# DOD Standard Design AW 78-24-27

## Aboveground Vertical Steel Fuel Tanks with Fixed Roofs

April 2015

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**Aboveground Vertical Steel Fuel Tanks with Fixed Roofs**

DOD Standard Design AW 78-24-27

Naval Facilities Engineering Command - Atlantic

Omaha District

US Army Corps of Engineers

As noted [57]

**Submitted By:**

**Date:** April 2015

**A/E Info:**

**Title Sheet**

**WVB**

**MSO**

**MHK**

**INDEX OF DRAWINGS**

**Unclassified//For Official Use Only**
GENERAL DESIGN NOTES

A. APPLICABILITY

1. THIS STANDARD APPLIES TO VERTICAL STEEL FUEL TANKS IN JET A, JP-5 OR JP-8 SERVICE, AS USED WITH OTHER PRODUCTS.

2. THIS STANDARD APPLIES TO TANKS WITH FLOATING PANS. FLOATING PANS ARE REQUIRED FOR JET A AND JP-5 SERVICE ONLY WHEN REQUIRED BY UFC 3-460-01 DESIGN: PETROLEUM FUEL FACILITIES.

3. TANK FOUNDATION DESIGN SHALL BE IN ACCORDANCE WITH API STANDARD 650, EXCEPT THAT THE MINIMUM ALLOWANCE OF 1/16" IS INCLUDED IN THESE THICKNESSES. PROVIDE CORROSION ALLOWANCE OF 1/16" FOR ALL SHELL AND COMPONENTS.

4. WHEN REQUESTED BY THE FACILITY AND APPROVED BY SERVICE HEADQUARTERS, PROVIDE A SIDESTREAM FILTRATION SYSTEM WITH A 100 GPM FILTER/SEPARATOR AND A 100 GPM PUMP IN ADDITION TO THE WATER DRAW-OFF SYSTEM. INCLUDE INSTRUCTIONS TO THE OPERATOR TO TURN OFF THE WATER DRAW-OFF SYSTEM AND SIDESTREAM FILTRATION SYSTEM PUMPS WHEN NOT IN USE.

5. PROVIDE OVERFILL PROTECTION WITH A HYDRAULICALLY OPERATED DIAPHRAGM CONTROL VALVE SHUTDOWN ON PIPELINE SURGING, ESPECIALLY TANKS CONNECTED TO OFF-BASE PIPELINES OR MARINE OFFLOAD SYSTEMS. SEE UFC 3-460-01 FOR GUIDANCE.

B. NOTES ON USE OF THIS STANDARD

1. ALL NOTES ON SHEETS G.03 AND G.04 ARE DESIGNER NOTES.

2. THE ENGINEER OF RECORD MIGHT INTERPRET THIS DESIGN AS MEANING "HOST NATION, IN ACCORDANCE WITH THE FINAL GOVERNING DOCUMENTS IN ORDER TO CONSTRUCT THE TANK IN ACCORDANCE WITH API STANDARD 650, UFC 3-460-01 DESIGN: PETROLEUM FUEL FACILITIES, AND ASSESS="

3. REQUIRE SLIP-RESISTANT COATING ON THE ROOF AT THE SAMPLING GAUGE WELL, THE ROOF MANHOLE, AND THE TANK BOTTOM UNDERSIDE (INCLUDING THE SUMP). PROVIDE SLIP-RESISTANT COATING FOR ALL SHELL AND COMPONENTS, EXCEPT FOR PIPING 2.5" AND SMALLER.

4. PROVIDE HIGH-PRESSURE AND LOW-PRESSURE DRAINS ON PIPING IN ACCORDANCE WITH UFC 3-460-01.

5. COAT ALL CARBON STEEL SURFACES IN ACCORDANCE WITH UFC 3-460-01 AND THE FOLLOWING UFCS SPECIFICATION SECTIONS: COAT EXTERNAL, CARBON STEEL SURFACES IN ACCORDANCE WITH UFCS 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT FOR TANKS WITHOUT FLOATING PANS. COAT EXTERNAL, CARBON STEEL SURFACES OF ALL OTHER TANKS IN ACCORDANCE WITH UFCS SECTION 60 13.17.

6. PROVIDE AND INSTALL MATERIAL, IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS PROVIDED IN THE SPECIFICATION FOR ALL SHEET METAL.

7. ARRANGE HLV FLOAT PILOT CHAMBER, LLS CHAMBER, HLS CHAMBER, AND ASSOCIATED SHELL CONNECTIONS TO BE ALLOWED EXCEPT WHERE WELDED OR FLANGED CONNECTIONS TO TANKS WITHOUT FLOATING PANS.

C. DESIGN PARAMETERS/TYPICAL DESIGN

1. THE FOLLOWING DESIGN PARAMETERS/ZIPSR shall BE CONSIDERED BY THE ENGINEER OF RECORD AND SHALL BE INDICATED ON THE SHEET OF THE TANK DESIGNS WITHOUT FLOATING PANS. CONSIDER THE BOUNDARIES MENTIONED IN THE NOTES TITLED "DESIGN CONSIDERATIONS FOR FLOATING PANS ON SHEET 3-460-01 WINDOWS."

2. THE GOVERNMENT SHALL DETERMINE PRIOR TO DESIGN IF THE FACILITY HAS, OR WILL HAVE, A TANK BOTTOM UNDERGROUND IN ADDITION TO THE TANK BOTTOM UNDERGROUND EXCEPT AS INDICATED. PIPING AND FITTINGS OF 2" AND LARGER SHALL BE SUBMETERED PIPING AND FITTINGS OF 1" AND SMALLER MAY BE BUTTERFOILED ON BOXEADS. LIDDED CONNECTIONS SHALL NOT BE ALLOWED EXCEPT WHERE WELDED OR PLANGED CONNECTIONS TO TANKS WITHOUT FLOATING PANS.

3. THE ENGINEER OF RECORD MIGHT INTERPRET THIS DESIGN AS MEANING "HOST NATION, IN ACCORDANCE WITH THE FINAL GOVERNING DOCUMENTS IN ORDER TO CONSTRUCT THE TANK IN ACCORDANCE WITH API STANDARD 650, UFC 3-460-01 DESIGN: PETROLEUM FUEL FACILITIES, AND ASSESS="

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5. PROVIDE AND INSTALL MATERIAL, IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS PROVIDED IN THE SPECIFICATION FOR ALL SHEET METAL.

D. SPECIFICATIONS

1. SPECIFICATIONS TO BE USED AS A PART OF THIS STANDARD:

   A. UFGS 33 52 43.11 AVIATION FUEL MECHANICAL EQUIPMENT

   B. UFGS 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PIPELINES

   C. UFGS 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT

   D. UFGS 01 33 00 SUBMITTAL PROCEDURES

2. SPECIFICATIONS TO BE USED AS A PART OF THIS STANDARD:

   A. UFGS 33 52 43.11 AVIATION FUEL MECHANICAL EQUIPMENT

   B. UFGS 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PIPELINES

   C. UFGS 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT

   D. UFGS 01 33 00 SUBMITTAL PROCEDURES

3. REQUIRE SLIP-RESISTANT COATING ON THE ROOF AT THE SAMPLING GAUGE WELL, THE ROOF MANHOLE, AND THE TANK BOTTOM UNDERSIDE (INCLUDING THE SUMP). PROVIDE SLIP-RESISTANT COATING FOR ALL SHELL AND COMPONENTS, EXCEPT FOR PIPING 2.5" AND SMALLER.

4. PROVIDE HIGH-PRESSURE AND LOW-PRESSURE DRAINS ON PIPING IN ACCORDANCE WITH UFC 3-460-01.

5. COAT ALL CARBON STEEL SURFACES IN ACCORDANCE WITH UFC 3-460-01 AND THE FOLLOWING UFCS SPECIFICATION SECTIONS: COAT EXTERNAL, CARBON STEEL SURFACES IN ACCORDANCE WITH UFCS 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT FOR TANKS WITHOUT FLOATING PANS. COAT EXTERNAL, CARBON STEEL SURFACES OF ALL OTHER TANKS IN ACCORDANCE WITH UFCS SECTION 60 13.17.

6. PROVIDE AND INSTALL MATERIAL, IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS PROVIDED IN THE SPECIFICATION FOR ALL SHEET METAL.

7. ARRANGE HLV FLOAT PILOT CHAMBER, LLS CHAMBER, HLS CHAMBER, AND ASSOCIATED SHELL CONNECTIONS TO BE ALLOWED EXCEPT WHERE WELDED OR FLANGED CONNECTIONS TO TANKS WITHOUT FLOATING PANS.

8. THE GOVERNMENT SHALL DETERMINE PRIOR TO DESIGN IF THE FACILITY HAS, OR WILL HAVE, A TANK BOTTOM UNDERGROUND IN ADDITION TO THE TANK BOTTOM UNDERGROUND EXCEPT AS INDICATED. PIPING AND FITTINGS OF 2" AND LARGER SHALL BE SUBMETERED PIPING AND FITTINGS OF 1" AND SMALLER MAY BE BUTTERFOILED ON BOXEADS. LIDDED CONNECTIONS SHALL NOT BE ALLOWED EXCEPT WHERE WELDED OR PLANGED CONNECTIONS TO TANKS WITHOUT FLOATING PANS.
F. DESIGN CONSIDERATIONS FOR TANKS WITHOUT FLOATING PANS:

1. The diameter and shell height of a tank without a floating pan shall be the same as that for the same nominal size tank with a floating pan.

2. Tank without floating pans are not required to have roof inspection hatches, roof perimeter vents, combination roof perimeter vent/inspector hatches, overflows, pan installation hatches, upper shell manholes, lower stairway landings, or manhole covers with filler drums.

3. Consult applicable fire codes and standards to address emergency venting. Emergency venting for tanks without floating pans shall be provided by opening(s) with/without emergency venting devices, although tank designs greater than 90 in diameter may meet the emergency venting requirements by use of a frameless roof-to-shell attachment as allowed by API standards.

4. Tanks without floating pans may be required to have additional fire protection such as fixed or semi-fixed fire systems.

5. The internal ladder in a tank without a floating pan shall be made of carbon steel, flat bar and round rods and attached to the shell by bolting.

6. The above mentioned internal ladder is not attached to the inside of a roof opening on a non-floating pan tank. The OSHA required clearance behind the ladder rungs is not limited by the neck of the opening; therefore, a standard 36-inch round roof manhole may be provided to access the ladder from the roof rather than the rectangular hatch required on tanks with floating pans.

7. Tanks without floating pans do not require upper shell manholes for accessing the top of the pan. Therefore, lower platform(s) are not required. The circumferential length of the stairway will differ from that for a tank with a floating pan and interference with other tank appurtenances will need to be considered.

8. The LLL shall be located so that it actuates at least 1 minute before the level of the fuel reaches loss of suction when issuing fuel. Loss of suction is typically considered to be 1/8 above the top of the suction elbow inside the tank, including the entrance pipe to the suction elbow. Therefore, the LLL shall be located 1/8 above the top of the suction elbow inside the tank, including the entrance pipe to the suction elbow. The LLL shall be located 1/8 above the top of the suction elbow inside the tank, including the entrance pipe to the suction elbow.

9. The LLLs, the HLS, the HLV, and the HHLS setpoint elevations similarly to tanks with floating pans. This standard is intended primarily for tanks with floating pans but may be used to design tanks without floating pans. Previous Notes apply except for those dealing specifically with floating pans. Some of the differences in design that shall be considered are as follows:

   a. The tank design will vary with the inlet and outlet flowrates and nozzle sizes, the tank height (field height restrictions, etc.), the presence or non-presence of a floating pan and other factors. The floating pan elevation, the level switches, and the HLV setpoint elevations in particular depend on these. These values should be calculated for tank sizes, heights, configurations, and nozzle combinations not shown on Table C.01.

b. The following is the philosophy used to lay out the tanks in this standard. It can be applied to tank sizes and configurations not included herein:

   a. Choose the normal tank size. For the most common tank sizes, the table on draining oil will show the shell height (as a product of shell size) and, consequently, for other sizes, use the general proportions shown herein and extrapolate or interpolate as required.

   b. Floating pan low LO position is based on normal size level. Switch setback elevations are based on the flat top and low LO position and are based on the calculated 98% fuel level, the high level switch, and the high-low level switch. These values should be calculated for tank sizes, heights, configurations, and nozzle combinations not shown on Table C.01.

   c. Using the design inlet flowrate, calculate the number of minutes between actuation of the high level switch and the HLV, then between the HLV and the high-high level switch, and then between the high-high level switch and the low-low level point. It is recommended that the time between these events be between 5 and 12 minutes apart.

   d. The following design parameters/sets are a partial list of other items that will also need to be taken into account at each site when designing tanks for a specific project:

      i. Level alarm setpoints, seismic design, air quality
      ii. Flight line clearances (tank height)
      iii. Orientation with aircraft (wind, etc.)
      iv. Existing structures

G. FLOATING PAN RECOMMENDATIONS:

1. The tank design will vary with the inlet and outlet flowrates and nozzle sizes, the tank height (field height restrictions, etc.), the presence or non-presence of a floating pan and other factors. The floating pan elevation, the level switches, and the HLV setpoint elevations in particular depend on these. These values should be calculated for tank sizes, heights, configurations, and nozzle combinations not shown on Table C.01.
NOTES:
1. SEE DESIGNER NOTES, SEQUENCE OF OPERATION, AND LEVEL SET POINT TABLE FOR LEVEL SWITCHES AND HLS & HLV SET POINT ELEVATIONS.
2. PROVIDE A WATER DRAIN-OFF SYSTEM. AS AN OPTION, PROVIDE, IN ADDITION, A SIDESTREAM FILTRATION SYSTEM. SEE NOTE 2.
3. PROVIDE LIMIT SWITCHES ON THE TANK FILL, LINC OBS, TANK ISSUE LINE DBB, 4" LOW Suction LINE DBB, AND HLS. AS AN OPTION, PROVIDE DBB LISTED HERE WITH MOTOR OPERATIONS WITH LIMIT SWITCHES ONLY WHEN APPROVED BY SERVICE HEADQUARTERS. HLS/HLV RETURN ITS LIMIT SWITCH IN THIS CASE.
4. HLS AND HLS CHAMBER AND HLS CONTROL FLOAT CHAMBER SHALL SHARE COMMON TANK NOZZLES AS INDICATED ON DETAILS; THEY ARE SHOWN SEPARATE TO SHOW FOR CLARITY. MOUNT TIPPING AND TUBING TO HLS CHAMBER AND HLS CONTROL FLOAT CHAMBER ALONG THE SIDE OF THE RINGWALL PRIOR TO RISING UP THE TANK SHELL.
5. HEAT TRACE IN COLD CLIMATES ONLY.
6. IF SIDESTREAM FILTRATION SYSTEM IS NOT PROVIDED, PROVIDE OUTLET INDICATED (FROM SIDESTREAM FILTRATION SYSTEM, SEE NOTE E15, SHEET G.03).
7. OPERATION FULL FILL LEVEL SHALL BE DETERMINED BY THE USER AFTER THE TANK IS IN SERVICE.
1. SITE PLAN SHOWN IS A TYPICAL 20K BBL TANK WITHOUT A MOUNDED TANK FOUNDATION. DIMENSIONS SHOWN IN TABLE 1 ARE FOR PLANNING PURPOSES ONLY AND ARE INTENDED TO INDICATE THE APPROXIMATE AREA REQUIRED FOR SECONDARY CONTAMINATION.

2. FOR PLANNING PURPOSES, THE SECONDARY CONTAINMENT AREA SIZE SHOWN HERE IS BASED UPON 4 X 4 FOOT (MAXIMUM ALLOWABLE HEIGHT) TRANSPORTABLE DIKE BEARING A 1.5 FOOT OF FREEBOARD WITH A SLOPE OF 2 TO 1 TO 1. SEE UFC 3-449-07 FOR MORE DETAILS ON DRIE AND CONTAINMENT REQUIREMENTS.

3. GROUPS OF TANKS, WITH NO TANK LARGER THAN 10K BBL AND NOT EXCEEDING 15K BBL TOTAL ASSIGNED CAPACITY, MAY BE ENCLOSED IN A SINGLE DIRECTED CONTAINMENT ENCLOSURE. SURFACE SEEPAGE FROM DIRECTED CONTAINMENT ENCLOSURE CONTAINING TWO OR MORE TANKS BY INTERSECTING WALLS OR DIKE NO LESS THAN 18 IN HEIGHT TO PROVIDE SEPARATE DRAINAGE AREA FOR EACH TANK. SEE SHEET CD.03 FOR INTERMEDIATE WALL DETAIL.

4. UNSURFACED OR AGGREGATE SURFACED DIKES SHALL BE DRIED OFF GREATERS THAN 10 FT. CONCRETE SURFACED DIKES HAVE A PREFERRED SLOPE OF 2:1 TO 2:3. WITH AN ABSOLUTE MAXIMUM MAXIMUM 3:1 TO 1. WHEN SPACE IS RESTRICTED, A 2:1 SLOPE IS ACCEPTABLE. DRAINAGE SWALES BETWEEN DIKES REQUIRE A MINIMUM OF 12" OF FREEBOARD. VERTICAL CONCRETE DIKE WALLS ARE AN ACCEPTABLE ALTERNATIVE. WHEN THERE IS NOT ENOUGH LAND AVAILABLE FOR TRANSPORTABLE RAMPS, SECONDARY CONTAINMENT AREA DESIGN SHALL COMPLY WITH UFC 348-01, 29 CFR 1915.158, NFPA 30 AND OTHER FEDERAL, STATE, COUNTY, AND LOCAL REGULATIONS.

5. A CONCRETE ACCESS RAMPS IS PERMITTED IN DRIE AREAS FOR 20K BBL OR GREATER AFA. ACCESS RAMPS WILL BE STRICTLY CONTROLLED WITH A LOCKABLE PORTABLE (IE. CHAIN GATE) AND A SIGN: "ACCESS IS RESTRICTED TO AUTHORIZED VEHICLES ONLY. VEHICLES MUST BE LIGHT-DUTY AND COATED IN BLACK. IN CLASS I, DIVISION 2, LOCATION 2. ACCESS IS RESTRICTED TO AUTHORIZED VEHICLES ONLY. VEHICLES MUST BE LIGHT-DUTY AND COATED IN BLACK. IN CLASS I, DIVISION 2, LOCATION 2. ACCESS IS RESTRICTED TO AUTHORIZED VEHICLES ONLY. VEHICLES MUST BE LIGHT-DUTY AND COATED IN BLACK. IN CLASS I, DIVISION 2, LOCATION 2. ACCESS IS RESTRICTED TO AUTHORIZED VEHICLES ONLY. VEHICLES MUST BE LIGHT-DUTY AND COATED IN BLACK. IN CLASS I, DIVISION 2, LOCATION 2.

