

DoD Standard Design for Vertical ASTs



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27 April 2015



OVERVIEW

- Unified Facilities Criteria and ASTs
- New Features
- Tank Sizing & Layout
- Drawing Excerpts
- Tank Bottom & Roof
- Dike Area
- Questions





DoD Fuels Facilities Documents

- **Unified Facility Criteria (UFCs)**
 - Authoritative, mandatory unless waived by Service HQ

- **Standard Designs (Std Dsn)**
 - Starting point for design, edited for site adapt
 - Engineering Design is still needed
 - Identifies preferences and design choices
 - Includes designer notes
 - Lists which UFGS to be used
 - Major Deviations require Service HQ approval

- **Unified Facilities Guide Specifications (UFGS)**
 - Edited for the job
 - Designer choices in brackets

Unified Facilities Criteria (UFC)

- **UFC 3-460-01 Design: Petroleum Fuels Facilities**
 - Guidance for all new design and construction

- **Chapter 2 – General Design Information**
 - Fire protection, Safety
 - Environmental
 - Electrical Design & Area Classifications
 - Security
 - Emergency shutdown



Unified Facilities Criteria (UFC)

■ Chapter 8 – Atmospheric Tanks

- Tank Spacing
- ASTs, vertical, horizontal,
- USTs

- Diking, spill containment
- Vapor Emission Control systems
- Tank Roofs, floating pans

- Foundations, tank bottoms
- Appurtenances
- General Design Considerations



- Follows/directs use of NFPA 30, 30A
- Directs use of DoD Standard Design AW 78-24-27

Specifications

UFGS	Title	Published
33 56 13.13	Steel Tanks With Fixed Roofs	May-2012
33 56 13.15	Undertank Interstitial Space	May-2012
33 56 63	Fuel Impermeable Liner System	Apr-2006
32 13 15.20	Concrete Pavement for Containment Dikes	Nov-2010
09 97 13.15	Low VOC Polysulfide Interior Coating of Welded Steel Petroleum Fuel Tanks	Feb-2015
09 97 13.27	Exterior Coating of Steel Structures	Feb-2010

AST Standard Design

- **Vertical Steel Tanks in JP-5 or JP-8/F-24 Service**
 - Can be used for other products
- **For >5K, <100K BBL Vertical ASTs**
- **Fixed roof, floating pan**
 - Considerations given for tanks w/o pans
- **For new construction, but can be used for renovations**
- **Elevated and non-elevated foundations**
 - Areas with/without high water tables
- **Requires design in accordance with API 650**
- **For CONUS and OCONUS**

History & Current Status

- **Original Design in mid 80's**
- **Update in Feb 1993**
 - Shop drawing detailed
 - Only included Tank, not site layout
- **Last Update Published in 2012**
 - Rely more on API 650, prescribe government preferences
- **Current Update 2015**
 - Includes piping/dike details
- **Will post to USACOE Std Dsn website**



AST Standard Design

- **Has sidestream filtration option**
 - Fuel polishing, water drawoff
- **Incorporates DLA ATG policy for gauge wells**
 - Fuel level and water detection
- **Includes 2 sheets designer notes**
 - Use in corrosive and northern environments
 - Tank sizing and site planning
 - Foundation options
 - Tanks without floating pans



AST Standard Design

- Useable Volumes
- High/Low Level Control & Shutoff Logic
- Roof Structure, Compression Ring
 - Single column for diameters $126 \text{ ft} > D > 91 \text{ ft}$
 - No columns for diameters $< 91 \text{ ft}$
- UFC 3-460-01 Was Updated To Resolve Conflicts.

