.150-in.
Impacted Area: 8,934.00-sf
Rainfall Volume: 4,578.68-cf

CONTAINMENT CAPACITY AVAILABLE:

CCA = Gross Volume - Displacement Volume - Rainfall Volume

CCA = 59,487-cf

Volume of Largest Tank (EF1) = 47,785.26-cf

Excess Containment Volume = 11,702-cf

Safety Factor = 1.24