6. SECONDARY CONTAINMENT SHALL BE PROVIDED BY A FUEL IMPERMEABLE LINER. THE LINER SHOULD BE A FLEXIBLE MEMBRANE LAYED NOT EXCEEDING 300 FT IN LENGTH. FIRE HYDRANTS MUST BE ACCESSIBLE TO FIRE DEPARTMENT PUMP VEHICLES. THE TOP OF THE DIKES. SEE UFGS SECTION 33 56 63 FUEL IMPERMEABLE LINER SYSTEM FOR MATERIALS.

7. THE DIKE CONSTRUCTION SHALL BE PER UFGS SECTION 32 11.2 SUSTAIN A PAVEMENT CONCRETE FOR DRAINAGE. THE CONCRETE SHALL BE REINFORCED WITH SYNTHETIC FIBERS. LOCATE CONTROL JOINTS NO GREATER THAN 15 FTD AND THE JOINT LINES ARE REINFORCED WITH FUEL RESISTANT JOINT SEALANT (NON-SAG ON THE SLOPES). SEE SHEET CD.04 FOR A TYPICAL JOINT SEALANT. LOCATE MINIMUM 12" WIDE AND 12" DEEP CONCRETE WORKING SURFACE AROUND THE PERIMETER OF THE TANK FOUNDATION NOT LESS THAN 10'-0" IN WIDTH. THIS PAVED AREA PROVIDES ADDED PROTECTION FOR THE UNDERLYING GEOMEMBRANE. THIS DESIGN FEATURE MAY BE MODIFIED WITH THE APPROVAL OF SERVICE HEADQUARTERS.

8. SLOPE DIKE BASIN SURFACES A MINIMUM OF 1% FOR DRAINAGE. DRAINAGE SWALES SHOULD BE SLOPED NO FLATTER THAN 0.5%. SEE SHEET CD.09 FOR INLET DETAILS.


10. PROVIDE AN ADDITIONAL 18" OF FREEBOARD FOR DRAINAGE PURPOSES. THE FREEBOARD PROVIDES ADDITIONAL PROTECTION AGAINST THE UNDERLYING GEOMEMBRANE. THIS DESIGN FEATURE MAY BE MODIFIED WITH THE APPROVAL OF SERVICE HEADQUARTERS.

11. DO NOT USE BURIED CONTAINMENT DRAIN VALVES IN CLIMATES WITH LOWEST ONE-DAY MEAN TEMPERATURE BELOW -15°F PER API STANDARD 650 FIGURE 4.2. PROVIDE MEANS TO CONTROL DRAINAGE THAT WILL NOT NORMALLY REMAIN FROZEN AFTER THAW OF THE UNDERLYING GEOMEMBRANE. THIS DESIGN FEATURE MAY BE MODIFIED WITH THE APPROVAL OF SERVICE HEADQUARTERS.

12. PROVIDE FIRE HYDRANTS TO PROTECT POL STORAGE FACILITIES IN ACCORDANCE WITH UFC 3-460-01 & 3-600-01, INCLUDING A MINIMUM OF TWO HYDRANTS SPACED A MAXIMUM OF 300 FT APART. LOCATE HYDRANTS SUCH THAT ASTs CAN BE REACHED BY HOSE LAYS NOT EXCEEDING 300 FT IN LENGTH. FIRE HYDRANTS MUST BE ACCESSIBLE TO FIRE DEPARTMENT PUMPER VEHICLES.

13. FOR EXPOSED GEOMEMBRANES, SKID-RESISTANT WALKWAYS SHOULD BE PROVIDED AT EXPECTED FOOT TRAFFIC PATHS, INCLUDING THE TOP OF THE DIKE. SEE UFGS SECTION 33 56 63 FUEL IMPERMEABLE LINER SYSTEM FOR MATERIALS.

**TABLE 1**

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<th>NOMINAL DIA (FT)</th>
<th>NOMINAL SHELL THICKNESS (IN)</th>
<th>NOMINAL WALL THICKNESS (IN)</th>
<th>TOTAL DIKE VOLUME (BBL)</th>
<th>TOTAL STORAGE VOLUME (BBL)</th>
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**NOTES:**

- **TYPICAL CONCRETE CONTAINMENT DIKE SITE PLAN**
- **SCALE: 1"=20'-0"**
- **GENERAL TANK INFORMATION**
- **SECONDARY CONTAINMENT DIMENSIONS (F.P.D.309265)**
- **TABLE 1**
- **DESIGNER NOTES:**
- **TABLE:**
TYPICAL VERTICAL CONTAINMENT WALL SITE PLAN

**TABLE 1**

<table>
<thead>
<tr>
<th>NOMINAL VOLUME (K BBL)</th>
<th>NOMINAL VOLUME (FT³)</th>
<th>SHELL VOLUME (K BBL)</th>
<th>SHELL VOLUME (FT³)</th>
<th>VERTICAL CONTAINMENT WALL (FT)</th>
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<td>620</td>
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**DESIGNER NOTES:**
1. SITE PLAN SHOWN IS A TYPICAL 20K BBL TANK WITHOUT A MOUNDED TANK FOUNDATION. DIMENSIONS SHOWN IN TABLE 1 ARE FOR PLANNING PURPOSES ONLY AND ARE INTENDED TO INDICATE THE APPROXIMATE AMOUNT OF AREA REQUIRED FOR SECONDARY CONTAINMENT.
2. FOR PLANNING PURPOSES, THE SECONDARY CONTAINMENT AREA SIZE SHOWN HERE IS BASED UPON A 4'-0" MAXIMUM ALLOWABLE HEIGHT VERTICAL WALL INCORPORATING A 1'-0" HEIGHT FREEBOARD WITH A WALL THICKNESS OF 1'-0". SEE FIG. 3-460-01 FOR DETAILED DRAIN AND CONTAINMENT REQUIREMENTS.
3. GROUPS OF TANKS, WITH NO TANK LARGER THAN 10K BBLs AND NOT EXCEEDING 10K BBLs IN AGGREGATE CAPACITY, MAY BE ENCLOSED IN A SINGLE FIXED CONTAINMENT ENCLOSURE. SUBDIVIDE EACH FIXED CONTAINMENT ENCLOSURE CONTAINING TWO OR MORE TANKS BY INTERMEDIATE WALLS NO LESS THAN 1'-0" IN HEIGHT TO PROVIDE A SEPARATE DRAINAGE AREA FOR EACH TANK. SEE SHEET CD-08 FOR INTERMEDIATE WALL DETAIL.
4. THE MAXIMUM ALLOWABLE WALL HEIGHT IS 4'-0". UTC-0401 REQUIRES A MINIMUM OF 1'-0" OF FREEBOARD. VERTICAL CONCRETE DIFE WALLS ARE AN ACCEPTABLE ALTERNATIVE WHEN THERE IS NOT ENOUGH LAND AVAILABLE FOR TRAPEZOIDAL BERM.
5. NO VEHICLE ACCESS IS PERMITTED WHEN VERTICAL DIFE WALLS ARE UTILIZED.
6. SECONDARY CONTAINMENT SHALL BE PROVIDED BY A FUEL IMPERMEABLE LINER. THE LINER SHOULD BE A FLEXIBLE MEMBRANE LINER OF A MINIMUM THICKNESS OF 1'-0". SEE FIG. 3-460-01 FOR A TYPICAL JOINT SEALANT USE.
7. CONCRETE DIKE SURFACING SHALL BE PER FIG. 4.2. PROVIDE MEANS TO CONTROL DRAINAGE THAT WILL NOT NORMALLY REMAIN FROZEN AFTER THAW OF THE UNDERLYING GEOMEMBRANE. THIS DESIGN FEATURE MAY BE MODIFIED WITH THE APPROVAL OF SERVICE HEADQUARTERS.
8. SLOPE DIKE BASIN SURFACES A MINIMUM OF 1% FOR DRAINAGE. DRAINAGE SWALES SHOULD BE SLOPED NO FLATTER THAN 0.5% TO THE DRAINAGE INLET. SEE SHEET CD.09 FOR INLET DETAILS.
9. PROVIDE STEEL STAIRWAYS OVER THE DIKE WALLS. NO LESS THAN TWO DIKE STAIRWAYS SHALL BE PROVIDED OVER DIKE WALLS FOR EMERGENCY EGRESS. SEE DETAILS ON SHEET CD.07.
10. PROVIDE ISLANDS OVER THE DIKE WALLS. NO LESS THAN TWO ISLAND STAIRWAYS SHALL BE PROVIDED OVER ISLAND WALLS FOR EMERGENCY EGRESS. SEE SHEET CD.09 FOR ISLAND DETAILS.
11. PROVIDE A NORMALLY CLOSED, LOCKABLE ECCENTRIC PLUG VALVE TO CONTROL DRAINAGE AND MUST BE ACCESSIBLE TO THE DRAINAGE INLET. SEE SHEET CD.09 FOR INLET DETAILS.
12. PROVIDE FIRE HYDRANTS TO PROTECT POL STORAGE FACILITIES IN ACCORDANCE WITH UFC 540-01 & 5-69-01, INCLUDING A MINIMUM OF ONE CONTROLLED FIRE HYDRANT PLACED AT LEAST 500 FT FROM ANY TANK. FIRE HYDRANTS MUST BE ACCESSIBLE TO FIRE DEPARTMENT PUMPER VEHICLES.
13. FOR A TYPICAL PIPING LAYOUT PLAN SEE SHEET C.05.
14. FOR EXPOSED CONCRETE, FUEL-RESISTANT WALLS SHOULD BE PROVIDED AT EXPECTED FOOT TRAFFIC PATHS. SEE FIG. 3-460-01 FOR DETAILED DRAIN AND CONTAINMENT REQUIREMENTS.
1. Joint layout panels should be as close to square as possible with a maximum joint spacing of 10 feet.

2. Expansion joints shall be placed around the tank foundation; at the dike footers; on each side of the concrete stairway; at the area inlet; and at the quarter sections of the basin, as indicated.

3. Odd shaped panels shall be reinforced with WWF.

4. Spot elevations shall be provided at the locations indicated and at other applicable change of grade points.

5. The top of the tank foundation shall be one foot above the containment basin, as indicated.

6. Provide positive drainage away from the tank foundation perimeter.

7. Project specifications shall use UFGS 32 13 15.20 concrete pavement for containment dikes.

8. Provide positive drainage away from the tank foundation perimeter.

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DESIGNER NOTES:

1. LOCATION AND CONFIGURATION SHOWN FOR PIPING IS GENERAL AND IS NOT INTENDED TO LIMIT OR RESTRICT PIPING LOCATION, CONFIGURATION OR PIPE SUPPORT ARRANGEMENT.

2. PIPE SUPPORT TYPES SHOWN ARE TYPICAL, IN GENERAL, WITHIN CONTAINMENT AFTER THE FIRST SUPPORT WHICH IS AN ANCHOR SUPPORT, USE OF AN ADJUSTABLE PIPE SADDLE SUPPORT (SEE SHEET CD.11) OR FREE SUPPORT (SEE SHEETS CD.12 & CD.13) IS COMMON. ON THE PLAIN OF THE DICI, USE OF A GUIDED SUPPORT (SEE SHEETS CD.12 & CD.13) IS COMMON. ACTUAL PIPE LAYOUT, SITE CONDITIONS, RELATION OF PIPE STRESS ANALYSIS, AND HYDRAULIC DESIGN ANNOTATIONS SHALL DICTATE ACTUAL SUPPORT TYPES AND LOCATIONS.

3. PROVIDE BALL JOINTS. BALL JOINTS MAY BE USED IN EXTREME NORTHERN CLIMATES (E.G. ALASKA) PROVIDED SUITABLE SEAL MATERIALS FOR LOW TEMPERATURES ARE SPECIFIED. A PAIR OF BALL JOINTS SHOULD BE PLACED INTO THE PIPING RUN AND SHALL BE A MINIMUM OF 8' APART. PLACE A THIRD BALL JOINT INTO THE PIPING RUN SUCH THAT LINEAR MOVEMENT FROM THE PIPING WITH THE TWO BALL JOINTS SEPARATED BY 8' IS ABSORBED. THE THIRD BALL JOINT SHOULD BE MOUNTED IN PIPING RUNNING PERPENDICULAR TO THE TANK SHELL IN THE PLAIN OF THE DICI. THE TWO BALL JOINTS SEPARATED BY 8', BEL FLEXIBLE BALL JOINT DETAIL ON SHEET CD.11.

4. AT LOCATIONS EXPERIENCING FREEZING CONDITIONS, ALL DRAIN PIPING ON THE PROJECT SAVER TANK AND FILTER SEPARATOR, IF PROVIDED, SHALL BE HEAT TRACED WITH APPROPRIATE HAZARD RATED TAPES AND INSULATED.

5. LOCATE EXTERIOR PIPING SUPPORTS TO PROVIDE ADEQUATE PIPE FLEXIBILITY FOR TANK SETTLEMENT, SEISMIC DESIGN AND THERMAL EXPANSION. EXCEPT FOR THE FIRST PIPE SUPPORT OFF THE TANK SHELL, SPRING PIPE SUPPORTS MAY BE USED IN HIGH SEISMIC AREAS WHEN DIRECTED BY SERVICE HEADQUARTERS. SEE DETAIL ON SHEET CD.13.

6. ALL FUEL PIPING SHALL BE ABOVE GROUND. ONLY ISSUE PIPING IS ALLOWED TO RUN THROUGH EXISTING WALLS). FACILITY REQUIREMENTS FOR FORCE PROTECTION, VANDALISM, BLAST DAMAGE, FIRE PROTECTION, ETC. MAY REQUIRE UNDERGROUND PIPING.

7. PENETRATIONS THROUGH IN-TANK WELLS SHALL BE MADE THROUGH PIPE SLEEVES WITH BRICK IN COMPRESSION BELLS. SLEEVES SHALL BE PROVIDED WITH LEAK TESTING CAPABILITY. SEE SHEET CD.10.

8. PENETRATIONS THROUGH THE FML SHALL BE MADE WITH A NOZZLE MADE BY THE MANUFACTURER OF THE FML FOR THAT PURPOSE AND SEATED ON THE PENETRATION SLEEVE. SEE CD.10.

9. LOCATIONS SUBJECT TO ICE AND SNOW, ORIENT STAIRWAYS AND HIGH LEVEL PIPING TO RECEIVE WINTER SUN SO AS TO MINIMIZE ACCUMULATIONS. IF PIPING AT TANK SHELL IS NOT BAIL OFF A STAIRWAY PROVIDE ICE SHIELD OVER PRODUCT PIPING AND VALVES AT TANK SHELL. ENDS OF ICE SHIELDS HAVE SUITABLE CLEARANCES ABOVE VALVES TO ALLOW MAINTENANCE OF VALVES AND VALVE OPERATIONS OR PROVIDE MEANS TO MOVE SHIELDS OUT OF THE WAY AND PROVIDE CATEGORIES OVER OTHER VALVES AND EQUIPMENT.

10. WHEN THE TANK FOUNDATION IS ELEVATED, MAINTAIN ELAVATION OF PIPING IN A ZONE SO THAT PIPING IS SLIGHTLY CONTINUOUS TO THE TANK NOZZLES TO ALLOW FLOWING TO A major PIPING WHEN TANK FOUNDATION IS NOT ELEVATED USE SLEEVES WITH A BURLED LEAK DETECTION MONITORING WELL. MAINTAIN ELAVATION OF PIPING IN A ZONE SO THAT PIPING IS SLIGHTLY CONTINUOUS TO THE TANK NOZZLES AND PERSONNEL MAY STEP MORE EASILY OVER PIPING. WHEN THIS IS REQUIRED PIPING TO PENETRATE THE CONCRETE.). PIPING STANDARDS SHALL BE CONSTRUCTED PER NOTE 18.

11. PIPING DESIGN SHALL ADDRESS BEARINGS. THE FIRST PIPE SUPPORT OF THE TANK SHALL BE AN ANCHOR WITH THE CONCRETE FILL TIED TO THE REILL.

LEGEND:

ANCHOR SUPPORT = SEE CD.12 AND CD.13
SADDLE SUPPORT = SEE CD.11 AND CD.12
FLUID BALL JOINT = SEE CD.11
GUIDED SUPPORT = SEE CD.12 AND CD.13
FREE SUPPORT = SEE CD.12 AND CD.13

TYPICAL PIPING LAYOUT

SCALE: 1' = 10'-0"
GENERAL NOTES:

1. ALL CONCRETE SHALL BE REINFORCED WITH SYNTHETIC FIBER REINFORCEMENT. ADDITIONAL STEEL
   REINFORCEMENT SHALL BE PROVIDED, WHERE INDICATED ON THE JOINT LAYOUT PLAN. SEE SPECIFICATIONS SECTION
   32 13 15.20 CONCRETE PAVEMENT FOR CONTAINMENT DIKES FOR CONCRETE AND REINFORCEMENT REQUIREMENTS.

2. PROVIDE A GEOMEMBRANE BOOT FOR ALL CIRCULAR GEOMEMBRANE PENETRATIONS. ALL SMALL LINER
   PENETRATIONS SHALL BE CIRCULAR TO ACCOMMODATE A BOOT SEAL.

3. ALL JOINTS SHALL BE SEALED PER SPECIFICATIONS SECTION 32 01 19 FIELD MOLDED SEALANTS FOR SEALING
   JOINTS IN RIGID PAVEMENTS. SEE SHEET C.04 FOR THE JOINT LAYOUT PLAN.

4. A GEOTEXTILE SHALL BE INSTALLED BELOW AND ABOVE THE GEOMEMBRANE. SEE SPECIFICATION SECTION 33 56 63
   CONCRETE PAVEMENT FOR CONTAINMENT DIKES FOR CONCRETE AND REINFORCEMENT REQUIREMENTS.

5. THE SURFACE UNDERLYING THE GEOTEXTILE/GEOMEMBRANE SHALL BE SMOOTH AND FREE OF ROCKS LARGER
   THAN 5 INCH IN DIAMETER OR ANY OTHER MATERIAL WHICH COULD DAMAGE THE GEOMEMBRANE LINER.

6. GEOMEMBRANE ANCHORAGE / EMBEDMENT STRIP MATERIALS AND INSTALLATION SHALL BE AS RECOMMENDED BY
   THE MANUFACTURER OF THE GEOMEMBRANE.