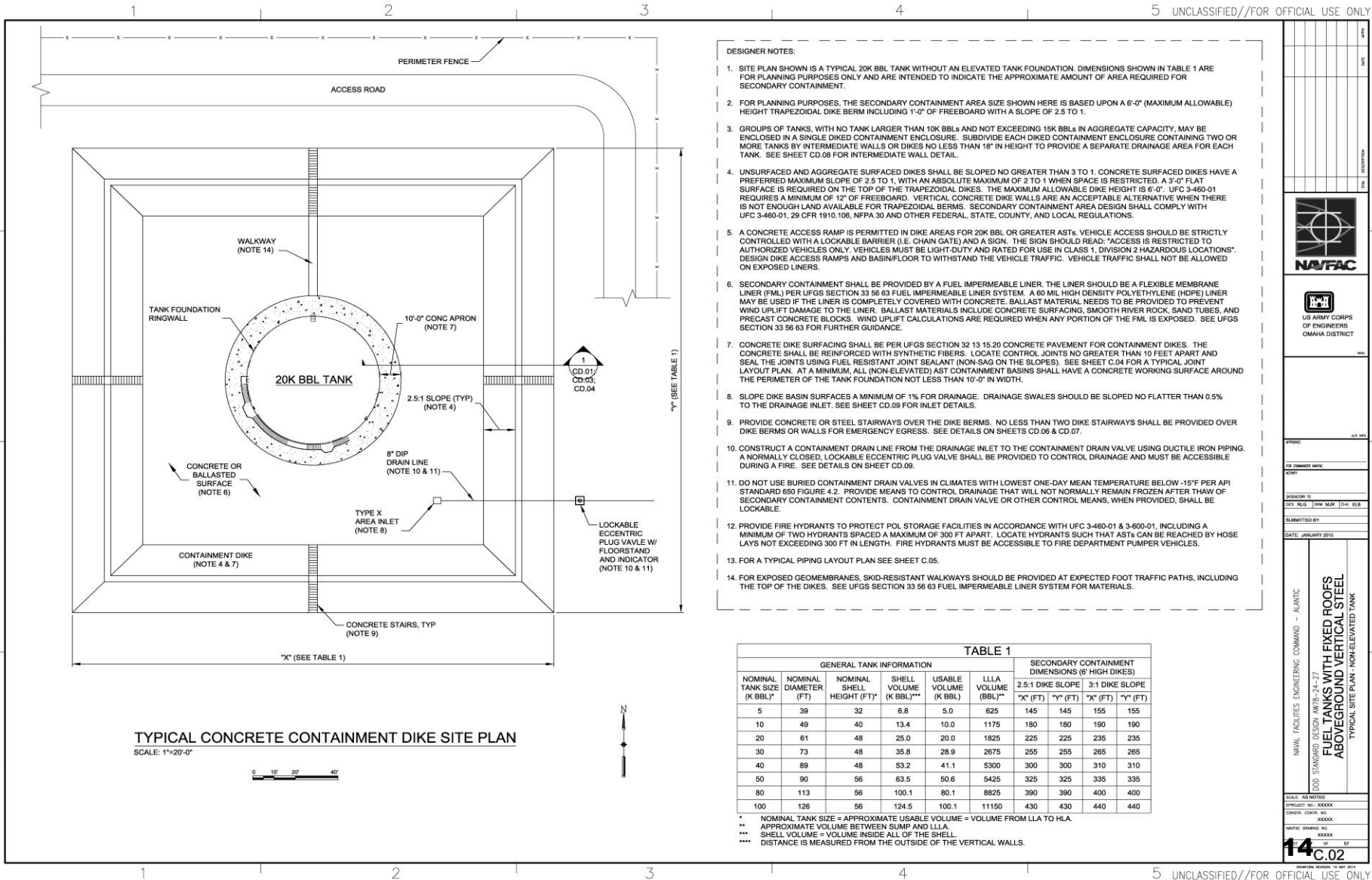




AST Standards Additions

- **Typical Site Plans**
- **Piping Layout Plan**
- **Containment System Details**
- **Stairway Details**
- **Misc Piping Details**
- **Pipe Support Details**
- **Typical Electrical Details**

Typical Site Plan – Non-Mounded Tank



- DESIGNER NOTES:**
- SITE PLAN SHOWN IS A TYPICAL 20K BBL TANK WITHOUT AN ELEVATED 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.
 - FOR PLANNING PURPOSES, THE SECONDARY CONTAINMENT AREA SIZE SHOWN HERE IS BASED UPON A 6'-0" (MAXIMUM ALLOWABLE) HEIGHT TRAPEZOIDAL DIKE BERM INCLUDING 1'-0" OF FREEBOARD WITH A SLOPE OF 2.5 TO 1.
 - GROUPS OF TANKS, WITH NO TANK LARGER THAN 10K BBLs AND NOT EXCEEDING 15K BBLs IN AGGREGATE CAPACITY, MAY BE ENCLOSED IN A SINGLE DIKED CONTAINMENT ENCLOSURE. SUBDIVIDE EACH DIKED CONTAINMENT ENCLOSURE CONTAINING TWO OR MORE TANKS BY INTERMEDIATE WALLS OR DIKES NO LESS THAN 18" IN HEIGHT TO PROVIDE A SEPARATE DRAINAGE AREA FOR EACH TANK. SEE SHEET CD.08 FOR INTERMEDIATE WALL DETAIL.
 - UNSURFACED AND AGGREGATE SURFACED DIKES SHALL BE SLOPED NO GREATER THAN 3 TO 1. CONCRETE SURFACED DIKES HAVE A PREFERRED MAXIMUM SLOPE OF 2.5 TO 1, WITH AN ABSOLUTE MAXIMUM OF 3 TO 1 WHEN SPACE IS RESTRICTED. A 3'-0" FLAT SURFACE IS REQUIRED ON THE TOP OF THE TRAPEZOIDAL DIKES. THE MAXIMUM ALLOWABLE DIKE HEIGHT IS 6'-0". UFC 3-460-01 REQUIRES A MINIMUM OF 12" OF FREEBOARD. VERTICAL CONCRETE DIKE WALLS ARE AN ACCEPTABLE ALTERNATIVE WHEN THERE IS NOT ENOUGH LAND AVAILABLE FOR TRAPEZOIDAL BERMS. SECONDARY CONTAINMENT AREA DESIGN SHALL COMPLY WITH UFC 3-460-01, 29 CFR 1910.106, NFPA 30 AND OTHER FEDERAL, STATE, COUNTY, AND LOCAL REGULATIONS.
 - A CONCRETE ACCESS RAMP IS PERMITTED IN DIKE AREAS FOR 20K BBL OR GREATER ASTs. VEHICLE ACCESS SHOULD BE STRICTLY CONTROLLED WITH A LOCKABLE BARRIER (I.E. CHAIN GATE) AND A SIGN. THE SIGN SHOULD READ: "ACCESS IS RESTRICTED TO AUTHORIZED VEHICLES ONLY. VEHICLES MUST BE LIGHT-DUTY AND RATED FOR USE IN CLASS 1, DIVISION 2 HAZARDOUS LOCATIONS". DESIGN DIKE ACCESS RAMP AND BASIN/FLOOR TO WITHSTAND THE VEHICLE TRAFFIC. VEHICLE TRAFFIC SHALL NOT BE ALLOWED ON EXPOSED LINERS.
 - SECONDARY CONTAINMENT SHALL BE PROVIDED BY A FUEL IMPERMEABLE LINER. THE LINER SHOULD BE A FLEXIBLE MEMBRANE LINER (FML) PER UFGS SECTION 33 56 63 FUEL IMPERMEABLE LINER SYSTEM. A 60 MIL HIGH DENSITY POLYETHYLENE (HDPE) LINER MAY BE USED IF THE LINER IS COMPLETED WITH CONCRETE BALLAST MATERIAL NEEDS TO BE PROVIDED TO PREVENT WIND UPLIFT DAMAGE TO THE LINER. BALLAST MATERIALS INCLUDE CONCRETE SURFACING, SMOOTH RIVER ROCK, SAND TUBES, AND PRECAST CONCRETE BLOCKS. WIND UPLIFT CALCULATIONS ARE REQUIRED WHEN ANY PORTION OF THE FML IS EXPOSED. SEE UFGS SECTION 33 56 63 FOR FURTHER GUIDANCE.
 - CONCRETE DIKE SURFACING SHALL BE PER UFGS SECTION 32 13 15.20 CONCRETE PAVEMENT FOR CONTAINMENT DIKES. THE CONCRETE SHALL BE REINFORCED WITH SYNTHETIC FIBERS. LOCATE CONTROL JOINTS NO GREATER THAN 10 FEET APART AND SEAL THE JOINTS USING FUEL RESISTANT JOINT SEALANT (NON-SAG ON THE SLOPES). SEE SHEET CD.04 FOR A TYPICAL JOINT LAYOUT PLAN. AT A MINIMUM, ALL (NON-ELEVATED) AST CONTAINMENT BASINS SHALL HAVE A CONCRETE WORKING SURFACE AROUND THE PERIMETER OF THE TANK FOUNDATION NOT LESS THAN 10'-0" IN WIDTH.
 - 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.
 - PROVIDE CONCRETE OR STEEL STAIRWAYS OVER THE DIKE BERMS. NO LESS THAN TWO DIKE STAIRWAYS SHALL BE PROVIDED OVER DIKE BERMS OR WALLS FOR EMERGENCY EGRESS. SEE DETAILS ON SHEETS CD.06 & CD.07.
 - CONSTRUCT A CONTAINMENT DRAIN LINE FROM THE DRAINAGE INLET TO THE CONTAINMENT DRAIN VALVE USING DUCTILE IRON PIPING. A NORMALLY CLOSED, LOCKABLE ECCENTRIC PLUG VALVE SHALL BE PROVIDED TO CONTROL DRAINAGE AND MUST BE ACCESSIBLE DURING A FIRE. SEE DETAILS ON SHEET CD.09.
 - 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 SECONDARY CONTAINMENT CONTENTS. CONTAINMENT DRAIN VALVE OR OTHER CONTROL MEANS, WHEN PROVIDED, SHALL BE LOCKABLE.
 - 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.
 - FOR A TYPICAL PIPING LAYOUT PLAN SEE SHEET C.05.
 - FOR EXPOSED GEOMEMBRANES, SKID-RESISTANT WALKWAYS SHOULD BE PROVIDED AT EXPECTED FOOT TRAFFIC PATHS, INCLUDING THE TOP OF THE DIKES. SEE UFGS SECTION 33 56 63 FUEL IMPERMEABLE LINER SYSTEM FOR MATERIALS.