DESIGNER NOTES:

1. THE GEOTEXTILE LAMINATIONS ARE PROVIDED TO PROTECT THE GEOMEMBRANE DURING AND AFTER CONSTRUCTION.
   THE BOTTOM GEOTEXTILE LAYER MAY BE OMITTED IF THE SUBGRADE SOIL IS KNOWN TO BE FREE OF ROCKS OR
   OTHER MATERIALS THAT COULD POTENTIALLY DAMAGE THE GEOMEMBRANE.
ABOVE GROUND VERTICAL STEEL FUEL TANKS WITH FIXED ROOFS

DOD STANDARD DESIGN AW 78-24-27

NAVAL FACILITIES ENGINEERING COMMAND - ATLANTIC
OMAHA DISTRICT
OF ENGINEERS

UNCLASSIFIED//FOR OFFICIAL USE ONLY

DRAWFORM REVISION: 10 MAY 2014

SUBMITTED BY: DATE: APRIL 2015

NOTE:
1. WELDED WIRE FABRIC SHALL BE OVERLAPPED FOR A DISTANCE EQUAL TO AT LEAST ONE SPACING OF THE WIRE IN THE FABRIC NEAR THE JOINT TO PREVENT SEPARATION DURING CONCRETE PLACEMENT.
2. JOINT SEALANT RECOMMENDED AS RECOMMENDED BY THE MANUFACTURER.
3. JOINT SEALANT TO PREVENT SEPARATION DURING CONCRETE PLACEMENT.
4. JOINT SEALANT RECOMMENDED AS RECOMMENDED BY THE MANUFACTURER.
GENERAL NOTES:
1. ALL CONCRETE SHALL BE REINFORCED WITH SYNTHETIC FIBER REINFORCEMENT. ADDITIONAL STEEL REINFORCEMENT SHALL BE PROVIDED, WHERE INDICATED, ON THE JOINT LAYOUT PLAN. SEE SPECIFICATIONS SECTION 32 13 19 25 CONCRETE PAVEMENT FOR CONTAINMENT DIKES FOR CONCRETE AND REINFORCEMENT REQUIREMENTS.
2. PROVIDE A GEOMEMBRANE BOOT FOR ALL CIRCULAR GEOMEMBRANE PENETRATIONS. ALL SMALL LINER PENETRATIONS SHALL BE CIRCUMFENT TO ACCOMMODATE A BOOT SEAL.
3. ALL CONCRETE JOINTS SHALL BE SEALED PER SPECIFICATIONS SECTION 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS. SEE SHEET C.04 FOR THE JOINT LAYOUT PLAN.
4. A GEOTEXTILE SHALL BE INSTALLED BELOW AND ABOVE THE GEOMEMBRANE. SEE SPECIFICATION SECTION 33 56 63 FUEL IMPERMEABLE LINER SYSTEM. THE GEOMEMBRANE AND GEOTEXTILE LINER PENETRATIONS SHALL BE CIRCULAR TO ACCOMMODATE A BOOT SEAL.
5. THE SURFACE UNDERLYING THE GEOTEXTILE/GEOMEMBRANE SHALL BE SMOOTH AND FREE OF ROCKS LARGER THAN 2". ROCK BALLAST MATERIAL SHALL BE CLEAN 1-IN DIAMETER OR ANY OTHER MATERIAL WHICH WOULD COULD DAMAGE THE GEOMEMBRANE LINER.
6. GEOMEMBRANE ANCHORAGE / EMBEDMENT STRIP MATERIALS AND INSTALLATION SHALL BE AS RECOMMENDED BY THE MANUFACTURER OF THE GEOMEMBRANE.
7. ROCK BALLAST MATERIAL SHALL BE CLEAN 1-1/2" IN 2" SMOOTH COBBLE STONES. THE ROCK BALLAST LAYER SHALL BE COMPACTED WITH TWO PASSES OF A WALK-BEHIND VIBRATORY ROLLER.

TYPICAL LINER SECTION - DIKE EXTERIOR WALLS (W/O LINER)

TYPICAL LINER SECTION - DIKE INTERIOR AND BASIN (W/ LINER)

TYPICAL LINER SECTION - CONCRETE WORKING SURFACE

TYPICAL LINER SECTION - PIPE PENETRATION DETAIL (GRAVEL)

GENERAL NOTES:
1. ALL CONCRETE SHALL BE REINFORCED WITH SYNTHETIC FIBER REINFORCEMENT. ADDITIONAL STEEL REINFORCEMENT SHALL BE PROVIDED, WHERE INDICATED, ON THE JOINT LAYOUT PLAN. SEE SPECIFICATIONS SECTION 32 13 19 25 CONCRETE PAVEMENT FOR CONTAINMENT DIKES FOR CONCRETE AND REINFORCEMENT REQUIREMENTS.
2. PROVIDE A GEOMEMBRANE BOOT FOR ALL CIRCULAR GEOMEMBRANE PENETRATIONS. ALL SMALL LINER PENETRATIONS SHALL BE CIRCUMFENT TO ACCOMMODATE A BOOT SEAL.
3. ALL CONCRETE JOINTS SHALL BE SEALED PER SPECIFICATIONS SECTION 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS. SEE SHEET C.04 FOR THE JOINT LAYOUT PLAN.
4. A GEOTEXTILE SHALL BE INSTALLED BELOW AND ABOVE THE GEOMEMBRANE. SEE SPECIFICATION SECTION 33 56 63 FUEL IMPERMEABLE LINER SYSTEM. THE GEOMEMBRANE AND GEOTEXTILE LINER PENETRATIONS SHALL BE CIRCULAR TO ACCOMMODATE A BOOT SEAL.
5. THE SURFACE UNDERLYING THE GEOTEXTILE/GEOMEMBRANE SHALL BE SMOOTH AND FREE OF ROCKS LARGER THAN 2". ROCK BALLAST MATERIAL SHALL BE CLEAN 1-IN DIAMETER OR ANY OTHER MATERIAL WHICH WOULD COULD DAMAGE THE GEOMEMBRANE LINER.
6. GEOMEMBRANE ANCHORAGE / EMBEDMENT STRIP MATERIALS AND INSTALLATION SHALL BE AS RECOMMENDED BY THE MANUFACTURER OF THE GEOMEMBRANE.
7. ROCK BALLAST MATERIAL SHALL BE CLEAN 1-1/2" IN 2" SMOOTH COBBLE STONES. THE ROCK BALLAST LAYER SHALL BE COMPACTED WITH TWO PASSES OF A WALK-BEHIND VIBRATORY ROLLER.
GEOMEMBRANE SHALL BE FASTENED TO TANK FOUNDATION, SEE CONCRETE STRUCTURE INTERFACE DETAILS ON SHEET CD.05.

EXTERIOR DIKE SLOPES
6" RIVER ROCK ON 4" CONCRETE (FOR DIKES) W/ SYNTHETIC FIBER REINFORCEMENT (95% ASTM 1557)

TYPICAL LINER SECTION

PIPE PENETRATION DETAIL

GENERAL NOTES:

1. ALL CONCRETE SHALL BE REINFORCED WITH SYNTHETIC FIBER REINFORCEMENT. ADDITIONAL STEEL REINFORCEMENT SHALL BE PROVIDED WHERE INDICATED ON THE JOINT LAYOUT PLAN. SEE SPECIFICATIONS SECTION 32 13 15.20 CONCRETE PAVEMENT FOR CONTAINMENT DIKES FOR CONCRETE AND REINFORCEMENT REQUIREMENTS.

2. PROVIDE A GEOMEMBRANE BOOT FOR ALL CIRCULAR GEOMEMBRANE PENETRATIONS. ALL SMALL LINER PENETRATIONS SHALL BE CIRCULAR TO ACCOMMODATE A BOOT SEAL.

3. ALL CONCRETE JOINTS SHALL BE SEALED PER SPECIFICATIONS SECTION 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS. SEE SHEET C.04 FOR THE JOINT LAYOUT PLAN.

4. A GEOTEXTILE SHALT BE INSTALLED BELOW AND ABOVE THE GEOMEMBRANE WHERE COVERED WITH CONCRETE. A GEOTEXTILE SHALL BE INSTALLED BELOW THE GEOMEMBRANE WHERE THE GEOMEMBRANE IS EXPOSED ON THE SURFACE. SEE SPECIFICATION SECTION 33 56 03 FUEL IMPERMEABLE LINER SYSTEM. THE GEOMEMBRANE AND GEOTEXTILE SHALL BE PROTECTED FROM DAMAGE AT ALL TIMES AS SPECIFIED.

5. THE BOTTOM GEOTEXTILE LAYER MAY BE OMITTED IF THE SUBGRADE SOIL IS KNOWN TO BE FREE OF ROCKS OR LARGE ROCK MATERIAL SHALL BE CLEAN, WELL GRADED "RIVER ROCK. THE ROCK LAYER SHALL BE COMPACTED WITH TWO PASSES OF A WALK-BEHIND VIBRATORY ROLLER.

6. PIPE OR CONDUIT PENETRATING LINER (2" DIAMETER OR LESS) SHALL BE SEALED IN ACCORDANCE WITH CONCRETE PAVEMENT FOR CONTAINMENT DIKES. PLUS MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS. SEE SHEET C.04 FOR THE JOINT LAYOUT PLAN. SEE SPECIFICATION SECTION 33 56 03 FUEL IMPERMEABLE LINER SYSTEM FOR ADDITIONAL DETAILS.

6. PIPE TUBES SHALL BE PROVIDED ON THE EXPOSED GEOMEMBRANE FOR BALLAST TO PREVENT WIND UPLIFT. SEE SPECIFICATION SECTION 33 56 03 FUEL IMPERMEABLE LINER SYSTEM FOR ADDITIONAL DETAILS.

DESIGNER NOTES:

1. THE GEOTEXTILE LAYERS ARE PROVIDED TO PROTECT THE GEOMEMBRANE DURING AND AFTER CONSTRUCTION. THE BOTTOM GEOTEXTILE LAYER MAY BE OMITTED IF THE SUBGRADE SOIL IS KNOWN TO BE FREE OF ROCKS OR OTHER MATERIALS THAT COULD POTENTIALLY DAMAGE THE GEOMEMBRANE.

2. OTHER BALLAST MATERIALS MAY BE SPECIFIED. WIND UPLIFT CALCULATIONS MUST BE PERFORMED REGARDLESS OF THE BALLAST MATERIALS USED. SPECIFICATION SECTION 33 56 03 FUEL IMPERMEABLE LINER SYSTEM PROVIDES WIND UPLIFT DESIGN GUIDANCE.

3. ALL CONCRETE JOINTS SHALL BE SEALED PER SPECIFICATIONS SECTION 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS. SEE SHEET C.04 FOR THE JOINT LAYOUT PLAN.
TYPICAL GEOMEMBRANE TERMINATION DETAIL - EXISTING STRUCTURE

CONCRETE STRUCTURE INTERFACE DETAIL - EXISTING STRUCTURE
SCALE: NONE

CONCRETE STRUCTURE INTERFACE DETAIL - NEW STRUCTURE
SCALE: NONE

CONCRETE STRUCTURE INTERFACE DETAIL - EXISTING STRUCTURE
SCALE: NONE

CONCRETE STRUCTURE INTERFACE DETAIL - NEW STRUCTURE
SCALE: NONE

CONCRETE STRUCTURE INTERFACE DETAIL - EXISTING STRUCTURE
SCALE: NONE

TYPICAL GEOMEMBRANE TERMINATION DETAIL - NEW STRUCTURE
SCALE: NONE

DESIGNER NOTES:

1. The geotextile layers are provided to protect the geomembrane during and after construction. The bottom geotextile layer may be omitted if the subgrade soil is known to be free of rocks or other materials that could potentially damage the geomembrane.

NOTE: VARIANCES TO THIS DETAIL MAY BE MADE WHEN RECOMMENDED BY THE GEOMEMBRANE MANUFACTURER.
NOTES:

1. PIPE HANDRAIL SHALL HAVE WELDS GROUNDED SMOOTH AND BE NUT CAPPED GALVANIZED AFTER FABRICATION.

2. ALL STAIR METALLIC COMPONENTS INCLUDING BUT NOT LIMITED TO STRUCTURAL STEEL, HANDRAILS AND REBAR, SHALL BE GROUNDED. ALL METALLIC COMPONENTS SHALL BE MADE CONTINUOUS VIA #4 BARE COPPER CONDUCTORS AS REQUIRED. GROUNDING SHALL BE BY CONNECTING METALLIC COMPONENTS TO TANK GROUNDING SYSTEM VIA #4 BARE COPPER CONDUCTORS BELOW LINER. BELOW GRADE CONNECTIONS SHALL BE PERFORMED VIA EXOTHERMIC WELD PROCESS.

3. HANDRAILS SHALL BE EXPOSED GALVANIZED. PAINTING IS NOT ALLOWED.

4. PER BSC AND ADA GUIDELINES RISERS HAVE A MINIMUM HEIGHT = 4" AND A MAXIMUM HEIGHT OF 7".

5. PER ADA GUIDELINES TREADS SHALL HAVE A MINIMUM WIDTH OF 11", AS MEASURED FROM RISER TO RISER.

6. HANDRAILS SHALL BE EXPOSED GALVANIZED. PAINTING IS NOT ALLOWED.

DESIGNER NOTES:

1. PER BSC AND ADA GUIDELINES RISERS HAVE A MINIMUM HEIGHT = 4" AND A MAXIMUM HEIGHT OF 7".

2. PER ADA GUIDELINES TREADS SHALL HAVE A MINIMUM WIDTH OF 11", AS MEASURED FROM RISER TO RISER.

3. HANDRAILS SHALL BE EXPOSED GALVANIZED. PAINTING IS NOT ALLOWED.
1. Metal grating for landings and stair treads shall be W-19-4 with bearing bars as indicated. Treads and landings shall have checker plate nosings. Grating shall be anchored with saddle clips, maximum width shall be 2'-0". Edges shall be banded. Tread shall be fabricated with carrier plates at ends.

2. All gratings, handrails, stringers, angles, plates and bolts for stairs shall be hot-dip galvanized in accordance with ASTM A123.2.

3. All stair metallic components, including but not limited to structural steel, handrails, and rebar, shall be grounded. All metallic components shall be made corrosion resistant using proper clamps. Grounding shall be by connecting metallic components to tank grounding system via #4 bare copper conductor below. Below grade connections shall be performed via exothermic weld process.
1. Containment walls shall be designed by a structural engineer based upon required heights and soil conditions.

2. Provide vertical routed joints as necessary to control cracking.

**Designer Notes:**

- Foundation, see concrete structure interface details on sheet CD.01.
- Fuel resistant sealant (over 2" diameter)
- Geotextile, geomembrane shall be fastened to the concrete wall, see concrete structure interface details on sheet CD.01.
- Steel sleeve, sleeve anchor and waterstop.
- Sleeve seal, nitrile boot seal (typ)
- Stainless steel boot clamps.
**Type X Area Inlet Plan**

**Section**

**Inlet Construction General Notes:**

1. Standard construction shall be cast in place reinforced concrete. Precast construction shall not be allowed.
2. Reinforcing steel Fy = 60 ksi.
3. Minimum clear cover of concrete over reinforcing steel shall be 3 inches for concrete placed against the soil.
4. Cast iron grate and frame shall be heavy-duty Neenah R-1878-B3G (where not subject to possible wheel loads), or approved equal. Or light-duty Neenah R-1879-B3G (where not subject to possible wheel loads), or approved equal.
5. Minimum 6" compacted (95%) subgrade required under inlets.

**Design Notes:**

1. A PV or gate valve is not allowed for containment drains.
2. Do not approve precast inlets as the joints and connections are susceptible to leaks.
3. Select the appropriate cross-sections for the selected liner cover material.

**Section**

**Containment Drain Valve Detail**

**General Notes:**

- Body (sealed).
- Eccentric plug valve.
- Note: 100% port eccentric plug valve shall conform to AWWA C517 and be resistant to hydrocarbons. Nitrile rubber seals, gear actuator box with handwheel shall be lockable.
- 1/2" perforations, 1" O.C.
- Nitrile boot seal w/ SS clamps.
- Segmented elastomeric seal (Typ of 2).
- Diameter, varies.
- Note: 100% port eccentric plug valve shall conform to AWWA C517 and be resistant to hydrocarbons. Nitrile rubber seals, gear actuator box with handwheel shall be lockable.
BERM DIKE WALL PENETRATION DETAIL (EXTERIOR)

SCALE: NONE

DESIGNER NOTES:
1. PIPE SUPPORT TYPES AND LOCATIONS SHALL BE CALCULATED BY PIPE STRESS ANALYSIS AND HYDRAULIC TRANSIENT CALCULATIONS. PIPE SUPPORT SHOWN IN THIS DETAIL IS FOR INFORMATION ONLY. CHANGE THE SUPPORT TYPE AS NECESSARY BASED UPON CALCULATION RESULTS.
2. SEE CHART FOR CARRIER AND SLEEVE PIPE DIMENSION COMBINATIONS FOR MECHANICALLY ADJUSTABLE SEGMENTED ELASTOMERIC SEAL. CONFIRM DIMENSIONS WITH SELECTED MECHANICALLY ADJUSTABLE SEGMENTED ELASTOMERIC SEAL MANUFACTURER BEFORE SELECTING SLEEVE PIPE SIZING.
3. FOR CONTAINMENT BERM AND FML PENETRATION INFORMATION, SEE CIVIL SHEETS.
4. SUPPORT CARRIER PIPE IN SLEEVES WITH NON-CONDUCTIVE SUPPORTS SPACED A MAXIMUM OF 10' APART.
5. SLOPE SLEEVE PIPING TO ALLOW FOR DRAINAGE THROUGH SLEEVE DRAIN.

CARRIER PIPE SIZE (IN) 2 3 4 5 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54
CASING PIPE SIZE (IN) 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56

BERM DIKE WALL PENETRATION DETAIL (CENTER)

SCALE: NONE

DESIGNER NOTES:
1. DETERMINE FORCES ACTING UPON PIPING PASSING THROUGH ONE BERM TO DETERMINE WHETHER OR NOT A CONCRETE DEADMAN ANCHOR IS REQUIRED AND, IF SO, ITS SIZE TO COUNTERACT FORCES. IF IT IS NOT REQUIRED THEN DELETE FROM DETAIL.
2. SLOPE SLEEVE PIPING TO ALLOW FOR DRAINAGE THROUGH SLEEVE DRAIN.
3. CONCRETE DEADMAN ANCHOR (IF REQUIRED) SHALL BE CENTERED ON THE CONFINEMENT BERM.
4. ENSURE THAT THE CONCRETE DEADMAN ANCHOR (IF REQUIRED) DOES NOT INTERFERE WITH PIPE SUPPORT STRUCTURES.