TABLE 1

GENERAL TANK INFORMATION						SECONDARY CONTAINMENT DIMENSIONS (6' HIGH DIKES)			
NOMINAL TANK SIZE (K BBL)*	NOMINAL DIAMETER (FT)	NOMINAL SHELL HEIGHT (FT)*	SHELL VOLUME (K BBL)**	USABLE VOLUME (K BBL)**	LLA VOLUME (BBL)**	2.5:1 DIKE SLOPE		3:1 DIKE SLOPE	
						"X" (FT)	"Y" (FT)	"X" (FT)	"Y" (FT)
5	39	32	6.8	5.0	625	145	145	155	155
10	49	40	13.4	10.0	1175	180	180	190	190
20	61	48	25.0	20.0	1825	225	225	235	235
30	73	48	35.8	28.9	2675	255	255	265	265
40	89	48	53.2	41.1	5300	300	300	310	310
50	90	56	63.5	50.6	5425	325	325	335	335
80	113	56	100.1	80.1	8825	390	390	400	400
100	126	56	124.5	100.1	11150	430	430	440	440

* NOMINAL TANK SIZE = APPROXIMATE USABLE VOLUME = VOLUME FROM LLA TO HLA.
 ** APPROXIMATE VOLUME BETWEEN SUMP AND LLA.
 *** SHELL VOLUME = VOLUME INSIDE ALL OF THE SHELL.
 **** DISTANCE IS MEASURED FROM THE OUTSIDE OF THE VERTICAL WALLS.

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US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

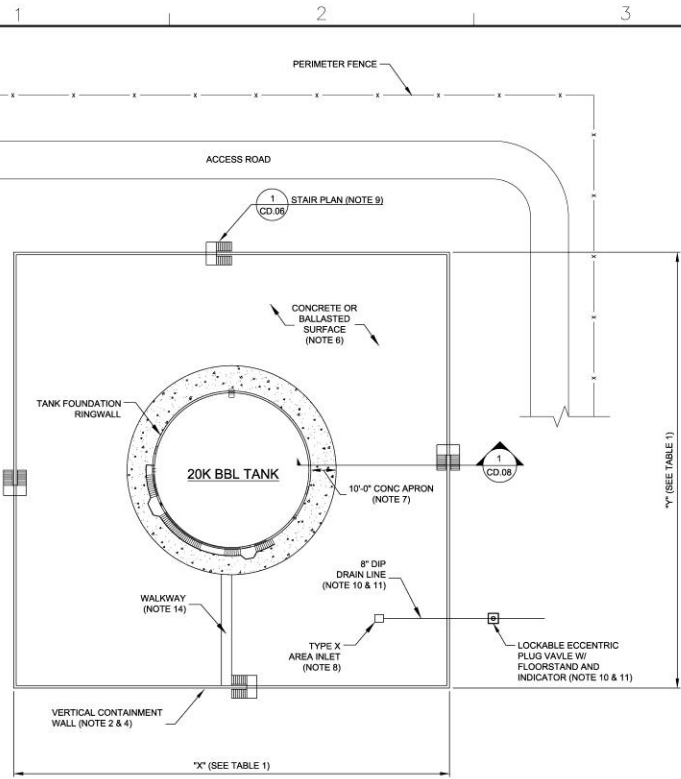
NAVAL FACILITIES ENGINEERING COMMAND - ATLANTIC
 500 STANFORD DESIGN WALK-2A-27
 FUEL TANKS WITH FIXED ROOFS ABOVEGROUND VERTICAL STEEL TYPICAL SITE PLAN - NON-ELEVATED TANK

DATE: JANUARY 2015

PROJECT NO. 00000
 CONDR CONTR NO. 00000
 NAVFAC DRAWING NO. 00000

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Typical Site Plan – Vertical Containment Walls



TYPICAL VERTICAL CONTAINMENT WALL SITE PLAN
SCALE: 1"=20'-0"

DESIGNER NOTES:

- SITE PLAN SHOWN IS A TYPICAL 20K BBL TANK WITHOUT AN ELEVATED 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.
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- 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.
- CONSTRUCT A CONTAINMENT DRAIN LINE FROM THE DRAINAGE INLET TO THE CONTAINMENT DRAIN VALVE USING DUCTILE IRON PIPING. A NORMALLY CLOSED, LOCKABLE ECCENTRIC PLUG VALVE SHALL BE PROVIDED TO CONTROL DRAINAGE AND MUST BE ACCESSIBLE DURING A FIRE. SEE DETAILS ON SHEET CD.09.
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- FOR A TYPICAL PIPING LAYOUT PLAN SEE SHEET C.05.
- FOR EXPOSED GEOMEMBRANES, SKID-RESISTANT WALKWAYS SHOULD BE PROVIDED AT EXPECTED FOOT TRAFFIC PATHS. SEE UFGS SECTION 33 56 63 FUEL IMPERMEABLE LINER SYSTEM FOR MATERIALS.