BERM DIKE WALL PENETRATION DETAIL (INTERIOR)

SCALE: NONE

DESIGNER NOTES:
1. DETERMINE FORCES ACTING UPON PIPING PASSING THROUGH ONE BERM TO DETERMINE WHETHER OR NOT A CONCRETE DEADMAN ANCHOR IS REQUIRED AND, IF SO, ITS SIZE TO COUNTERACT FORCES. IF IT IS NOT REQUIRED THEN DELETE FROM DETAIL.
2. SLOPE SLEEVE PIPING TO ALLOW FOR DRAINAGE THROUGH SLEEVE DRAIN.
3. CONCRETE DEADMAN ANCHOR (IF REQUIRED) SHALL BE CENTERED ON THE CONFINEMENT BERM.
4. ENSURE THAT THE CONCRETE DEADMAN ANCHOR (IF REQUIRED) DOES NOT INTERFERE WITH PIPE SUPPORT STRUCTURES.
1. Ensure that the aboveground low point drain has adequate clearance to allow for full rotation of the ball valve handle.

Flexible Ball Joints

Designer Notes:
1. Distance to third ball joint after the elbow should be as long as piping layout allows while minimizing droop, but not to exceed 8 feet or maximum allowable pipe support distance.

Typical Expansion Loop

Base Plate

Designer Notes:
1. Other pipe supports and support locations shall be calculated by a pipe stress analysis and hydraulic transient computations.

Adjustable Pipe Saddle Support Detail (PS-1)

Adjustable Pipe Support Detail (PS-2)

Manual Air Vent

Aboveground Low Point Drain

Designer Notes:
1. Ensure the aboveground low point drain has adequate clearance to allow for full rotation of the ball valve handle.

Pipe Flow Symbol Detail

Product Flow Symbol Detail

Designer Notes:
The example markings shown are for jet A turbine fuel. For other fuel types, refer to MIL-STD-161G.

Sizes of Letters and Bands

<table>
<thead>
<tr>
<th>PIPE DIAMETER (IN)</th>
<th>BAND WIDTH AND SPACING (IN)</th>
<th>FIELD LETTER SIZE (IN)</th>
<th>BACKGROUND AND ARROWS (IN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNDER 3</td>
<td>3</td>
<td>0.6</td>
<td>1</td>
</tr>
<tr>
<td>3 TO 6</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>OVER 6</td>
<td>4</td>
<td>3</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Designer Notes:
The example marking size shown are for jet A turbine fuel. For other fuel types, refer to MIL-STD-161G.
DRW 5

A PP R

DATE

DESCRIPT ION

B

D

C

A

UNCLASSIFIED//FOR OFFICIAL USE ONLY

10. CLEAR COVER TO REINFORCING FOR CAST-IN-PLACE CONCRETE SHALL BE AS

1. CAST-IN-PLACE CONCRETE SHALL CONFORM TO AMERICAN CONCRETE INSTITUTE

2. SPECIFIED COMpressive STRENGTH: \( f'c = 4,000 \text{ PSI} \) AT 28 DAYS TYP.

3. REINFORCING MATERIAL:

REINFORCING BARS SHALL CONFORM TO ACI 318 USING CLASS B TENSION SPLICES UNLESS OTHERWISE NOTED.

4. LAP SPLICES AND CONCRETE COVER OF REINFORCEMENT SHALL CONFORM TO

ACI 318, AND ACI 315.

5. REINFORCING BARS SHALL BE SUPPORTED AT 2'-0" O.C., EACH WAY, MAX.

6. ALL REINFORCING STEEL AND EMBEDDED ITEMS SUCH AS ANCHOR RODS AND

7. DO NOT WELD CARBON STEEL PLATES OR TEES TO STAINLESS STEEL PIPE.

8. PROVIDE ACCESSORIES NECESSARY TO PROPERLY SUPPORT REINFORCING AT

POSITIONS SHOWN ON DRAWINGS.

9. EXPOSED EDGES OF CONCRETE SHALL BE CHAMFERED

10. CLEAR COVER TO REINFORCING FOR CAST-IN-PLACE CONCRETE SHALL BE AS FOLLOWS UNLESS NOTED OTHERWISE:

A. CONCRETE CAST AGAINST OR PERMANENTLY EXPOSED TO EARTH: 3"

B. CONCRETE EXPOSED TO EARTH OR WEATHER:

C. CONCRETE NOT EXPOSED TO WEATHER OR IN CONTACT WITH GROUND:

1. MAX ALLOWABLE NET SOIL BEARING PRESSURE: \( X,XXX \text{ PSF} \)

2. LATERAL BEARING PRESSURE: XXX PSF/FT BELOW FINISHED GRADE

3. FRICTION ANGLE: \( \phi = XX^\circ \)

4. FROST PENETRATION:

5. COEFFICIENT OF FRICTION:

6. ROLLED PLATES AND SHAPES: SHALL CONFORM TO ASTM A36, \( F_y = 36 \text{ KSI} \).

7. STRUCTURAL TUBING: SHALL CONFORM TO ASTM A500, GRADE B, \( F_y = 46 \text{ KSI} \).

8. DO NOT WELD GALVANIZED CARBON STEEL PLATES OR TEES TO STAINLESS

STEEL OR CARBON STEEL PIPE.

9. STRUCTURAL STEEL SHALL CONFORM TO LATEST EDITION OF THE AMERICAN

INSTITUTE OF STEEL CONSTRUCTION "STEEL CONSTRUCTION MANUAL".

10. CLEAR COVER TO REINFORCING FOR CAST-IN-PLACE CONCRETE SHALL BE AS

FOLLOWS UNLESS NOTED OTHERWISE:

A. CONCRETE CAST AGAINST OR PERMANENTLY EXPOSED TO EARTH: 3"

B. CAST-IN-PLACE CONCRETE SHALL CONFORM TO AMERICAN CONCRETE INSTITUTE

C. PASSIVE:

D. AT-REST:

E. ONE-THIRD OVERSTRESS MAY BE ALLOWED FOR TEMPORARY WIND/SEISMIC LOADING.

F. STRUCTURAL TUBING: SHALL CONFORM TO ASTM A500, GRADE B, \( F_y = 46 \text{ KSI} \).

G. ANCHOR BOLTS: SHALL CONFORM TO ASTM F1554, \( F_y = 36 \text{ KSI} \).

H. ROLLED PLATES AND SHAPES: SHALL CONFORM TO ASTM A36, \( F_y = 36 \text{ KSI} \).

I. FRAC TION ANGLE: \( \phi = XX^\circ \)

J. WELDING SHALL CONFORM WITH SPECIFICATION 33 52 43.13.

K. COEFFICIENT OF FRICTION:

L. FRICTION ANGLE: \( \phi = XX^\circ \)

M. STRUCTURAL STEEL SHALL CONFORM TO LATEST EDITION OF THE AMERICAN

INSTITUTE OF STEEL CONSTRUCTION "STEEL CONSTRUCTION MANUAL".

N. WIDE FLANGE SHAPES: SHALL CONFORM TO ASTM A992, \( F_y = 50 \text{ KSI} \).

O. ROLLED PLATES AND SHAPES: SHALL CONFORM TO ASTM A36, \( F_y = 36 \text{ KSI} \).

P. FRICTION ANGLE: \( \phi = XX^\circ \)

Q. STEEL OR CARBON STEEL PIPE.

R. ONE-THIRD OVERSTRESS MAY BE ALLOWED FOR TEMPORARY WIND/SEISMIC LOADING.

S. STRUCTURAL STEEL SHALL CONFORM TO LATEST EDITION OF THE AMERICAN

INSTITUTE OF STEEL CONSTRUCTION "STEEL CONSTRUCTION MANUAL".

T. STRUCTURAL STEEL SHALL CONFORM TO LATEST EDITION OF THE AMERICAN

INSTITUTE OF STEEL CONSTRUCTION "STEEL CONSTRUCTION MANUAL".

U. STRUCTURAL STEEL SHALL CONFORM TO LATEST EDITION OF THE AMERICAN

INSTITUTE OF STEEL CONSTRUCTION "STEEL CONSTRUCTION MANUAL".

V. STRUCTURAL STEEL SHALL CONFORM TO LATEST EDITION OF THE AMERICAN

INSTITUTE OF STEEL CONSTRUCTION "STEEL CONSTRUCTION MANUAL".

W. STRUCTURAL STEEL SHALL CONFORM TO LATEST EDITION OF THE AMERICAN

INSTITUTE OF STEEL CONSTRUCTION "STEEL CONSTRUCTION MANUAL".

X. STRUCTURAL STEEL SHALL CONFORM TO LATEST EDITION OF THE AMERICAN

INSTITUTE OF STEEL CONSTRUCTION "STEEL CONSTRUCTION MANUAL".

Y. STRUCTURAL STEEL SHALL CONFORM TO LATEST EDITION OF THE AMERICAN

INSTITUTE OF STEEL CONSTRUCTION "STEEL CONSTRUCTION MANUAL".

Z. STRUCTURAL STEEL SHALL CONFORM TO LATEST EDITION OF THE AMERICAN

INSTITUTE OF STEEL CONSTRUCTION "STEEL CONSTRUCTION MANUAL".
PIPE SUPPORT NOTES:

1. PROVIDE CARBON STEEL PIPE SUPPORTS, INCLUDING STRAPS, PLATES, GUIDES AND TEES WHERE CARBON STEEL PIPE IS USED. ALL CARBON STEEL ELEMENTS SHALL HAVE THE SAME MECHANICAL PROPERTIES PROVIDE STAINLESS STEEL PIPE SUPPORTS, INCLUDING STRAPS, PLATES, GUIDES AND TEES WHERE STAINLESS STEEL PIPE IS USED. ALL STAINLESS STEEL ELEMENTS SHALL HAVE THE SAME MECHANICAL PROPERTIES. DO NOT WELD CARBON STEEL PLATES OR TEES TO STAINLESS STEEL PIPE.

2. THE 16" x 16"-horizontal plate between saddles shall have 1" x 1" triangles cut off of all 4 corners. This plate shall not be square in shape so as to avoid 3 welds intersecting in the corners, which causes areas of high restraint and increased potential for cracking.
DESIGNER NOTE:
1. IF ELECTRODE TYPE LEVEL ALARMS ARE TO BE USED INSTEAD OF THE MECHANICAL FLOAT TYPE INDICATED ON THE STORAGE TANK ELECTRICAL ELEVATION DETAIL, THEN MODIFY THE DETAIL WITH REQUIREMENTS APPLICABLE TO THE ELECTRICAL LEVEL ALARMS.
2. IF AN ATG SYSTEM OTHER THAN THE ENRAF 854 TYPE DEPICTED HERE IS TO BE USED, THE STORAGE TANK ELECTRICAL ELEVATION DETAIL SHALL BE MODIFIED TO SHOW APPROPRIATE CONDUITS AND CONDUIT SEAL-OFF (TYP).

NOTE:
1. SEE TANK DRAWINGS FOR EXACT LOCATION OF LEVEL SWITCHES AND PRODUCT RETURN PUMP.
2. WELD CONDUIT SUPPORT STRUCTURES (UNISTRUT OR EQUAL) TO TANK WALL. DO NOT WELD THREADED COUPLERS OF THE SAME MATERIAL AS THE CARBON STEEL MATERIAL OF THE TANK SHELL.
3. REMOTE EPDS STATION TO BE PLACED IMMEDIATELY OUTSIDE OF CONTAINMENT AREA. SEE THIS SHEET FOR DETAILS.
4. CATHODIC PROTECTION TERMINAL CABINET TO BE PLACED OUTSIDE OF CONTAINMENT AND HAZARDOUS LOCATIONS. IT MAY BE PLACED IMMEDIATELY OUTSIDE OF CONTAINMENT AREA OR NEAR RECTIFIER. SEE DETAILS SHEET ED.02 FOR DETAILS.

STORAGE TANK ELECTRICAL ELEVATION
SCALE: NONE

CONTINUE TO STILLWELL FOR ATG SYSTEM.
NEW ALARMS AND FLOATS TO BE ACCESSIBLE FROM TANK.

DRAW-OFF SYSTEM
10'-0" EXTENDING IN ALL DIRECTIONS FROM TANK VENT

EXTERNAL FUEL PIPING HAZARDOUS AREA DETAIL
SCALE: NONE

NEW 4" HERMETICALLY SEAL (FOR CLASS I, DIV 2) JUMBO ALUMINUM MUSHROOMHEAD, 30mm MOUNTING HOLE, NORMALLY CLOSED WITH A PUSH IN - STAY IN PUSHBUTTON WITH LEGEND PLATE "EMERGENCY STOP" MOUNTED IN A NEMA 4 ENCLOSURE.
BUTTON SHALL HAVE NO COVER.

EXTERNAL FUEL PIPING HAZARDOUS AREA DETAIL
SCALE: NONE

NEW 4" HERMETICALLY SEAL (FOR CLASS I, DIV 2) JUMBO ALUMINUM MUSHROOMHEAD, 30mm MOUNTING HOLE, NORMALLY CLOSED WITH A PUSH IN - STAY IN PUSHBUTTON WITH LEGEND PLATE "EMERGENCY STOP" MOUNTED IN A NEMA 4 ENCLOSURE.
BUTTON SHALL HAVE NO COVER.

EXTERNAL FUEL PIPING HAZARDOUS AREA DETAIL
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BUTTON SHALL HAVE NO COVER.

EXTERNAL FUEL PIPING HAZARDOUS AREA DETAIL
SCALE: NONE

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BUTTON SHALL HAVE NO COVER.

EXTERNAL FUEL PIPING HAZARDOUS AREA DETAIL
SCALE: NONE

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BUTTON SHALL HAVE NO COVER.

EXTERNAL FUEL PIPING HAZARDOUS AREA DETAIL
SCALE: NONE

NEW 4" HERMETICALLY SEAL (FOR CLASS I, DIV 2) JUMBO ALUMINUM MUSHROOMHEAD, 30mm MOUNTING HOLE, NORMALLY CLOSED WITH A PUSH IN - STAY IN PUSHBUTTON WITH LEGEND PLATE "EMERGENCY STOP" MOUNTED IN A NEMA 4 ENCLOSURE.
BUTTON SHALL HAVE NO COVER.

EXTERNAL FUEL PIPING HAZARDOUS AREA DETAIL
SCALE: NONE

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BUTTON SHALL HAVE NO COVER.

EXTERNAL FUEL PIPING HAZARDOUS AREA DETAIL
SCALE: NONE

NEW 4" HERMETICALLY SEAL (FOR CLASS I, DIV 2) JUMBO ALUMINUM MUSHROOMHEAD, 30mm MOUNTING HOLE, NORMALLY CLOSED WITH A PUSH IN - STAY IN PUSHBUTTON WITH LEGEND PLATE "EMERGENCY STOP" MOUNTED IN A NEMA 4 ENCLOSURE.
BUTTON SHALL HAVE NO COVER.

EXTERNAL FUEL PIPING HAZARDOUS AREA DETAIL
SCALE: NONE

NEW 4" HERMETICALLY SEAL (FOR CLASS I, DIV 2) JUMBO ALUMINUM MUSHROOMHEAD, 30mm MOUNTING HOLE, NORMALLY CLOSED WITH A PUSH IN - STAY IN PUSHBUTTON WITH LEGEND PLATE "EMERGENCY STOP" MOUNTED IN A NEMA 4 ENCLOSURE.
BUTTON SHALL HAVE NO COVER.

EXTERNAL FUEL PIPING HAZARDOUS AREA DETAIL
SCALE: NONE

NEW 4" HERMETICALLY SEAL (FOR CLASS I, DIV 2) JUMBO ALUMINUM MUSHROOMHEAD, 30mm MOUNTING HOLE, NORMALLY CLOSED WITH A PUSH IN - STAY IN PUSHBUTTON WITH LEGEND PLATE "EMERGENCY STOP" MOUNTED IN A NEMA 4 ENCLOSURE.
BUTTON SHALL HAVE NO COVER.

EXTERNAL FUEL PIPING HAZARDOUS AREA DETAIL
SCALE: NONE

NEW 4" HERMETICALLY SEAL (FOR CLASS I, DIV 2) JUMBO ALUMINUM MUSHROOMHEAD, 30mm MOUNTING HOLE, NORMALLY CLOSED WITH A PUSH IN - STAY IN PUSHBUTTON WITH LEGEND PLATE "EMERGENCY STOP" MOUNTED IN A NEMA 4 ENCLOSURE.
BUTTON SHALL HAVE NO COVER.

EXTERNAL FUEL PIPING HAZARDOUS AREA DETAIL
SCALE: NONE

NEW 4" HERMETICALLY SEAL (FOR CLASS I, DIV 2) JUMBO ALUMINUM MUSHROOMHEAD, 30mm MOUNTING HOLE, NORMALLY CLOSED WITH A PUSH IN - STAY IN PUSHBUTTON WITH LEGEND PLATE "EMERGENCY STOP" MOUNTED IN A NEMA 4 ENCLOSURE.
BUTTON SHALL HAVE NO COVER.

EXTERNAL FUEL PIPING HAZARDOUS AREA DETAIL
SCALE: NONE

NEW 4" HERMETICALLY SEAL (FOR CLASS I, DIV 2) JUMBO ALUMINUM MUSHROOMHEAD, 30mm MOUNTING HOLE, NORMALLY CLOSED WITH A PUSH IN - STAY IN PUSHBUTTON WITH LEGEND PLATE "EMERGENCY STOP" MOUNTED IN A NEMA 4 ENCLOSURE.
BUTTON SHALL HAVE NO COVER.
TANK GROUNDING SYSTEM

GROUND ROD BOX DETAIL

PRECAST BOX SET FLUSH WITH FINISHED GRADE. COVER SHALL READ "GROUND ROD".

GROUND ROD BOX MOUNTED ON TOP OF DIKE ON PUMPHOUSE SIDE.

#4/0 AWG COPPER WIRE TO TANK GROUNDING SYSTEM. SEE ED.11 FOR STAIRWAY GROUNDING.

TANK SHELL

GROUND CABLE TO EXOTHERMIC WELD.

6" DIAMETER CARBON STEEL MOUNTING PLATE

3" X 3" X 3/16" ROUND CORNERS 1/2" (TYP.)

#4/0 BARE COPPER WIRE TO TANK GROUNDING SYSTEM.