GENERAL TANK INFORMATION						SECONDARY CONTAINMENT DIMENSIONS @ HIGH DIKES)	
NOMINAL TANK SIZE (K BBL)**	NOMINAL DIAMETER (FT)	NOMINAL SHELL HEIGHT (FT)**	SHELL VOLUME (K BBL)***	USABLE VOLUME (K BBL)**	LLA VOLUME (BBL)**	VERTICAL CONTAINMENT WALLS	
						"X" (FT)****	"Y" (FT)****
5	39	32	6.8	5.0	625	90	90
10	49	40	13.4	10.0	1175	125	125
20	61	48	25.0	20.0	1825	170	170
30	73	48	35.8	28.9	2675	205	205
40	89	48	53.2	41.1	5300	250	250
50	90	56	63.5	50.6	5425	270	270
60	113	56	100.1	80.1	8825	340	340
100	126	56	124.5	100.1	11150	380	380

* NOMINAL TANK SIZE = APPROXIMATE USABLE VOLUME = VOLUME FROM LLA TO HLA.
 ** APPROXIMATE VOLUME BETWEEN SLUMP AND LLA.
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 **** DISTANCE IS MEASURED FROM THE OUTSIDE OF THE VERTICAL WALLS.

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CMAA DISTRICT

NAVAL FACILITIES ENGINEERING COMMAND - NAVFAC
FUEL TANKS WITH FIXED ROOFS ABOVEGROUND VERTICAL STEEL TYPICAL SITE PLAN - VERTICAL CONTAINMENT WALLS

DESIGN: WFR-24-27
DD STANDARD

SCALE: AS NOTED
 UNCLASSIFIED: XXXXXX
 CONTROLLED: XXXXXX
 CONFIDENTIAL: XXXXXX
 NAVAL FACILITIES ENGINEERING COMMAND: XXXXXX
 SHEET: 01 OF 17

C.03



Non-Mounded Tank

Add photo of non-mounded tank

Mounded Tank



TABLE 1

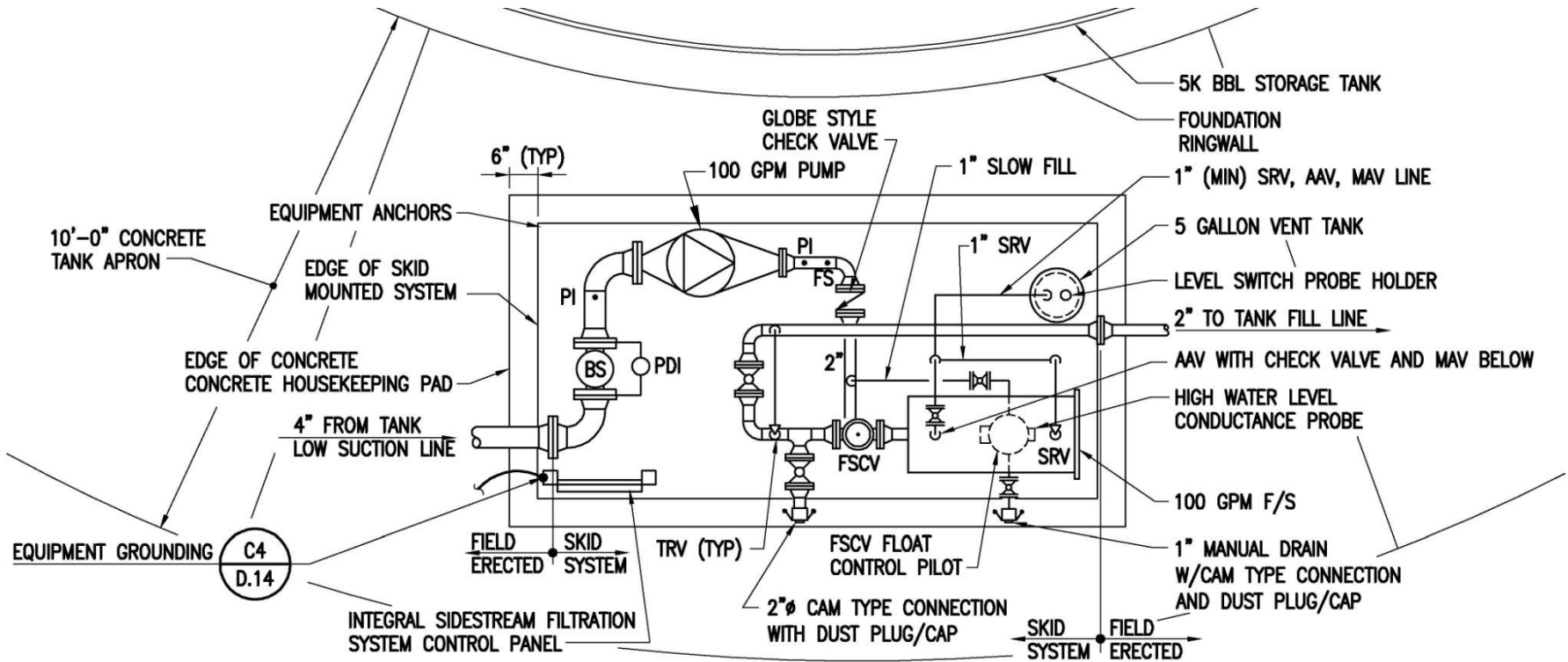
NOMINAL TANK SIZE (KBBL)*	NOMINAL DIAMETER (FT)	NOMINAL SHELL HEIGHT (FT)*	FLOWRATE FILL/ISSUE (GPM)	NOZZLE SIZE FILL/ISSUE (INCHES)	SHELL VOLUME (KBBL)***	USABLE VOLUME (KBBL)	LLA VOLUME (BBL)**	SECONDARY CONTAINMENT DIMENSIONS	
								"X" (FT)	"Y" (FT)
5	39	32	1200/1200	8"/12"	6.8	5.0	625	130	130
10	49	40	1200/3000	8"/16"	13.4	10.0	1175	170	170
20	61	48	1200/3000	8"/16"	25.0	20.0	1825	220	220
30	73	48	1200/3000	8"/16"	35.8	28.9	2675	255	255
40	89	48	7000/7000	18"/24"	53.2	41.1	5300	305	305
50	90	56	7000/7000	18"/24"	63.5	50.6	5425	330	330
80	113	56	7000/7000	18"/24"	100.1	80.1	8825	405	405
100	126	56	7000/7000	18"/24"	124.5	100.1	11150	450	450

* NOMINAL TANK SIZE = APPROXIMATE USABLE VOLUME = VOLUME FROM LLA TO HLA.