TANK GROUNDING LUG

10'-0" LONG X 3/4" DIA. GROUND ROD. MATERIAL INDICATED IN SPECIFICATIONS.
ON GRADE TANKS CATHODIC PROTECTION

NOTES:

1. ANODES, REFERENCE ELECTRODES SHALL BE LOCATED UNDER THE TANK AS SHOWN.

2. ALL PIPING WITH ELECTRICAL COMPONENTS CONNECTED TO THE ELECTRICAL GROUND SYSTEM SHALL BE ISOLATED FROM THE TANK.

3. TERMINAL CABINET SHALL HAVE 0.01 OHM, 10 AMP SHUNTS PROVIDED FOR EACH ANODE CONNECTION.

4. ANODE CABLES SHALL BE NO. 6 AWG, HMWPE INSULATION. RUN 3#6 IN 0.75 INCH COATED RIGID STEEL CONDUIT BETWEEN TANK AND TERMINAL CABINET. SEE J-BOX 2 & 3 DETAIL 2, THIS SHEET.

5. REFERENCE CELL CABLES SHALL BE RUN IN 1" COATED RIGID STEEL CONDUIT (10#14) BETWEEN TANK AND TERMINAL CABINET. SEE J-BOX 1 DETAIL 1, THIS SHEET.

6. ANODE SYSTEMS SHALL BE OF THE SOLDERLESS TYPE. WIRE SHALL HAVE RING OR LUG TERMINATIONS.

7. RECTIFIER UNIT NEGATIVE CABLE AND POSITIVE CABLE SHALL BE NO. 6 AWG, HMWPE INSULATION. RUN 2#6, 0.75 INCH COATED RIGID STEEL CONDUIT BETWEEN RECTIFIER AND TERMINAL CABINET.

8. TERMINAL CABINET SHALL BE LOCATED OUTSIDE OF THE CONTAINMENT BASIN.

9. TERMINAL CABINET SHALL BE LOCATED OUTSIDE OF THE CONTAINMENT BASIN.

10. ALL UNDERGROUND CONNECTIONS SHALL BE ENCASED IN A WATERTIGHT SPLICE.

11. PROVIDE ETCHED LABELS BY EACH TERMINAL INDICATING THE NUMBER AND/OR FUNCTION E.G. ANODE, REFERENCE CELL 1, RECTIFIER POS, ETC.

CERAMIC ANODE SYSTEM BLOCK DIAGRAM IMPRESSED CURRENT CATHODIC PROTECTION AREA UNDER STORAGE TANK
TANK ON GRADE CERAMIC ANODE CATHODIC PROTECTION PLAN

SCALE: NONE

NOTE: THIS PLAN IS FOR GRAPHICAL REPRESENTATION ONLY AND DOES NOT NECESSARILY MATCH ACTUAL SPACING OF GRID. SEE ON GRADE SPACING REQUIREMENTS.

1. PROVIDE SHUNTS WITH THE APPROPRIATE POWER RATINGS. SEE SPECIFICATIONS. SHUNTS SHALL BE 0.01 OHM.

2. ALL UNDERGROUND CONNECTIONS SHALL BE ENCAESCED TO BE WATER TIGHT.

3. PROVIDE ETCHED LABELS BY EACH TERMINAL INDICATING THE NUMBER AND/OR FUNCTION.

4. ALL TERMINALS SHALL BE SOLDERLESS TYPE AND ALL WIRES SHALL HAVE RING OR LUG TERMINATIONS.

5. PROVIDE 24X3X24X6X3 NEMA 4X ENCLOSURE WITH HINGED COVER AND LOCKABLE STAINLESS STEEL HARDWARE.

6. LAYOUT OF TERMINALS CAN BE ADJUSTED. NOTE THAT IF ANOTHER ANODE CONFIGURATION IS USED, THE NUMBER OF ANODE CONDUCTORS COULD CHANGE. CABINET SHALL BE ADJUSTED IN SIZE ACCORDINGLY.

7. LOCATE TERMINAL CABINET OUTSIDE OF CONCRETE CONTAINMENT AREA AND HAZARDOUS LOCATION. TERMINAL CABINET MAY BE LOCATED NEXT TO RECTIFIER.

DESIGNER NOTE:
- THE SYSTEM SHOWN IS BASED ON A GRID SYSTEM WITH THE DISTANCES SHOWN. THE ANODES HAVE A MAXIMUM 18 MA HAT RATING WITH A TARGET OF 4 MA. THE CONTRACTOR HAS THE OPTION OF USING OTHER SYSTEMS WHICH MEET THE FOLLOWING:
  - A TANK BOTTOM IS BARE, PROTECTIVE COVERAGE SHALL BE A MAXIMUM OF 1 FT. MINIMUM 100 FT. IS REQUIRED. RECTIFIER SHALL HAVE A 4 MA OUTPUT. VOLTAGE OUTPUT SHALL HAVE A MAXIMUM SAFETY FACTOR OF 3 TIMES WHAT IS SHOWN.
  - BOLTED OR COMPRESSION TERMINAL: CONDUCT NUMBER OF CABLES, SIZE OF RECTIFIER, ETC. TO MAKE A COMPLETE AND USABLE SYSTEM.

- (1) SPIRAL SYSTEM: ONE CONTINUOUS SPIRAL WITH A LINEAR ANODE. THE SPIRALS SHALL BE PLACED A MAXIMUM OF 3 FT APART. USE SAME SPACING BETWEEN SPIRALS. THE ANODE SHALL HAVE BETWEEN 5 MA AND 25 MA RATING. IF THE SPIRAL ANODE WOULD BE A TOTAL LENGTH OVER 600 FT, THERE SHALL BE A CONNECTION ON EACH END OF THE ANODES. IF THE SPIRAL ANODE WOULD BE A TOTAL LENGTH OVER 600 FT, THERE SHALL BE A CONNECTION ON THE OUTSIDE TO THE TERMINAL CABINET OR TO THE GRILLE OR WALL. THE MAXIMUM INDIVIDUAL ANODE LENGTH WAS ASSUMED TO BE 1000 FT. THE ANODE SHALL BE A MIXED METAL OXIDE TYPE. OUTER SPIRAL SHALL BE BETWEEN 1 FT TO 2.5 FT FROM TANK EDGE.

- (2) CONCENTRIC CIRCLES: USING A MIXED METAL OXIDE ANODE, PLACE THE ANODES IN CONCENTRIC CIRCLES. EACH ANODE SHALL HAVE A CABLE CONNECTED TO THE END AND BRING IT OUT TO THE TERMINAL CABINET. IF THE ANODE CABLE HAS A TOTAL LENGTH OF 3 FT OR MORE, THE ANODE CABLE SHALL BE A TOTAL LENGTH OVER 600 FT, THERE SHALL BE A CONNECTION ON EACH END OF THE ANODES. IF THE SPIRAL ANODE WOULD BE A TOTAL LENGTH OVER 600 FT, THERE SHALL BE A CONNECTION ON THE OUTSIDE TO THE TERMINAL CABINET OR TO THE GRILLE OR WALL. THE MAXIMUM INDIVIDUAL ANODE LENGTH WAS ASSUMED TO BE 1000 FT. THE ANODE SHALL BE A MIXED METAL OXIDE TYPE. OUTER CONCENTRIC CIRCLE SHALL BE BETWEEN 1 FT TO 2.5 FT FROM TANK EDGE.

- LIGHTNING SURGE ARRESTER DETAIL

- WRAP ENTIRE INSULATING FLANGE IN PVC PIPING AND SECURE WITH STAINLESS STEEL BAND CLAMP. LEAVES LIGHTNING SURGE ARRESTER EXPOSED.

- LIGHTNING SURGE ARRESTER DETAIL

- STAINLESS STEEL BRACKET (TYPE)

- LIGHTNING SURGE ARRESTER PER SPECIFICATION 22-01-01-152

- INSULATING MATERIAL

- CONDUCTORS SHALL BE SHORT AND STRAIGHT AS POSSIBLE (6" MAX.)

- BOLTED OR COMPRESSION TERMINAL PVC PROTECTOR

- ANODE CONNECTION BRACKET

- TERMINAL CABINET

- SCALE: NONE

- TERMINAL CABINET

- DESIGNER NOTE:

- WEATHER VENT (WVB)

- CONST. CONTR. NO.

- DOD STANDARD DESIGN AW 78-24-27

- NAVAD

- NAVFAC DRAWING NO.

- MHK

- X..X..X.

- FOR COMMANDER NAVFAC APPROVED

- NAVFAC ENGINEERING COMMAND - ALANTIC

- A/E INFO

- NAVFAC

- DATE: APRIL 2015

- DRAWFORM REVISION: 10 MAY 2014

- NAVAL FACILITIES ENGINEERING COMMAND - ALANTIC

- US ARMY CORPS OF ENGINEERS
1. THE ATG SYSTEM CONSISTS OF THE ATG, AND THE TEMPERATURE, BOTTOM SEGMENT, AND WATER LEVEL SYSTEMS. THE ATG SYSTEM TAKES MEASUREMENTS OF THE TANK LEVEL, TEMPERATURE DATA TO THE MONITORING SYSTEM WHICH WILL STORES STRAPPING CHART DATA TO CALCULATE THE GROSS AND Void VOLUMES.

2. AUTOMATION SYSTEM: AUTOMATIC TANK GAUGING (ATG) SYSTEM:

3. ELECTRONIC AUTOMATIC TANK GAUGING (ATG) SYSTEM:

4. PUMP MOTORS, MOTORIZED VALVE ACTUATORS, OR ANY OTHER MOTORIZED EQUIPMENT THAT HAS BEEN PROVIDED ON THE TANK SHALL BE COMBINED INTO A SINGLE PANEL WHERE POSSIBLE.

5. LOCAL CONTROL STATION FOR EACH MOTOR OPERATED DBB SHALL BE READILY ACCESSIBLE AND MAY BE LOCATED ON THE MOTOR OPERATOR. IF THERE IS MORE THAN ONE MOV IN THE SAME TANK ISSUE, RECEIPT, AND LOW SUCTION LINES. THESE VALVES SHALL BE DOUBLE BLOCK AND BLEED (DBB) VALVES.

6. WHEN AN MOV IS PROVIDED ON THE LOW SUCTION NOZZLE THE MOV MAY BE OPEN, CLOSED, OR STOPPED AT ANY TIME WHEN THE TANK IS ABOVE THE LOW-LOW LEVEL. WHEN THE LEVEL IN THE TANK DROPS TO THE LOW-LOW LEVEL SETPOINT AS SENSED BY THE HIGH-HIGH LEVEL SWITCH, THE MOV SHALL OPEN AND SHALL BE ADJUSTED TO BE FULL OPEN BY THE TIME THE LEVEL FALLS TO THE LOW-HIGH LEVEL.

7. PROVIDE SLOW CLOSING SPEED CONTROL FEATURE TO MINIMIZE PRESSURE SURGE WHEN HLV VALVES CLOSE. WHEN THE LEVEL OF THE TANK DESCENDS BELOW THE ACTUATION LEVEL OF THE FLOAT PILOT, THE MANUAL BYPASS VALVE SHALL BE FITTED WITH A POSITION SWITCH THAT ACTIVATES A SPARE HLV SOLENOID CONTROL, ENABLING THE CONTROL VALVE TO BE OPENED DURING A LOSS OF POWER.

8. THE HLV FLOAT PILOT SHALL BE BACKED-UP WITH A SOLENOID PILOT TO BEGIN CLOSURE OF THE CONTROL VALVE WHEN THE TANK LEVEL REACHES THE HIGH-HIGH LEVEL, AS SENSED BY THE HIGH-HIGH LEVEL SWITCH.

9. THE SOLIDNOID SHALL BE NORMALLY ENERGIZED ENABLING THE CONTROL VALVE TO OPEN ON A RISE IN UPSTREAM PRESSURE. WHEN THE LEVEL IN THE TANK DESCENDS TO THE LOW LOW LEVEL, OR THERE IS A LOSS OF POWER, THE SOLIDNOID SHALL BE DEENERGIZED UNBLOCKING THE CONTROL VALVE AND ALLOWING IT TO CLOSE. A MANUAL BYPASS VALVE SHALL BE PROVIDED TO BYPASS THE CONTROL VALVE AND ALLOW THE CONTROL VALVE TO BE OPENED CLOSED OR CHANGED TO A NEW SETPOINT AS NEEDED. THE MANUAL BYPASS VALVE SHALL BE EJECTED WITH A PREDETERMINED WEIGHT; A ARM SYSTEM MAY BE INSTALLED TO ALLOW THE CONTROL VALVE TO CLOSE AFTER POWER IS RESTORED. EMERGENCY POWER DOWN SYSTEM (EPS) FUNCTION SHALL BE HARDWIRED TO THE EPS SYSTEM (EPS) FUNCTION SHALL BE STARTED ONLY IF BOTH LIMITS OF THE LEVEL ARE REACHED.

5. PROVIDE MINIMAL TIME DELAYS ON ALL LEVEL SWITCHES, FLOW SWITCHES, ETC, TO PREVENT ALARM CONDITION RETURNS TO A NON-ALARM STATE AND THE EQUIPMENT IS MANUALLY RESTARTED.

6. MANUALLY START AND STOP PUMP WITH START/STOP PUSHBUTTONS.

7. PROVIDE RED WINDOW ALARMS (CRITICAL) SHALL STOP ALL PUMPS RUNNING IN AUTOMATIC MODE.

8. ON THE TANK ISSUE, RECEIPT, AND LOW SUCTION LINES. THE PUMP SHALL BE DE-ENERGIZED. THE ALARM CONDITION SHALL REMAIN UNTIL THE LEVEL IN THE TANK DROPS BELOW THE HIGH LOW LEVEL.

9. WHEN THE LEVEL IN THE PRODUCT BAVIER TANK RISES TO THE HIGH-HIGH LEVEL SETPOINT AS SENSED BY THE HIGH-HIGH LEVEL MAXIMUM SENSOR, A TROUBLE ALARM SHALL BE ANNOUNCED ON THE TANK ANNUCATOR PANEL, AND AN AUDIBLE AND VISUAL ALARM SHALL BE PROVIDED TO INDICATE THE TROUBLE ALARM CONDITION SHALL REMAIN UNTIL THE LEVEL IN THE TANK DROPS BELOW THE HIGH LOW LEVEL.

10. THE CONTROL PANEL SHALL BE INTERCONNECTED WITH THE LIMIT SWITCHES ON THE TANK ISSUE, RECEIPT, AND LOW SUCTION LINES TO ALLOW THE PUMP TO BE STARTED ONLY IF BOTH LIMITS OF THE LEVEL ARE REACHED.

11. THE CONTROL PANEL SHALL BE INTERCONNECTED WITH THE EMERGENCY POWER DOWN SWITCH BOARD TO DE-ENERGIZE THE PUMP IF ANY OPEN CONDITION EXISTS.
1. See nozzle/equipment schedule on sheet 5.02 for size, elevation and orientation of nozzles and appurtenances.
2. Provide a roof with slope of 1/12.
3. Provide 6"x18" opening in intermediate landing for piping and conduit.
4. Lap roof plate seams to shed water (inner plates on top).
5. See level set-point table 4/D.12 for elevations of alarms and controls.
6. Rafters not shown for clarity.
7. Space internal pipe supports per interior pipe support 6/D.08.
8. Provide a roof with slope of 1/12.

Notes:
- =1'-0"

Scale:
- Plan
- Elevation

Elevation is shown without regard to orientation, see note 1.

Circumferential stairs not shown for clarity. Items shown on note 2.

Approach step, concrete.
1. **Distance Values Shown on Table for Shell Nozzles Are as Measured from the Bottom of the Shell to the Centerline of the Roof Nozzles.** Distance values shown on Table for Roof Nozzles are as measured from the Center of the Tank to the Centerline of the Nozzle.

2. **Adjust Size of Fill, Issue, and Low Suction Nozzles to Suit Site Conditions such as Distance to Pumps and Operational Requirements.**

3. **Provide a Pan Installation Hatch on the Fixed Roof in Accordance with the Pan Manufacturer’s Requirements.**

4. **Size of Fill and Issue Nozzles and Piping Must be Determined by the Designer.** Refer to UFC 3-460-01 for Design Requirements.

5. **Adjust Size of Fill, Issue, and Low Suction Nozzles to Suit Site Conditions such as Distance to Pumps and Operational Requirements.**

6. **Locate Upper Shell Manhole 90° Above Upper Surface of Floating Pan at High Level Position.**

7. **High Level Shut-Off Valve Float Valve Assembly, as Well as High and High-High Level Alarm Sensors, Shall Be Accessible from Spiral Stairway Intermediate Platforms.**

8. **Mount the 6” ATG Water Probe Well over the Tank Bottom Sump Through an 8” Flanged Roof Nozzle Per the Indicated Details.**

9. **The 2” Water Drain Off Nozzle Shown in the Standard is Based on the Smallest Double Burned and Bleed Value Available at the Time This Standard Was Written.** For Tanks That Are Expected to Receive a Minimum Amount of Water Injected to Produce Minimum Condensation, Provide Internal piping that would result in 180° Near the Internal Nozzle Flange to Limit the Amount of Water that is Retained in the Internal piping.

10. **The Elevation of Fill and Issue Nozzle Sizes 12” and Larger Shall Be As Low As Allowed by API STD 650 Using Low Type Reinforcing Plates.** Fills and Issue Nozzle Sizes Smaller Than 12” Shall Be As Low As Allowed by API STD 650 Using Regular Type Reinforcing Plates.

11. **Floating Pan Cross Level Shall Provide a Minimum of 6” Clearance from the Top of Any Internal Nozzle Flanged to the Bottom of the Floating Pan.**

12. **Provide at least one Overflow for every 2500 GPM of Receipt.** Do not locate overflows over stairs or Shell Suction Nozzle Bleed Values. Where the Pattern of Roof Diameter Circulation Vents Would Result in an Overflow Circulation Vent over Product piping on the Stairway, Provide a Shell Circulation Vent Constructed Similar to an Overflow Circulation Vent but 180° FARTHER in Location at Tank Location and Ensure the Remaining Overflowing Aids and Adequate.