** APPROXIMATE VOLUME BETWEEN SUMP AND LLLA.

*** SHELL VOLUME = VOLUME INSIDE ALL OF THE SHELL

GRAPHIC SCALE



NOTES:

1. SYSTEM SHALL BE FACTORY ASSEMBLED, SKID MOUNTED, FACTORY RUN.
2. PROVIDE ONLY CLASS 1, DIVISION 1, RATED ELECTRICAL COMPONENTS.
3. HEAT TRACE DRAIN PIPING (AND SLOW FILL PIPING TO FIRST VALVE) IN COLD CLIMATES.
4. PIPING ARRANGEMENT SHOWN IS CONCEPTUAL ONLY.
5. COORDINATE LOCATION OF CONCRETE HOUSEKEEPING PAD WITH PAVING JOINTS TO PREVENT CRACKING.

OPTIONAL SIDESTREAM FILTRATION SYSTEM

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

C1
D.13

* G.05, D.12

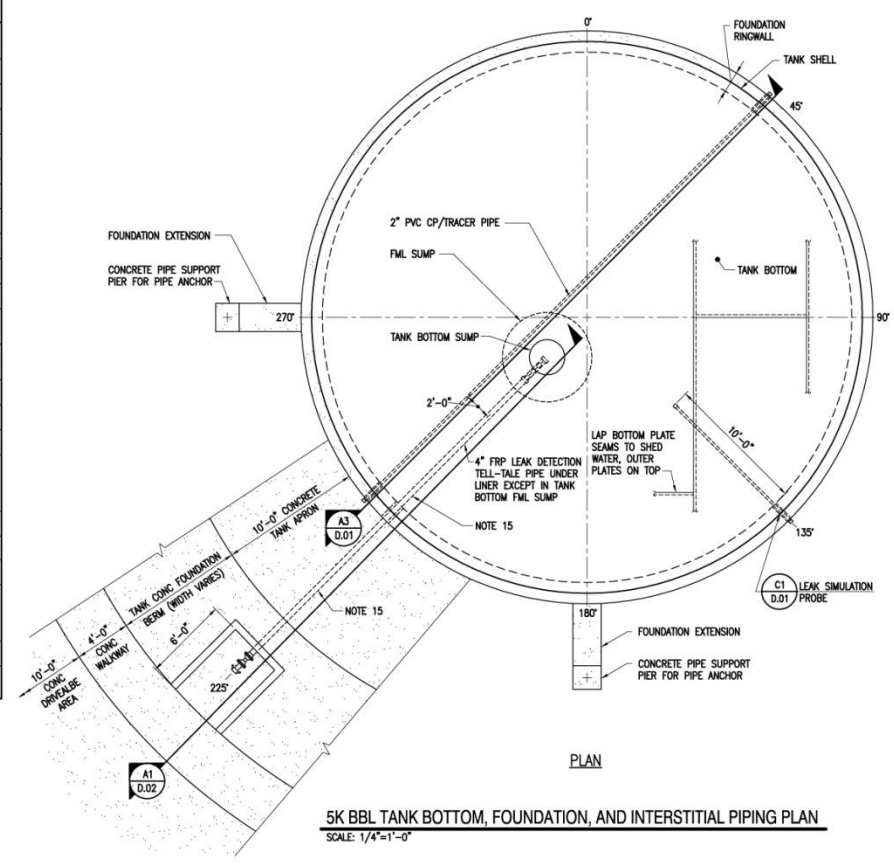


5K BBL TANK NOZZLE/EQUIPMENT SCHEDULE

ITEM	DESCRIPTION	SIZE (INCHES)	ANGLE (DEGREES)	DISTANCE (NOTE 1)	DETAIL (DETAIL/SHEET SHOWN)	NOTES
A	ISSUE	12	270	1'-1 1/2"	A1/D.08	NOTES 4, 5, 10
B	FILL	8	180	1'-1 3/4"	C1/D.08	NOTES 4, 5, 10
C	LOW SUCTION	4	-	1'-1 1/2"	A3/D.07, C1/D.10	NOTES 5, 13
D	WATER DRAW-OFF	2	-	11 7/8"	A3/D.07, C1/D.10, A1/D.13	NOTES 9, 13
E	PRODUCT RETURN	2	246	7"	A1/D.13	
F	SHELL MANHOLES (LOWER)	36	-	3'-6"	C4/D.10, A4/D.10	NOTES 2, 17
G	SHELL MANHOLE (UPPER)	36	162	9'-9"	C4/D.10, A4/D.10	NOTES 6, 17
H	ATG GAUGE WELL	10	259	16'-6"	A1/D.07	NOTE 16
I	ATG WATER PROBE WELL	8	235	4'-0 1/2"	C4/D.07	NOTE 8
J	MECHANICAL TAPE LEVEL GAUGE	1 1/2	90	-	C1/D.07	
K	LOW & LOW-LOW LEVEL ALARM NOZZLES	1	230	3'-9" 2'-1"	C1/D.12	
L	HIGH & HIGH-HIGH LEVEL ALARM AND HLV NOZZLES	1	230	28'-1" 26'-3"	C3/D.12	NOTE 7
M	SAMPLE GAUGE WELL	10	280	16'-6"	C3/D.07	NOTE 16
N	ROOF MANHOLE/LADDER HATCH	36 x 48	295	13'-6"	A1/D.09	
O	CENTER ROOF VENT	24	-	-	C4/D.09	
P	CIRCULATION VENT/INSPECTION HATCHES	18 x 24	45 135 225 315	-	C1/D.09	
Q	OVERFLOW/CIRCULATION VENT	12 x 36	45	28'-1"	A4/D.07	NOTE 12
R	PAN INSTALLATION HATCH	-	45	-	-	NOTE 3
S	SUMP	30	225	4'-0"	A3/D.07	
T	GROUNDING LUGS	3 x 3 x 3/8	20 110 200 290	1'-0"	A1/D.14	
U	FLOATING PAN LOW LEG LEVEL	-	-	2'-5"	-	NOTE 11
V	SCAFFOLD CABLE SUPPORTS	-	135 315	6'-0"	-	

NOTES:

- 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 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.
- ALIGN LOWER SHELL MANHOLES 180° APART AND PARALLEL WITH PREVAILING WINDS.
- PROVIDE A PAN INSTALLATION HATCH ON THE FIXED ROOF IN ACCORDANCE WITH THE PAN MANUFACTURER'S REQUIREMENTS.
- 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.
- ADJUST SIZE OF FILL, ISSUE AND LOW SUCTION NOZZLES TO SUIT SITE CONDITIONS SUCH AS DISTANCE TO PUMPS AND OPERATIONAL REQUIREMENTS.
- LOCATE UPPER SHELL MANHOLE 3'-6" ABOVE UPPER SURFACE OF FLOATING PAN AT HIGH LEG POSITION.
- 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.
- MOUNT THE 6" ATG WATER PROBE WELL OVER THE TANK BOTTOM SUMP THROUGH AN 8" FLANGED ROOF NOZZLE PER THE INDICATED DETAILS.
- 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 MINIMUM CONDENSATE, PROVIDE INTERNAL WATER DRAW-OFF PIPING REDUCED TO 1" SIZE NEAR THE INTERNAL NOZZLE FLANGE TO LIMIT THE AMOUNT OF WATER THAT IS RETAINED IN THE INTERNAL PIPING.
- 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. NOZZLE SIZES SMALLER THAN 12" SHALL BE AS LOW AS ALLOWED BY API STD 650 USING REGULAR TYPE REINFORCING PLATES.

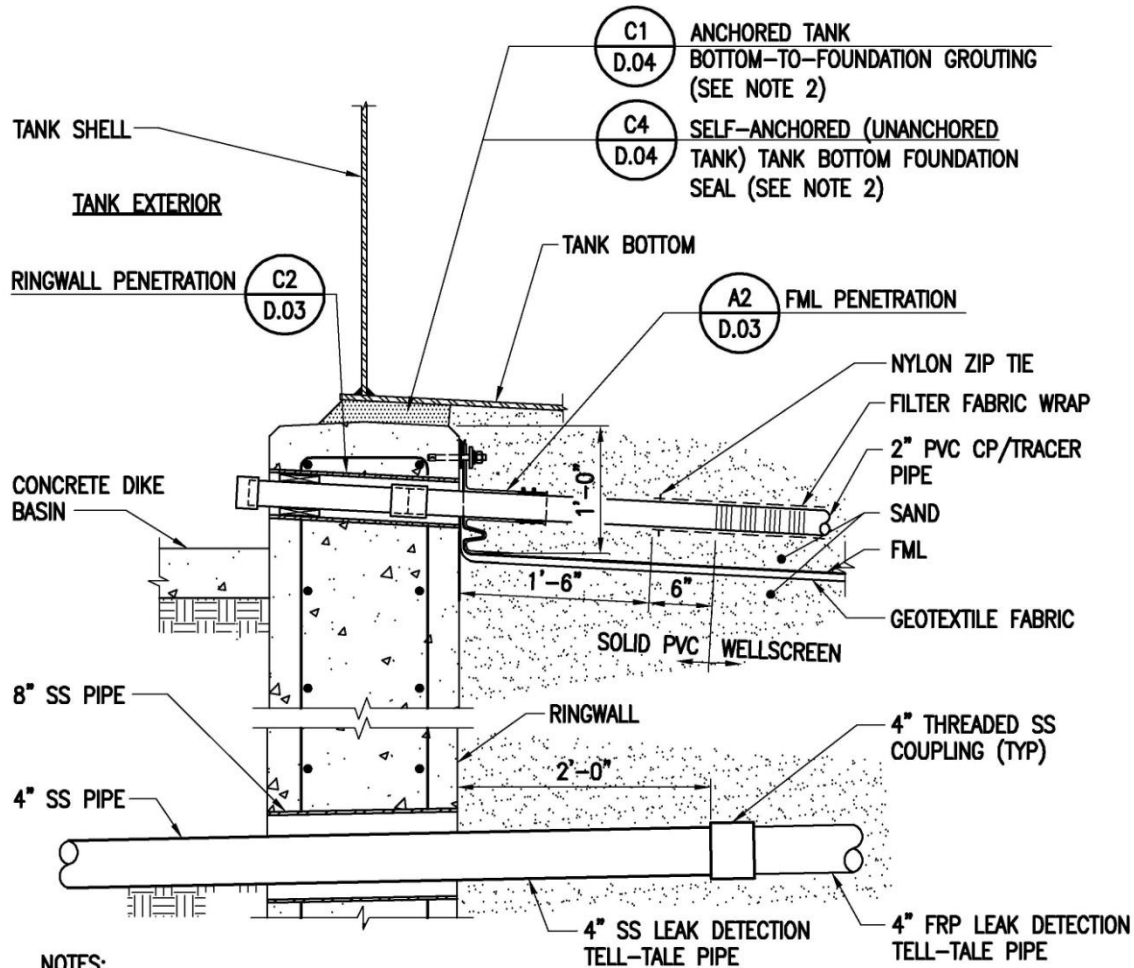


- FLOATING PAN LOW-LEG LEVEL SHALL PROVIDE A MINIMUM OF 6" CLEARANCE FROM THE TOP OF ANY INTERNAL NOZZLE FLANGE TO THE BOTTOM OF THE FLOATING PAN.
- PROVIDE AT LEAST ONE OVERFLOW FOR EVERY 1200 GPM OF RECEIPT. DO NOT LOCATE OVERFLOWS OVER STAIRS OR SHELL NOZZLE ISOLATION VALVES. WHERE THE PATTERN OF ROOF PERIMETER CIRCULATION VENTS WOULD RESULT IN AN OVERFLOW/CIRCULATION VENT OVER PRODUCT PIPING OR THE STAIRWAY, PROVIDE A SHELL CIRCULATION VENT CONSTRUCTED SIMILAR TO AN OVERFLOW CIRCULATION VENT BUT 1'-0" HIGHER IN ELEVATION AT THAT LOCATION AND ENSURE THE REMAINING OVERFLOWS ARE ADEQUATE.
- INSTALL LOW SUCTION AND WATER DRAW-OFF NOZZLES PARALLEL TO THE ISSUE NOZZLE.
- ALL SHELL AND ROOF NOZZLES SHALL BE FLANGED UNLESS OTHERWISE INDICATED.
- INTERSTITIAL PIPING FOR ELEVATED TANK FOUNDATION IS SHOWN, FOR NON-ELEVATED TANK BOTTOM, FOUNDATION, AND INTERSTITIAL PIPING PLAN, SEE B3/D.01.
- MOUNT THE 8" ATG AND SAMPLE GAUGE WELLS THROUGH 10" FLANGED ROOF NOZZLES PER THE INDICATED DETAILS.
- 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".