13. **Install Low Suction and Water Drain-Off Nozzles Parallel to the Issue Nozzle.**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>SIZE (IN)</th>
<th>ANGLE (DEGREES)</th>
<th>DISTANCE (NOTE 1)</th>
<th>DETAIL SHOWN (DETAIL SHEET)</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>ISSUE</td>
<td>12</td>
<td>270</td>
<td>1-1/2”</td>
<td>400-28</td>
<td>4, 5, 10</td>
</tr>
<tr>
<td>B</td>
<td>FILL</td>
<td>8</td>
<td>160</td>
<td>1-1/2”</td>
<td>400-28</td>
<td>4, 5, 10</td>
</tr>
<tr>
<td>C</td>
<td>LOW SUCTION</td>
<td>4</td>
<td>-</td>
<td>1-1/2”</td>
<td>400-28, 10/10</td>
<td>5, 10</td>
</tr>
<tr>
<td>D</td>
<td>WATER DRAIN-OFF</td>
<td>2</td>
<td>-</td>
<td>1-1/2”</td>
<td>400-28, 10/10, 15/10, 10/10</td>
<td>9, 13</td>
</tr>
<tr>
<td>E</td>
<td>PRODUCT RETURN</td>
<td>2</td>
<td>260</td>
<td>-</td>
<td>400-28</td>
<td>9, 13</td>
</tr>
<tr>
<td>F</td>
<td>SHELL MANHOLE (LOWER)</td>
<td>36</td>
<td>-</td>
<td>3’-0”</td>
<td>300-10, 300-10</td>
<td>2, 11</td>
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<tr>
<td>G</td>
<td>SHELL MANHOLE (UPPER)</td>
<td>36</td>
<td>162</td>
<td>9’-0”</td>
<td>300-10, 300-10</td>
<td>6, 11</td>
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<tr>
<td>H</td>
<td>ATG GAUGE WELL</td>
<td>10</td>
<td>250</td>
<td>10’-4”</td>
<td>400-27</td>
<td>16</td>
</tr>
<tr>
<td>I</td>
<td>ATG WATER PROBE WELL</td>
<td>12</td>
<td>225</td>
<td>3’-3”</td>
<td>300-27</td>
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<tr>
<td>J</td>
<td>MECANICAL TAPE LEVEL GAUGE</td>
<td>1-3/4</td>
<td>20</td>
<td>300-27</td>
<td>8</td>
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</tr>
<tr>
<td>K</td>
<td>LOW &amp; HIGH LEVEL ALARM NOZZLES</td>
<td>1</td>
<td>200</td>
<td>X’-X”, X’-X”</td>
<td>180-12</td>
<td>7</td>
</tr>
<tr>
<td>L</td>
<td>HIGH &amp; HIGH-HIGH LEVEL ALARM AND HV NOZZLES</td>
<td>1</td>
<td>200</td>
<td>X’-X”, X’-X”</td>
<td>200-12</td>
<td>7</td>
</tr>
<tr>
<td>M</td>
<td>SAMPLE GAUGE WELL</td>
<td>10</td>
<td>250</td>
<td>10’-4”</td>
<td>200-27</td>
<td>16</td>
</tr>
<tr>
<td>N</td>
<td>ROOF MANHOLE/LADDER HATCH</td>
<td>30 X 48</td>
<td>255</td>
<td>12’-4”</td>
<td>300-28</td>
<td></td>
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<tr>
<td>O</td>
<td>CENTER ROOF VENT</td>
<td>24</td>
<td>-</td>
<td>-</td>
<td>250-28</td>
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<tr>
<td>P</td>
<td>CIRCULATION VENT/INSPECTION HATCHES</td>
<td>18 X 24</td>
<td>45</td>
<td>180-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q</td>
<td>OVERFLOW/CIRCULATION VENT</td>
<td>1’-1/4”</td>
<td>3’-1/4”</td>
<td>300-27</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>PAN INSTALLATION HATCH</td>
<td>45</td>
<td>-</td>
<td>-</td>
<td>300-27</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>SUMP</td>
<td>35</td>
<td>205</td>
<td>6’-0”</td>
<td>300-27</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>GROUNDING LUGS</td>
<td>3 X 3’-3”</td>
<td>300-11, 300-20, 200-20</td>
<td>1-2”</td>
<td>300-14</td>
<td></td>
</tr>
<tr>
<td>U</td>
<td>FLOATING PAN LOW LEVEL</td>
<td>-</td>
<td>2’-0”</td>
<td>-</td>
<td>300-14</td>
<td></td>
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<tr>
<td>V</td>
<td>SCABFOLD CABLE SUPPORTS</td>
<td>130, 215</td>
<td>6’-9”</td>
<td>-</td>
<td>300-14</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

1. **Distance Values Shown on Table for Shell Nozzles Are as Measured from the Bottom of the Tank to the Centerline of the Roof Nozzles.**

2. **Adjust Size of Fill and Issue Nozzles to Suit Site Conditions such as Distance to Pumps and Operational Requirements.**

3. **Provide a Pan Installation Hatch on the Fixed Roof in Accordance with the Pan Manufacturer’s Requirements.**

4. **Size of Fill and Issue Nozzles and Piping Must be Determined by the Designer.** Refer to UFC 3-460-01 for Design Fluctuators when sizing Tank piping.

5. **Align Low Level Shell Manholes 180° Apart and Parallel with Prevailing Wind Winds.**

6. **Locate Upper Shell Manhole 90° Above Upper Surface of Floating Pan at High Level Position.**

7. **High Level Shut-Off Valve Float Valve Assembly, as Well as High and High-High Level Alarm Sensors, Shall Be Accessible from Spiral Stairway Intermediate Platforms.**

8. **Mount the 6” ATG Water Probe Well over the Tank Bottom Sump Through an 8” Flanged Roof Nozzle Per the Indicated Details.**

9. **The 2” Water Drain Off Nozzle Shown in the Standard is Based on the Smallest Double Burned and Bleed Value Available at the Time This Standard Was Written.** For Tanks That Are Expected to Receive a Minimum Amount of Water Injected to Produce Minimum Condensation, Provide Internal piping that would result in 180° Near the Internal Nozzle Flange to Limit the Amount of Water that is Retained in the Internal piping.

10. **The Elevation of Fill and Issue Nozzle Sizes 12” and Larger Shall Be As Low As Allowed by API STD 650 Using Low Type Reinforcing Plates.** Fills and Issue Nozzle Sizes Smaller Than 12” Shall Be As Low As Allowed by API STD 650 Using Regular Type Reinforcing Plates.

11. **Floating Pan Cross Level Shall Provide a Minimum of 6” Clearance from the Top of Any Internal Nozzle Flanged to the Bottom of the Floating Pan.**

12. **Provide at least one Overflow for every 2500 GPM of Receipt.** Do not locate overflows over stairs or Shell Suction Nozzle Bleed Values. Where the Pattern of Roof Diameter Circulation Vents Would Result in an Overflow Circulation Vent over Product piping on the Stairway, Provide a Shell Circulation Vent Constructed Similar to an Overflow Circulation Vent but 180° FARTHER in Location at Tank Location and Ensure the Remaining Overflowing Aids and Adequate.

13. **Install Low Suction and Water Drain-Off Nozzles Parallel to the Issue Nozzle.**

14. **All Shell and Roof Nozzles Shall Be Flanged Unless Otherwise Indicated.**

15. **Interstellar piping for elevated tank foundation is shown for non-elevated tank bottom, foundation, and interstitial piping plan, see 3/D.01.**

16. **Mount the 6” ATG and Sample Gauge Wells Through 10” Flanged Roof Nozzles Per the Indicated Details.**

17. **The Maximum Distance from the Shell Manhole Reinforcing Plate to the Backside of the Manhole Flange, As Measured Horizontally on the Vertical Centerline, Shall Not Be More than 6”.**

**Scale: 1" = 1'-0"**

**5,000 BBL TANK BOTTOM, FOUNDATION, AND INTERSTITIAL PIPING PLAN**

**Notes:**

- 5,000 BBL Tank Nozzle/Equipment Schedule
- 5,000 BBL Tank Bottom, Foundation, and Interstitial Piping Plan
- Foundation Ringwall Extents
- Tank Shell
- Foundation Extension
- Concrete Pipe Support Pier for Pipe Anchor
- 2" PVC Pipe Tracer Pipe
- FML Sump
- FML Sump
- 4" FIP Leak Detection Tell Tale Pipe Unless Exempt in Tank Bottom FML Sump
- Lap Bottom Plate Seal to Land Water Outer Plates on Top
- Leak Simulation Probe
1. SEE NOZZLE/EQUIPMENT SCHEDULE ON SHEET 10.02 FOR SIZE, ELEVATION AND NOTES.
2. PROVIDE GUARDRAIL ALL AROUND PERIMETER OF ROOF EXCEPT AT STAIRWAY TOP ORIENTATION OF NOZZLES AND APPURTENANCES.
3. PROVIDE 6"x18" OPENING IN INTERMEDIATE LANDING FOR PIPING AND CONDUIT.
4. LAP ROOF PLATE SEAMS TO SHED WATER (INNER PLATES ON TOP).
5. SEE LEVEL SET-POINT TABLE 4/D.12 FOR ELEVATIONS OF ALARMS AND CONTROLS.
6. RAFTERS NOT SHOWN FOR CLARITY.
7. SPACE INTERNAL PIPE SUPPORTS PER INTERIOR PIPE SUPPORT ISO 58.
8. PROVIDE A ROOF WITH SLOPE OF 1:12.

NOTE:
CIRCUMFERENTIAL STAIRS NOT SHOWN FOR CLARITY. ITEMS SHOWN ON ELEVATION ARE SHOWN WITHOUT REGARD TO ORIENTATION. SEE NOTE 1.

10,000 BBL TANK

PLAN

ELEVATION
1. DISTANCE VALUES SHOWN ON TABLE FOR SHELL NOZZLES ARE AS MEASURED FROM THE BOTTOM OF THE SHELL TO THE CENTERLINE OF SHELL NOZZLES. DISTANCE VALUES SHOWN ON TABLE FOR ROOF NOZZLES ARE AS MEASURED FROM THE CENTER OF THE TANK TO THE CENTERLINE OF THE ROOF NOZZLE. DISTANCE VALUES SHOWN ON TABLE FOR TANK BOTTOM SUMP ARE MEASURED FROM THE CENTER OF THE TANK TO THE CENTERLINE OF THE SUMP.

2. ALIGN LOWER SHELL MANHOLES 180° APART AND PARALLEL WITH PREVAILING WINDS.

3. PROVIDE A PAIN INSTALLATION HATCH ON THE FIXED ROOF IN ACCORDANCE WITH THE PAIN MANUFACTURER'S REQUIREMENTS.

4. SIZE OF FILL AND ISSUE NOZZLES AND PIPING MUST BE DETERMINED BY THE DESIGNER. REFER TO LFC 3-480-01 FOR DESIGN FLOWMETERS WHEN USING TANK PIPING.

5. ADJUST SIZE OF FILL, ISSUE, AND LOW SUCTION NOZZLES TO SUIT SITE CONDITIONS SUCH AS DISTANCE TO PUMPS AND OPERATIONAL REQUIREMENTS.

6. LOCATE UPPER SHELL MANHOLE 3'-6" ABOVE UPPER SURFACE OF FLOATING PAN AT HIGH LEG POSITION.


8. MOUNT THE 6" ATG WATER PROBE WELL OVER THE TANK BOTTOM SUMP THROUGH AN 8" FLANGED ROOF NOZZLE AND OPERATIONAL REQUIREMENTS.

9. LOW SUCTION AND WATER DRAW-OFF NOZZLES PARALLEL TO THE ISSUE NOZZLE.

10. THE ELEVATION OF FILL AND ISSUE NOZZLE SIZES 12" AND LARGER SHALL BE AS LOW AS ALLOWED BY API STD 650 USING REGULAR TYPE REINFORCING PLATES. FILL AND ISSUE NOZZLE SIZES SMALLER THAN 12" SHALL BE AS LOW AS ALLOWED BY API STD 650 USING LOW TYPE REINFORCING PLATES.

11. FLOATING PAN LOW-LEG LEVEL SHALL PROVIDE A MINIMUM OF 6" CLEARANCE FROM THE TOP OF ANY INTERNAL DRAW-OFF PIPING REDUCED TO 1" SIZE NEAR THE INTERNAL NOZZLE FLANGE TO LIMIT THE AMOUNT OF WATER THAT WOULD RESULT IN AN OVERFLOW/CIRCULATION VENT OVER PRODUCT PIPING OR THE STAIRWAY, PROVIDE A SHELL CIRCULATION VENT/INSPECTION HATCHES.

12. PROVIDE AT LEAST ONE OVERFLOW FOR EVERY 100 BPM OF RECEPTOR. DO NOT LOCATE OVERFLOW OVER STAIRS OR SHELL NOZZLE ISOLATION VALVES. PREVENT THE PATTERN OF ROOF PERIMETER CIRCULATION VENTS FROM RESULTING IN AN OVERFLOW/CIRCULATION VENT OVER PRODUCT PIPING OR THE STAIRWAY. PROVIDE A SHELL CIRCULATION VENT CONNECTED SIMILAR TO AN OVERFLOW/CIRCULATION VENT BUT 1/3' HIGHER IN ELEVATION AT THAT LOCATION AND ENSURE THE REMAINING OVERFLOWS ARE ADEQUATE.

13. INSTALL LOW SUCTION AND WATER DRAW-OFF NOZZLES PARALLEL TO THE ISSUE NOZZLE.

14. ALL SHELL AND ROOF NOZZLES SHALL BE FLANGED UNLESS OTHERWISE INDICATED.

15. INTERSTITIAL PIPING FOR ELEVATED TANK FOUNDATION IS SHOWN FOR NON-ELEVATED TANK BOTTOM FOUNDATION, AND INTERSTITIAL PIPING PLAN SIZE 3/D.01.

16. MOUNT THE 8" ATG AND SAMPLE GAUGE WELLS THROUGH 10" FLANGED ROOF NOZZLES PER THE INDICATED DETAILS.

17. THE MAXIMUM DISTANCE FROM THE SHELL MANHOLE REINFORCING PLATE TO THE BACKSIDE OF THE MANHOLE FLANGE, AS MEASURED VERTICAL/HORIZONTALLY, SHALL NOT BE MORE THAN 9'.
1. PROVIDE GUARDRAIL ALL AROUND PERIMETER OF ROOF EXCEPT AT STAIRWAY TOP PLATFORM.

2. PROVIDE OPENING IN INTERMEDIATE LANDING FOR PIPING AND CONDUIT.

3. PROVIDE A ROOF WITH SLOPE OF 1.7.

4. LAP ROOF PLATE SEAMS TO SHED WATER (INNER PLATES ON TOP).

5. RAFTERS NOT SHOWN FOR CLARITY.

6. SEE LEVEL SET-POINT TABLE 4/D.12 FOR ELEVATIONS OF ALARMS AND CONTROLS.

7. SPACE INTERNAL PIPE SUPPORTS PER INTERIOR PIPE SUPPORT 6/D.

8. SEE NOZZLE EQUIPMENT SCHEDULE ON SHEET 20.02 FOR SIZE, ELEVATION AND ORIENTATION NOTES.
1. The maximum distance from the shell manhole reinforcing plate to the backside of the manhole and interstitial piping plan, see 3/D.01.

2. Provide a pan installation hatch on the fixed roof in accordance with the pan manufacturer's requirements.

3. Size of fill and issue nozzles and piping must be determined by the designer. Refer to UFC 3-460-01 for design data selecting when sizing tank piping.

4. Adjust size of fill, issue, and low suction nozzles to suit site conditions such as distance to pumps and operational requirements.

5. Locate upper shell manhole 3'-6" above upper surface of floating pan at high leg position.


7. High & high level alarm and high leg nozzles.

8. Sample gauge well.

9. Roof manhole/adder hatch.

10. Pan installation hatch.

11. Pump well.

12. Sump.


14. Floating pan/low level.

15. Scalloped cable supports.

16. All shell and roof nozzles shall be flanged unless otherwise indicated.

17. Interstitial piping for elevated tank foundation is shown for non-elevated tank bottom, foundation, and interstitial piping plan set 3/D.01.

18. Mount the 4" water drain probe well over the tank bottom sump through an 8" flanged roof nozzle per the indicated details.

19. The 2" water drain-off nozzle shown in this standard is based on the smallest double block and bleed valve available at the time this standard was written. For tanks that are expected to receive a minimum amount of water and expected to produce minimum condensate, provide internal water bleed valve available at the time this standard was written.

20. The 2" water drain-off nozzle shown in this standard is based on the smallest double block and bleed valve available at the time this standard was written. For tanks that are expected to receive a minimum amount of water and expected to produce minimum condensate, provide internal water

21. Provide at least one overflow for every 1000 gpm of receipt. Do not locate over flows over stands or shell nozzles isolation valves. Where the pattern of roof perimeter circulation vents would result in an overflow circulation vent over project piping or the standpipe, provide a shell circulation vent constructed similar to an over low circulation vent but 1'-0" higher in elevation at that location and ensure the remaining overflows are adequate.

22. Install low suction and water drain-off nozzles parallel to the issue nozzle.

23. Provide a minimum of 6" clearance from the top of any internal nozzle flange to the bottom of the floating pan.

24. Provide at least one overflow for every 1000 gpm of receipt. Do not locate over flows over stands or shell nozzles isolation valves. Where the pattern of roof perimeter circulation vents would result in an overflow circulation vent over project piping or the standpipe, provide a shell circulation vent constructed similar to an over low circulation vent but 1'-0" higher in elevation at that location and ensure the remaining overflows are adequate.

25. Install low suction and water drain-off nozzles parallel to the issue nozzle.
1. See nozzle equipment schedule on sheet 30.02 for size, elevation, and orientation of nozzles and appurtenances.
2. Provide guardrail all around perimeter of roof except at stairway top platform.
3. Provide 6"x18" opening in intermediate landing for piping and conduit.
4. Lap roof plate seams to shed water (inner plates on top).
5. See level set-point table 4/D.12 for elevations of alarms and controls.
6. Rafters not shown for clarity.
7. Space internal pipe supports per interior pipe support 6/D.08.
8. Provide a roof with slope of 1/12.

NOTE:
- CIRCUMFERENTIAL STAIRS NOT SHOWN FOR CLARITY. ITEMS SHOWN ON ELEVATION ARE SHOWN WITHOUT REGARD TO ORIENTATION. SEE NOTE 1.

ELEVATION

NOTE 3:
- PLATFORM C
- INTERMEDIATE PLATFORM
- NOTE 7
- PLATFORM SUPPORT
- NOTE 3
- CIRCUMFERENTIAL STAIR
- NOTE 3
- STAIRWAY SUPPORT
- NOTE 3
- CONCRETE APPROACH STEPS
- NOTE 3
- TANK BOTTOM PLATFORM
- NOTE 3
- TOP PLATFORM
1. Distance values shown on table for shell nozzles are as measured from the bottom of the shell to the center of the tank to the centerline of roof nozzles. Distance values shown on table for tank bottom sump is measured from the center of the tank to the centerline of the roof nozzles. Distance values shown on table for roof nozzles are as measured from the center of the tank to the centerline of roof nozzles. Distance value shown on table for tank bottom sump is measured from the center of the tank to the centerline of the sump.