GRAPHIC SCALE(S):
1/4"=1'-0"



DATE	DATE
DESCRIPTION	DESCRIPTION
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Brockenbrough 10100 Station Road, Suite 201, Norfolk, Virginia 23502-3000 Phone: 757/261-1000 Fax: 757/261-1001	
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NOTES:

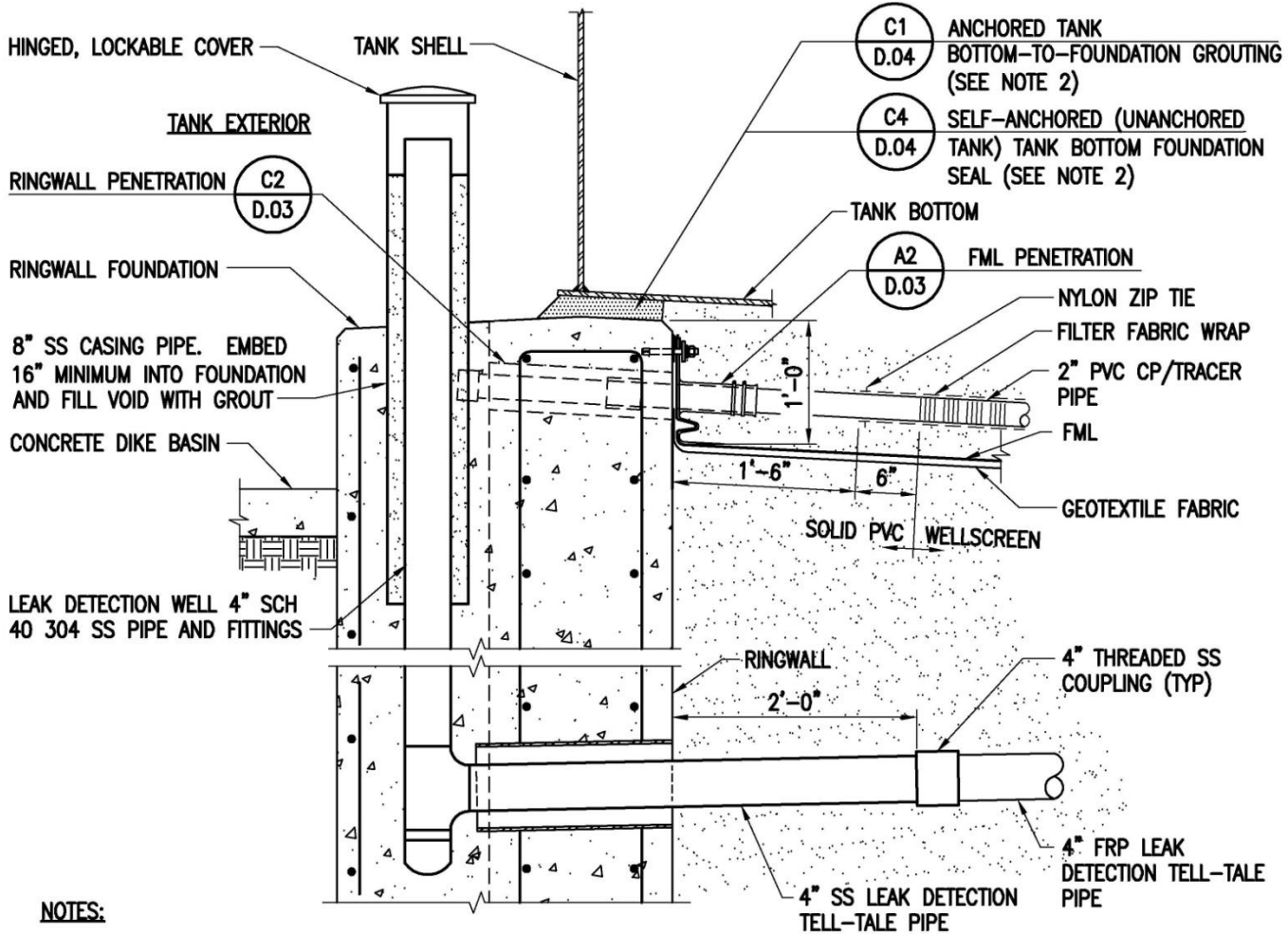
1. 10K BBL TANK IS SHOWN. OTHER TANK SIZES ARE SIMILAR.
2. TANK BOTTOM FOUNDATION SEAL FOR ANCHORED TANK SHOWN.

ELEVATED RINGWALL

SCALE: 1"=1'-0"

D.02

C4
D.03



NOTES:

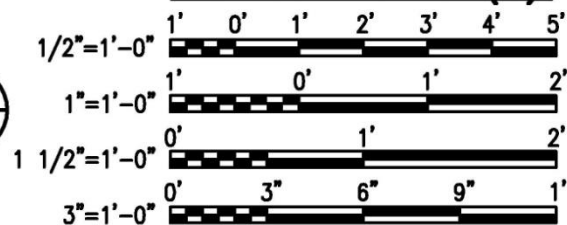
1. 10 KBBL TANK IS SHOWN. OTHER TANK SIZES ARE SIMILAR.
2. TANK BOTTOM FOUNDATION SEAL FOR ANCHORED TANK SHOWN.