2. Align lower shell manholes 180° apart and parallel with prevailing winds.

3. Provide a pan installation hatch on the fixed roof in accordance with the pan manufacturer’s requirements.

4. Size of fill and issue nozzles and piping must be determined by the designer. Refer to UFC 3-460-01 for design requirements when sizing tank piping.

5. Shell manholes (lower) shall provide a minimum of 6" clearance from the top of any internal nozzle flange to the bottom of the floating pan.

6. Locate upper shell manhole 3'-6" above upper surface of floating pan at high leg position.

7. High level shut-off valve float plate assembly, as well as high and high-high level alarm sensors, shall be accessible from spiral, starway intermediate platform.

8. Mount the 8" water probe well over the tank bottom sump through an 8" flanged roof nozzle per the indicated details.

9. The elevation of fill and issue nozzle sizes 12" and larger shall be as low as allowed by API STD 650 using low type reinforcing plates. Fill and issue nozzle sizes smaller than 12" shall be as low as allowed by API STD 650 using regular type reinforcing plates.

10. The elevation of fill and issue nozzle sizes 12" and larger shall be as low as allowed by API STD 650 using low type reinforcing plates. Fill and issue nozzle sizes smaller than 12" shall be as low as allowed by API STD 650 using regular type reinforcing plates.

11. Provide at least one overflow for every 100 SPF (pint per second). Do not locate overflows over strainers or shell nozzle isolation valves. Where the pattern of roof permitting circulation vents would result in an overflow circulation vent over product piping on the starway, provide a shell circulation vent constructed in addition to an overlow circulation vent but 1'-0" higher in elevation at that location and ensure the remaining overflows are adequate.

12. Install low suction and water drain off nozzles parallel to the issue nozzle.

13. All shell and roof nozzles shall be flanged unless otherwise indicated.

14. Interstitial piping for elevated tank foundation is shown. For non-elevated tank bottom, foundation, and interstitial piping plan, see 3/D.01.

15. Interstitial piping for elevated tank foundation is shown. For non-elevated tank bottom, foundation, and interstitial piping plan, see 3/D.01.

16. Mount the 8" and sample gauge wells through 10" flanged roof nozzles per the indicated details.

17. The maximum distance from the shell manhole reinforcing plate to the backside of the manhole flange, as measured horizontally on the vertical centerline, shall not be more than 4'-0".
NOTES:

1. SEE NOZZLE EQUIPMENT SCHEDULE ON SHEET 30.02 FOR SIZE, ELEVATION AND ORIENTATION
   OF NOZZLES AND APPURtenANCES.

2. PROVIDE GUARDRAIL ALL AROUND PERIMTER OF ROOF EXCEPT AT STAIRWAY TOP
   PLATFORM.

3. PROVIDE 6"x18" OPENING IN INTERMEDIATE LANDING FOR PIPING AND CONDUIT.

4. LAP ROOF PLATE SEAMS TO SHED WATER (INNER PLATES ON TOP).

5. SEE LEVEL SET-POINT TABLE 4/D.12 FOR ELEVATIONS OF ALARMS AND CONTROLS.

6. RAFTERS NOT SHOWN FOR CLARITY.

7. SPACE INTERIOR PIPE SUPPORTS PER INTERIOR PIPE SUPPORT (OBS).

8. PROVIDE A ROOF WITH SLOPE OF 15/12.
1. SEE NOZZLE EQUIPMENT SCHEDULE ON SHEET 5.01 FOR SIZE, ELEVATION AND NOTES.

2. PROVIDE GUARDRAIL ALL AROUND PERIMETER OF ROOF EXCEPT AT STAIRWAY ORIENTATION OF NOZZLES AND APPURTENANCES.

3. PROVIDE 6"x18" OPENING IN INTERMEDIATE LANDING FOR PIPING AND CONDUIT.

4. LAP BOTTOM PLATE SEAMS TO SHED WATER (INNER PLATES ON TOP).

5. SEE LEVEL SET-POINT TABLE 4.012 FOR ELEVATIONS OF ALARMS AND CONTROLS.

6. RAFTERS NOT SHOWN FOR CLARITY.

7. SPACE INTERNAL PIPE SUPPORTS PER INTERIOR PIPE SUPPORT ISO 28.

8. PROVIDE ROOF WITH SLOPE OF 1:12.
50,000 BBL TANK BOTTOM, FOUNDATION, AND INTERSTITIAL PIPING PLAN

Scale: 1/4" = 1'

1.  THE MAXIMUM DISTANCE FROM THE SHELL MANHOLE REINFORCING PLATE TO THE BACKSIDE OF THE MANHOLE FLANGE, AS MEASURED FROM THE CENTER OF THE MANHOLE TO THE CENTERLINE OF SHELL NOZZLES. DISTANCE VALUE SHOWN ON TABLE FOR ROOF NOZZLES IS MEASURED FROM CENTER OF THE TANK TO THE CENTERLINE OF THE BUMP.

2.  ALIGN LOWER SHELL MANHOLE 18" APART AND PARALLEL WITH PREVIOUS HOLES.

3.  PROVIDE A PAN INSTALLATION HATCH ON THE FIXED ROOF IN ACCORDANCE WITH THE MANUFACTURER'S REQUIREMENTS.

4.  SIZE OF FILL AND ISSUE NOZZLES AND PIPING MUST BE DETERMINED BY THE DESIGNER. REFER TO UFC 3-460-01 FOR DESIGN FLOWRATES WHEN SIZING TANK PIPING.

5.  ADJUST SIZE OF FILL, ISSUE AND LOW SUCTION NOZZLES TO SUIT SITE CONDITIONS SUCH AS DISTANCE TO PUMPS AND OPERATIONAL REQUIREMENTS.

6.  LOCATE UPPER SHELL MANHOLE 3' ABOVE UPPER END OF FLOATING PIER AT HIGH LEG POSITION.

7.  HIGH LEVEL SHUT-OFF VALVE FLOAT PILOT ASSEMBLY, AS WELL AS HIGH AND HIGH-HIGH LEVEL ALARM SENSORS, SHALL BE ACCOMMODATED FROM SPIRAL START-UP AND內部 INTERCONNECT PLATFORM.

8.  MOUNT THE 8" WATER PROBE WELL OVER THE TANK BOTTOM SUMP THROUGH AN 8" SLANTED NOZZLE PIER FOR THE INDICATED DETAILS.

9.  THE 2" WATER SHUT-OFF NOZZLE SHOWN IN THIS STANDARD IS BASED ON THE SMALLEST DOUBLE BLOCK AND BLEED VALVE AVAILABLE AT THE TIME THIS STANDARD WAS WRITTEN. FOR TANKS THAT ARE EXPECTED TO RECEIVE A MAXIMUM AMOUNT OF WATER AND EXPECTED TO PRODUCE MINIMUM CONDENSATE, PROVIDE INTERNAL WATER SHUT-OFF PIPING REDUCED TO 1" IN SIZE, WASHING THE INTERNAL NOZZLE PIER TO LIMIT THE AMOUNT OF WATER AT THE INTERNAL PIER PUMP LOCATION.

10.  THE ELEVATION OF FILL AND ISSUE NOZZLE SIZES 12" AND LARGER SHALL BE AS LOW AS ALLOWED BY API STD 650 USING LOW TYPE ISOLATION VALVES. WHERE THE PATTERN OF ROOF PERIMETER CIRCULATION VENTS WOULD RESULT IN AN OVERFLOW/CIRCULATION VENT OVER HIGHER IN ELEVATION AT THAT LOCATION AND ENSURE THE REMAINING OVERFLOWS ARE ADEQUATE.

11.  FLOTTING PANS LOW LEG LEVEL SHALL PROVIDE A MINIMUM OF 6" CLEARANCE FROM THE TOP OF ANY INTERNAL NOZZLE FLANGE TO THE BOTTOM OF THE FLOATING PANN.

12.  PROVIDE AT LEAST ONE OVERFLOW FOR EVERY 1200 GPM OF RECEIPT. DO NOT LOCATE OVERFLOWS OVER STAIRS OR SHELL NOZZLE REINFORCING PLATES.

13.  INSTALL LOW SUCTION AND WATER DRAW-OFF NOZZLES PARALLEL TO THE ISSUE NOZZLE.

14.  ALL SHELL AND ROOF NOZZLES SHALL BE FLANGED UNLESS OTHERWISE INDICATED.

15.  INTERSTITIAL PIPING FOR ELEVATED TANK FOUNDATION IS SHOWN. FOR NON-ELEVATED TANK BOTTOM, FOUNDATION, AND INTERSTITIAL PIPING PLAN, SEE 3/D.01.
NOTES:
1. See nozzle equipment schedule on sheet 80.02 for size, elevation and orientation of nozzles and appurtenances.
2. Provide guardrail all around perimeter of roof except at stairway platform.
3. Provide 5" x 10" opening in intermediate landing for piping and conduit.
4. Lap bottom plate seams to shed water (inner plates on top).
5. See Level set-point table 4D.12 for elevations of alarms and controls.
6. Rafters not shown for clarity.
7. Space internal pipe supports per interior pipe support 6D.08.
8. Provide roof with slope of 1:12.

CIRCUMFERENTIAL STAIRS NOT SHOWN FOR CLARITY. ITEMS SHOWN ON ELEVATION ARE SHOWN WITHOUT REGARD TO ORIENTATION, SEE NOTE 1.
**DESCRIPTION**

**5' SHELL CIRCULATION VENTS**

2. ALIGN LOWER SHELL MANHOLES 180° APART AND PARALLEL WITH PREVAILING WINDS.

4. SIZE OF FILL AND ISSUE NOZZLES AND PIPING MUST BE DETERMINED BY THE DESIGNER. REFER TO MANUFACTURER'S REQUIREMENTS.

5. ADJUST SIZE OF FILL, ISSUE AND LOW SUCTION NOZZLES TO SUIT SITE CONDITIONS SUCH AS DISTANCE TO PUMPS AND OPERATIONAL REQUIREMENTS.

6. LOCATE UPPER SHELL MANHOLE 3'-6" ABOVE UPPER SURFACE OF FLOATING PAN AT HIGH LEG POSITION.

7. HIGH-LEVEL SHUT-OFF VALVE FLOAT PILOT ASSEMBLY, AS WELL AS HIGH AND HIGH-HIGH LEVEL ALARM SENSORS, SHALL BE ACCESSIBLE FROM SPIRAL STAIRWAY INTERMEDIATE PLATFORM.

8. MOUNT THE 6" ATG WATER PROBE WELL OVER THE TANK BOTTOM SUMP THROUGH AN 8" FLANGED ROOF NOZZLE PER THE INDICATED DETAILS.

9. THE 2" WATER DRAW-OFF NOZZLE SHOWN IN THIS STANDARD IS BASED ON THE SMALLEST DOUBLE BLOCK AND BLEED VALVE AVAILABLE AT THE TIME THIS STANDARD WAS WRITTEN. FOR TANKS THAT ARE EXPECTED TO RECEIVE A MINIMUM AMOUNT OF WATER AND EXPECTED TO PRODUCE MAXIMUM CONDENSATE, PROVIDE INTERNAL WATER DRAW-OFF PIPING REDUCED TO 1" SIZE NEAR THE INTERNAL SUMP TO LIMIT THE AMOUNT OF WATER THAT IS RETAINED IN THE INTERNAL PIPING.

10. THE ELEVATION OF FILL AND ISSUE NOZZLE SIZES 12" AND LARGER SHALL BE AS LOW AS ALLOWED BY API STDS 650 USING LOW TYPE REINFORCING PLATES. FILL AND ISSUE NOZZLE SIZES SMALLER THAN 12" SHALL BE AS LOW AS ALLOWED BY API STDS 650 USING REGULAR TYPE REINFORCING PLATES.

11. FLOATING PAN LOW LEG LEVEL SHALL PROVIDE A MINIMUM OF 6" CLEARANCE FROM THE TOP OF ANY INTERNAL NOZZLE FLANGE TO THE BOTTOM OF THE FLOATING PAN.

12. PROVIDE AT LEAST ONE OVERFLOW FOR EVERY 1000 GPM OF RECEPT. DO NOT LOCATE OVERWalls OVER STAIRS OR SHELL NOZZLE ELEVATION VALUES. WHERE THE PATTERN OF ROOF PERIMETER CIRCULATION VENTS WOULD RESULT IN AN OVERWALL CIRCULATION VENT OVER PRODUCT PIPING ON THE STAIRWAY, PROVIDE A SHELL CIRCULATION VENT CONSTRUCTED SIMILAR TO AN OVERWALL CIRCULATION VENT BUT 1'-0" HIGHER IN ELEVATION AT THAT LOCATION AND Ensure THE REMAINING OVERWALLS ARE ADEQUATE.

13. INSTALL LOW SUCTION AND WATER DRAW-OFF NOZZLES PARALLEL TO THE ISSUE NOZZLE.

14. ALL SHELL AND ROOF NOZZLES SHALL BE FLANGED UNLESS OTHERWISE INDICATED.

15. MOUNT THE 8" ATD AND SAMPLE GAUGE WELLS THROUGH 10" FLANGED ROOF NOZZLES PER THE INDICATED DETAILS.

16. MOUNT THE 8" ATG AND SAMPLE GAUGE WELLS THROUGH 10" FLANGED ROOF NOZZLES PER THE INDICATED DETAILS.

17. THE MAXIMUM DISTANCE FROM THE SHELL MANHOLE REINFORCING PLATE TO THE BACKSIDE OF THE TANK SUMP FLANGE, AS MEASURED HORIZONTALLY ON THE VERTICAL CENTERLINE, SHALL NOT BE MORE THAN 3'-6".
NOTES:

1. See nozzle equipment schedule on Sheet 80.02 for size, elevation and orientation of nozzles and appurtenances.

2. Provide guardrail all around perimeter of roof except at stairway platform.

3. Provide 6'-0" opening in intermediate landing for piping and conduit.

4. Lap bottom plate seams to shed water (inner plates on top).

5. See level set-point table 4/D.12 for elevations of alarms and controls.

6. Rafter not shown for clarity.

7. Space internal pipe supports per interior pipe support 6/D.08.

8. Provide roof with slope of 1/12.
1. DISTANCE VALUES SHOWN ON TABLE FOR SHELL NOZZLES ARE AS MEASURED FROM THE BOTTOM OF THE SHELL TO THE CENTERLINE OF SHELL NOZZLES. DISTANCE VALUES SHOWN ON TABLE FOR ROOF NOZZLES ARE AS MEASURED FROM THE CENTER OF THE ROOF NOZZLE PER THE INDICATED DETAILS.

2. ALIGN LOWER SHELL MANHOLES 180° APART AND PARALLEL WITH PREVAILING WINDS.

3. PROVIDE A PAN INSTALLATION HATCH ON THE FIXED ROOF IN ACCORDANCE WITH THE PAN INSTALLATION HATCH DETAIL SHOWN.

4. SIZE OF FILL AND ISSUE NOZZLES AND PIPING MUST BE DETERMINED BY THE DESIGNER. REFER TO UFC 3-460-01 FOR DESIGN FLOWRATES WHEN SIZING TANK PIPING.

5. ADJUST SIZE OF FILL, ISSUE AND LOW SUCTION NOZZLES TO SUIT SITE CONDITIONS SUCH AS CONCRETE PIPE SUPPORT.

6. SHELL CIRCULATION VENTS shall be installed at the shell elevation as shown in the table above.

7. HIGH LEVEL SHUT-OFF VALVE FLOAT PILOT ASSEMBLY, AS WELL AS HIGH AND HIGH-HIGH LEVEL ALARM SENSORS, SHALL BE ACCESSIBLE FROM SPIRAL STAIRWAY INTERMEDIATE PLATFORM.

8. MOUNT THE 6" WATER DRAW-OFF NOZZLE SHOWN IN THIS STANDARD IS BASED ON THE SMALLEST DOUBLE NOZZLE SUPPORT PIPE FOR PIPE ANCHOR.

9. THE 2" WATER DRAW-OFF NOZZLE SHOWN IN THIS STANDARD IS BASED ON THE SMALLEST DOUBLE NOZZLE SUPPORT PIPE FOR PIPE ANCHOR.

10. THE ELEVATION OF FILL AND ISSUE NOZZLE SIZES 12" AND LARGER SHALL BE AS LOW AS ALLOWED BY AP STD 690 USING LOW TYPE REINFORCEMENT PLATES. FILL AND ISSUE NOZZLE SIZES SMALLER THAN 12" SHALL BE AS LOW AS ALLOWED BY AP STD 690 USING REGULAR TYPE REINFORCEMENT PLATES.

11. FLOATING FAN LOW LEG LEVEL SHALL PROVIDE A MINIMUM OF 6" CLEARANCE FROM ANY INTERNAL NOZZLE FLANGE TO THE BOTTOM OF THE FLOAT IN PAN.

12. PROVIDE AT LEAST ONE OVERFLOW FOR EVERY 1200 GPM OF RECEIPT. DO NOT LOCATE OVERFLOWS WITHIN 6' OF WALL, FOUNDATION, AND INTERSTITIAL PIPING PLAN, SEE 3/D.01.

13. INSTALL LOW SUCTION AND WATER DRAW-OFF NOZZLES PARALLEL TO THE ISSUE NOZZLE.

14. ALL SHELL AND ROOF NOZZLES SHALL BE FLANGED UNLESS OTHERWISE INDICATED.


16. MOUNT THE 6" ATG AND SAMPLE GAUGE WELLS SEEN TO SHELL WATER OUTER PLATES ON TOP.
1. DETAIL IS BASED ON TYPICAL 80,000 BBL TANK, OTHER TANK SIZES ARE SIMILAR.

2. SLOPE TOP OF CONCRETE TANK FOUNDATION BERM 1:20 TO OUTSIDE.

3. ON SIDE FURTHERMOST FROM SUMP, SLOPE TANK BOTTOM FROM SHELL TO OFF-CENTER SUMP AT A SLOPE OF NOT LESS THAN 1:20. SEE TANK 'ELEVATION', NOTE 3, FOR ELEVATION OF TOP OF SUMP.

4. FOR TANKS WITHOUT AN ELEVATED TANK FOUNDATION, SEE DETAIL 1 ON THIS SHEET.

5. FOUNDATION EXTENSION FOR CONCRETE PIPE SUPPORT PIER AND PIPE ANCHOR SHOWN ROTATED OUT OF POSITION FOR CLARITY.
1. 10,000 BBL TANK IS SHOWN. OTHER TANK SIZES ARE SIMILAR.

2. TANK BOTTOM FOUNDATION SEAL FOR ANCHORED TANK IS SHOWN.

- **FML SUMP LEAK DETECTION**
  - Scale: 3"=1'-0"
  - Notes:

- **RINGWALL PENETRATION**
  - Scale: 1"=1'-0"
  - Notes:
    - FML PENETRATION BOOT
      - 4½" OD 410 STAINLESS STEEL BUNN IN GASKET
      - (2) SS CLAMPS
      - FUEL RESISTANT SEALANT
      - CATHODIC PROTECTION SYSTEM CONDUIT
    - SAND
    - TANK SHELL
    - GEOTEXTILE FABRIC
    - SELF-ANCHORED (UNANCHORED TANK) TANK BOTTOM
    - TANK BOTTOM TO FOUNDATION SEAL (SEE NOTE 2)

- **LINER ANCHOR TO CONCRETE**
  - Scale: 1"=1'-0"
  - Notes:
    - LINER ANCHOR TO CONCRETE FOUNDATION SEAL FOR ANCHORED TANK IS SHOWN.
    - SAND
    - CONCRETE DRIE BAY
    - SAND
    - FML PENETRATION BOOT
      - 4½" OD 410 STAINLESS STEEL BUNN IN GASKET
      - (2) SS CLAMPS
      - FUEL RESISTANT SEALANT
      - CATHODIC PROTECTION SYSTEM CONDUIT
    - SAND
    - TANK SHELL
    - GEOTEXTILE FABRIC
    - SELF-ANCHORED (UNANCHORED TANK) TANK BOTTOM
    - TANK BOTTOM TO FOUNDATION SEAL (SEE NOTE 2)

- **NON-ELEVATED RINGWALL**
  - Scale: 1"=1'-0"
  - Notes:
    - JLINER ANCHOR TO CONCRETE FOUNDATION SEAL FOR ANCHORED TANK IS SHOWN.
    - SAND
    - CONCRETE DRIE BAY
    - SAND
    - FML PENETRATION BOOT
      - 4½" OD 410 STAINLESS STEEL BUNN IN GASKET
      - (2) SS CLAMPS
      - FUEL RESISTANT SEALANT
      - CATHODIC PROTECTION SYSTEM CONDUIT
    - SAND
    - TANK SHELL
    - GEOTEXTILE FABRIC
    - SELF-ANCHORED (UNANCHORED TANK) TANK BOTTOM
    - TANK BOTTOM TO FOUNDATION SEAL (SEE NOTE 2)
ROOF SUPPORT PLAN - NO COLUMNS

 SCALE: 1"=1'-0"

HSS OR W SHAPE RAFTER (TYP)

COMPRESSION RING, MITER AND PROVIDE TELI PENETRATION WELD TO MOMENT CONNECTION AT COMPRESSION RING (TYP). SHELL MAY BE CIRCULAR. SHELL STIFFENER PLATE (AS REQUIRED TO RESIST BUCKLING OF SHELL PLATE DUE TO VERTICAL LOADS AND THERMAL MOVEMENT OF ROOF PLATE)

TOP OF TANK TENSION RING AT TANK SHELL OF ROOF PLATE) AND THERMAL MOVEMENT DUE TO VERTICAL LOADS BUCKLING OF SHELL PLATE (AS REQUIRED TO RESIST SHELL STIFFENER PLATE

NOTES:

1. SLOPE OF ROOF SHALL BE CONSISTENT AND CONTINUOUS. TANK ROOF SHALL BE DESIGNED WITH A ROOF SLOPE OF 1/2 INCHES IN 12 INCHES. SLOPE OF FINISHED TANK ROOF PLATE SHALL BE DETERMINED AS SPECIFIED. PUDDLES OF WATER DEEPER THAN 3/16 INCH ANYWHERE ON THE TANK ROOF PLATES SHALL NOT BE ACCUMULATED.

2. NUMBER OF RAFTERS AT COMPRESSION RING CAN BE REDUCED BY INSTALLING HEADERS OR ADDITIONAL FRAMING BETWEEN RAFTERS.

3. TANKS GREATER THAN 91 FEET IN DIAMETER SHALL HAVE NO MORE THAN ONE COLUMN LOCATED AT CENTER OF TANK. LESSER DIAMETER TANKS SHALL HAVE NO INTERIOR COLUMN SUPPORTS.

SHELF SHELL RIM ANGLE (TYP)

RAFTER-COMPRESSION RING CONNECTION (TYP)

RAFTER-SHELL CONNECTION (TYP)

ROOF PLATE

STEEL PLATE TANK BOTTOM

VENT HOLE

FLUID TANKS WITHOUT FIXED ROOF SUPPORT PLAN AS NOTED

SCALE: 1"=1'-0"

SECTIONS 1

SECTIONS 2

DRAWFORM REVISION: 10 MAY 2014

UNCLASSIFIED//FOR OFFICIAL USE ONLY

SUBMITTED BY:

DATE: APRIL 2015

NAVFA C DRAWING NO.

DES
DRW
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DATE
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chk
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FOR COMMANDER NAVFAC

NAVY ENG. COMMAND - ALANTIC

OMAHA DISTRICT

US ARMY CORPS

ENGINEERING COMMAND - OHIO DISTRICT

A/E INFO

EPROJECT NO.:

5,000 THROUGH 50,000 BBLS TANK ROOF FRAMING PLAN

ABOVE GROUND FUEL TANKS WITH FIXED ROOF

DOD STANDARD DESIGN AAW 78-24-27

NAVAL FACILITIES ENGINEERING COMMAND - ALANTIC
SUPPORTS.

1. SLOPE OF ROOF SHALL BE CONSISTENT AND CONTINUOUS.  TANK SHELL SHALL HAVE A CONSTANT ROOF SLOPE OF 2 INCHES IN 12 INCHES. SLOPE OF FINISHED TANK ROOF PLATE SHALL BE FUSIBLE TESTED AS SPECIFIED. FUSIBLE PLATING OF WATER DEEPER THAN 5 INCHES ANYWHERE ON THE TANK ROOF PLATES SHALL NOT BE ACCEPTED.

2. NUMBER OF RAFTERS AT BEARING PLATE CAN BE REDUCED BY INSTALLING HEADERS OR ADDITIONAL FRAMING BETWEEN RAFTERS.

3. TANKS GREATER THAN 91 FEET IN DIAMETER SHALL HAVE MORE THAN ONE COLUMN LOCATED AT CENTER OF TANK. LESSER DIAMETER TANKS, SHALL HAVE NO INTERNAL COLUMN SUPPORTS.

RAFTER-COLUMN CONNECTION

PROVIDE SLEW CONNECTION AT BEARING OF RAFTER TO PREVENT MOVEMENT OF MEMBER DUE TO THERMAL CHANGES. SEAL END OF HSS RAPHER WITH FULLY WELDED END PLATE (TYP). HSS OR W SHAPE RAPHER (HSS SHOWN). PROVIDE VENT HOLE NEAR TOP OF OUTER COLUMN.

PROVIDE SUITABLE BEARING LENGTH TO RESIST MEMBER BUCKLING UNDER THERMAL LOADS AND TO RESIST MEMBER BUCKLING.

NOTE:

1. SLOPE OF ROOF SHALL BE CONSISTENT AND CONTINUOUS. TANK SHELL SHALL HAVE A CONSTANT ROOF SLOPE OF 2 INCHES IN 12 INCHES. SLOPE OF FINISHED TANK ROOF PLATE SHALL BE FUSIBLE TESTED AS SPECIFIED. FUSIBLE PLATING OF WATER DEEPER THAN 5 INCHES ANYWHERE ON THE TANK ROOF PLATES SHALL NOT BE ACCEPTED.

2. NUMBER OF RAFTERS AT BEARING PLATE CAN BE REDUCED BY INSTALLING HEADERS OR ADDITIONAL FRAMING BETWEEN RAFTERS.

3. TANKS GREATER THAN 91 FEET IN DIAMETER SHALL HAVE MORE THAN ONE COLUMN LOCATED AT CENTER OF TANK. LESSER DIAMETER TANKS, SHALL HAVE NO INTERNAL COLUMN SUPPORTS.

ROOF SUPPORT PLAN - SINGLE COLUMN TANKS

SCALE: 1/4" = 1'-0"
TABLE 2

<table>
<thead>
<tr>
<th>SIZE OF NOZZLE</th>
<th>&quot;W&quot;</th>
<th>&quot;N&quot;</th>
</tr>
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<tr>
<td>4</td>
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<tr>
<td>6</td>
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<td>6</td>
</tr>
<tr>
<td>8</td>
<td>16</td>
<td>8</td>
</tr>
</tbody>
</table>

**NOTES:**

1. LOCATE MITER JOINT SO AS TO PROVIDE SLOPE OF PIPE PARALLEL TO TANK BOTTOM.

2. FLOATING PAN SHALL CLEAR HIGHEST POINT OF FLANGE ON ANY NOZZLE AND OTHER INTERNAL APPURTENANCES BY 6 INCHES AT LOW LEG LEVEL. OTHER INTERNAL APPURTENANCES BY 6 INCHES AT LOW LEG LEVEL.

3. Provide 2" half round drain hole at bottom of each LADDER RAIL, TOP on LOW SIDE.

4. Provide 2" half round drain hole at bottom of each LADDER RAIL, TOP on LOW SIDE.

**SECTION 8**

**INTERIOR PIPE SUPPORT**

**NOTES:**

1. Provide internal pipe supports every 6" for pipes #4 and smaller. Provide internal pipe supports every 4" for larger size pipes.

2. Provide internal pipe supports every 6" for pipes #4 and smaller. Provide internal pipe supports every 4" for larger size pipes.
NOTE: TANK DATA/NAMEPLATE SHALL INDICATE THE DIAMETER OF THE TANK, JOINT EFFICIENCY, NOMINAL THICKNESS, AND MATERIAL FOR EACH SHELL COURSE IN ADDITION TO INFORMATION REQUIRED BY API STANDARD 650. LOCATE NEAR MANHOLE ON MOST USED APPROACH SIDE AND AT EYE LEVEL.

NOTE: COUPLING NUT SHALL BE COATED WITH TANK. INSTALL MOUNTING CHANNEL ASSEMBLY ON FOUNDATION, EXCEPT THE STAND-OFF IS NOT REQUIRED. BOLT SUPPORTS ON THE SIDE OF THE CONCRETE RINGWALL NOT THE TOP.

NOTE: PROVIDE FILLER DRUM ON SHELL MANHOLES OF TANKS WITH FLOATING PANS.

NOTE: DATA/NAMEPLATE OF TANKS WITH FLOATING PANS.
D.11

ROOF PERIMETER GUARDRAIL

SCALE: 1"=1'-0"

PLATFOM SUPPORT

SCALE: 1"=1'-0"

STAIRWAY SUPPORT

SCALE: 1"=1'-0"

SECTION

SCALE: 1"=1'-0"

SECTION - CIRCUMFERENTIAL STAIR

SCALE: 1"=1'-0"
FILTRATION SYSTEM ON TANKS

DESCRIPTION

SHUT-OFF VALVE (HLV)

1. MAY BE INCREASED FOR LARGER SPACING BETWEEN LLS AND LLLS SET POINTS.
2. EQUIPMENT, PIPE, FITTINGS, CHAMBER AND VALVES SHALL BE STAINLESS STEEL.
3. FOR TANKS WITH FLOATING PAN, LOW AND LOW-LOW ALARM SHELL NOZZLES WILL BE HIGHER. ENSURE TEST DRAIN IS NEVER LOWER THAN AS INDICATED AND TEST VENT IS NEVER HIGHER THAN AS INDICATED.

LOW AND LOW-LOW LEVEL SWITCHES

SCALE: 1"=1'-0"

LEVEL SET-POINT TABLE

1. SIZE AS SHOWN IS BASED ON AN 8" FILL NOZZLE (8" PIPE).
2. COORDINATE WITH PIPELINE/FACILITY OPERATOR TO CONFIRM HLV IS STANDARD AT FACILITY AND PROVIDE HLV SEQUENCE OF OPERATION ON G.06.
3. THE SOLENOID SHALL BE NORMALLY ENERGIZED UNLESS DIRECTED OTHERWISE BY SERVICE HEADQUARTERS.
   a. WHEN ENERGIZED, THE SOLENOID PILOT CONTROL VALVE WILL EXTINGUISH, ENABLING THE HLV TO REMAIN OPEN AND FUNCTION SATISFACTORY TO THE OPERATOR.
   b. WHEN DE-ENERGIZED, THE SOLENOID PILOT CONTROL VALVE WILL ENGAGE, CLOSING THE HLV.
   c. FOR TANKS WITH FLOATING PAN, LOW AND LOW-LOW ALARM SHELL NOZZLES WILL BE HIGHER. ENSURE TEST DRAIN IS NEVER LOWER THAN AS INDICATED AND TEST VENT IS NEVER HIGHER THAN AS INDICATED.

HIGH AND HIGH-HIGH LEVEL SWITCHES AND HIGH LIQUID LEVEL SHUT-OFF VALVE (HLV)

NOTES:
1. EQUIPMENT, PIPE, FITTINGS, CHAMBERS AND VALVES SHALL BE STAINLESS STEEL.
2. NOT TO EXCEED DISTANCE SHOWN PLUS ONE DEGREE FOR TANKS WITHOUT FLOATING PAN (SEE NOTE 3).
3. SEE SHEET G.03 FOR DESIGNER NOTES; LEVELS SHALL BE SITE ADAPTED TO ALLOW SUFFICIENT OPERATOR RESPONSE TIME.

LEVEL SET-POINT TABLE

1. SIZE AS SHOWN IS BASED ON AN 8" FILL NOZZLE (8" PIPE).
2. COORDINATE WITH PIPELINE/FACILITY OPERATOR TO CONFIRM HLV IS STANDARD AT FACILITY AND PROVIDE HLV SEQUENCE OF OPERATION ON G.06.
3. THE SOLENOID FLOAT CHAMBER SHALL CAUSE THE VALVE TO CLOSE. SEE SEQUENCE OF OPERATION ON G.06.
4. SIZE AS SHOWN IS BASED ON AN 8" FILL NOZZLE (8" PIPE).
   a. WHEN ENERGIZED, THE SOLENOID PILOT CONTROL VALVE WILL EXTINGUISH, ENABLING THE HLV TO REMAIN OPEN AND FUNCTION SATISFACTORY TO THE OPERATOR.
   b. WHEN DE-ENERGIZED, THE SOLENOID PILOT CONTROL VALVE WILL ENGAGE, CLOSING THE HLV.

HIGH LIQUID LEVEL SHUT-OFF VALVE (HLV)

NOTES:
1. EQUIPMENT, PIPE, FITTINGS, CHAMBERS AND VALVES SHALL BE STAINLESS STEEL.
2. NOT TO EXCEED DISTANCE SHOWN PLUS ONE DEGREE FOR TANKS WITHOUT FLOATING PAN (SEE NOTE 3).
3. SEE SHEET G.03 FOR DESIGNER NOTES; LEVELS SHALL BE SITE ADAPTED TO ALLOW SUFFICIENT OPERATOR RESPONSE TIME.
1. Identify tanks as to product service by color coding, banding, product names, and Nato designation in accordance with MIL-STD-1610.

2. Samples/tank labeling shown is for jet a turbine fuel. For other turbine fuels refer to MIL-STD-1810. Dimensions vary based on tank size.

3. Mark tanks with early crossing & painted numbers and letters indicating the following in addition to the requirements stated in MIL-STD-1610: tank numbers, facility numbers, "no smoking" or class 1 tanks, and "confined space" on roof manhole/ladder hatch.

4. Provide hazard identification system labeling in accordance with NFPA 704.

5. Coordinate location of concrete housesing pad with paving joints to prevent cracking.

6. Equipment grounding issue per project.

7. Scale: None

8. Sheet: 3/4" = 1'-0"

9. Water draw-off system, see detail.

10. Diagram: SHUT-OFF VALVE (TYPE)


15. Variable spring pipe support.

16. Pipe in 0.050" plate with load flange.

17. Carbon steel or stainless steel pipe (seed pipes for size).


19. High water level conduction plate.

20. 1/2" cam type connection with dust plug cap.

21. 10 GPM pump.

22. 6" (typ).

23. 1/2" manual drain.

24. 2" cam type quick disconnect with cap.

25. 1/2" threaded branch connection.

26. 1" ball valve.

27. 2" cam type quick disconnect with cap.

28. 1/2" globe style check valve.

29. SS guide support; steel pipe (see plans for size).

30. Expansion anchor, baseplate-to-pier (4 req'd).

31. 1" sight glass:

32. 2" cam type quick disconnect with cap.

33. 1/2" globe style check valve.

34. SS guide support; steel pipe (see plans for size).

35. Expansion anchor, baseplate-to-pier (4 req'd).

36. 1" sight glass:

37. 2" cam type quick disconnect with cap.

38. 1/2" globe style check valve.

39. SS guide support; steel pipe (see plans for size).

40. Expansion anchor, baseplate-to-pier (4 req'd).

41. 1" sight glass:

42. 2" cam type quick disconnect with cap.

43. 1/2" globe style check valve.

44. SS guide support; steel pipe (see plans for size).

45. Expansion anchor, baseplate-to-pier (4 req'd).

46. 1" sight glass:

47. 2" cam type quick disconnect with cap.

48. 1/2" globe style check valve.

49. SS guide support; steel pipe (see plans for size).

50. Expansion anchor, baseplate-to-pier (4 req'd).

51. 1" sight glass:

52. 2" cam type quick disconnect with cap.

53. 1/2" globe style check valve.

54. SS guide support; steel pipe (see plans for size).

55. Expansion anchor, baseplate-to-pier (4 req'd).

56. 1" sight glass:

57. 2" cam type quick disconnect with cap.

58. 1/2" globe style check valve.

59. SS guide support; steel pipe (see plans for size).

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62. 2" cam type quick disconnect with cap.

63. 1/2" globe style check valve.

64. SS guide support; steel pipe (see plans for size).

65. Expansion anchor, baseplate-to-pier (4 req'd).

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67. 2" cam type quick disconnect with cap.

68. 1/2" globe style check valve.

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83. 1/2" globe style check valve.

84. SS guide support; steel pipe (see plans for size).

85. Expansion anchor, baseplate-to-pier (4 req'd).

86. 1" sight glass:

87. 2" cam type quick disconnect with cap.

88. 1/2" globe style check valve.

89. SS guide support; steel pipe (see plans for size).

90. Expansion anchor, baseplate-to-pier (4 req'd).