NON-ELEVATED RINGWALL

SCALE: 1"=1'-0"

(A4 D.02 D.03)

GRAPHIC SCALE(S):



UFGS 33 56 63 Fuel Impermeable Liner System

- Flexible Membrane Liner (FML) **or**
- 60 Mil HDPE Liner
 - NOT Concrete Surface
 - NOT Clay / Bentonite
- Non-Woven Geotextile (Protective Layer)
- Walkway Materials (Slip-Resistant)
- Ballast Materials
 - Concrete
 - Gravel (River Rock)
 - Sand Tubes
 - Precast Concrete Block

Flexible Membrane Liner

- 30 mil Reinforced Liner with a 7.5 oz/sy Base Fabric Material
- Can be Exposed (with Ballast Material)
 - Wind Uplift Calculations are Required
 - Walkways are Required

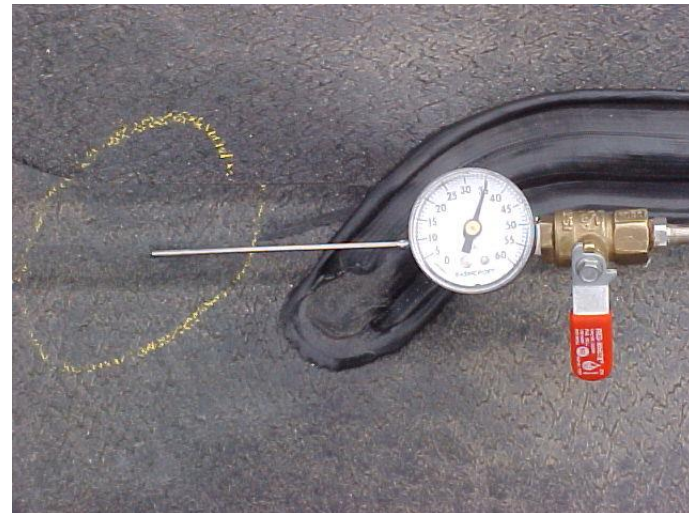
HDPE Liner

- Non-Reinforced 60 mil High Density Polyethylene
- Susceptible to Thermal Expansion and Degradation from UV light
- Must be Completely Covered (Concrete or Gravel)
- Biggest Advantage is Economics

HDPE Liner



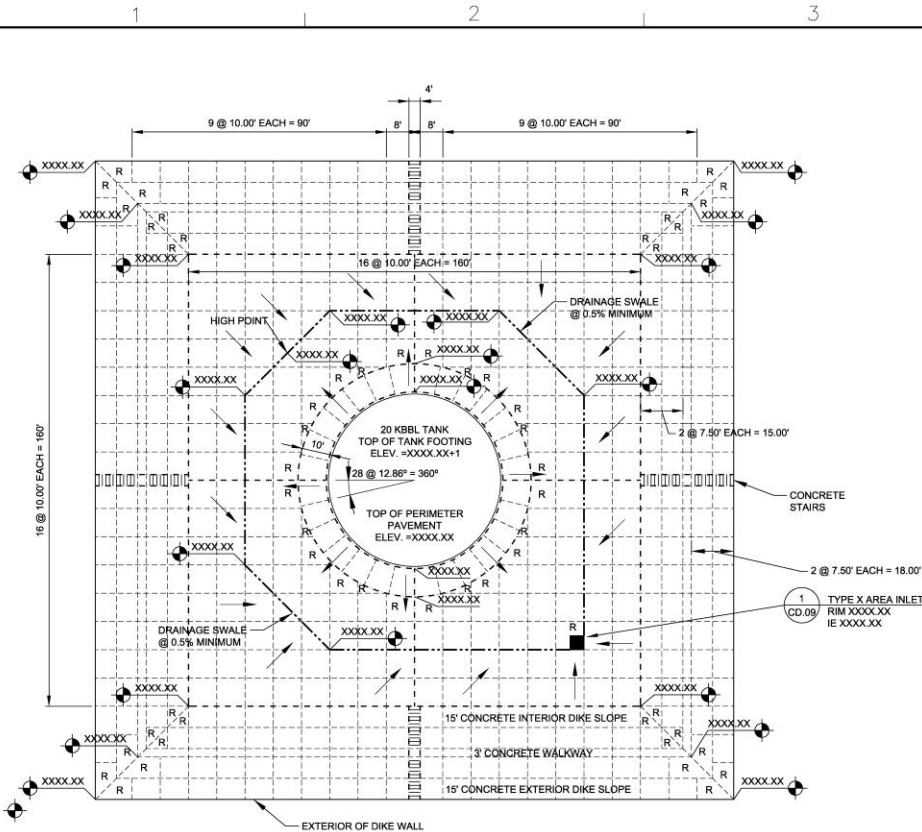
Liner Joints and Testing



Typical Dike Area Joint Layout Plan

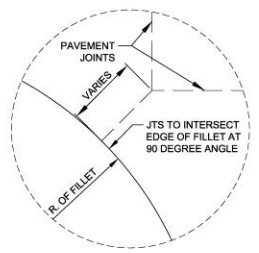
5 UNCLASSIFIED//FOR OFFICIAL USE ONLY

- DESIGNER NOTES:
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 STAIRWAYS; 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.

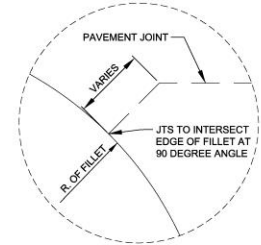


TYPICAL CONCRETE JOINT LAYOUT PLAN
SCALE: 1"=20'-0"

- LEGEND:
- CONTRACTION JOINT
 - - - EXPANSION JOINT
 - · - · - DRAINAGE SWALE
 - R REINFORCED CONCRETE PER CD.02
 - FLOW DIRECTION
 - XXXXXX SPOT ELEVATION



JOINT DETAIL A
SCALE: NONE



JOINT DETAIL B
SCALE: NONE

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PROJECT NO.	XXXXXX
CONTRACT NO.	XXXXXX
DATE	OCTOBER 2014

NAVAL FACILITIES ENGINEERING COMMAND - ATLANTIC
3000 STANDARD DESIGN #109-24-27
FUEL TANKS WITH FIXED ROOFS ABOVEGROUND VERTICAL STEEL
TYPICAL DIKE AREA JOINT LAYOUT PLAN

SCALE	AS NOTED
PROJECT NO.	XXXXXX
CONTRACT NO.	XXXXXX
DRAWING NO.	XXXXXX

5 UNCLASSIFIED//FOR OFFICIAL USE ONLY

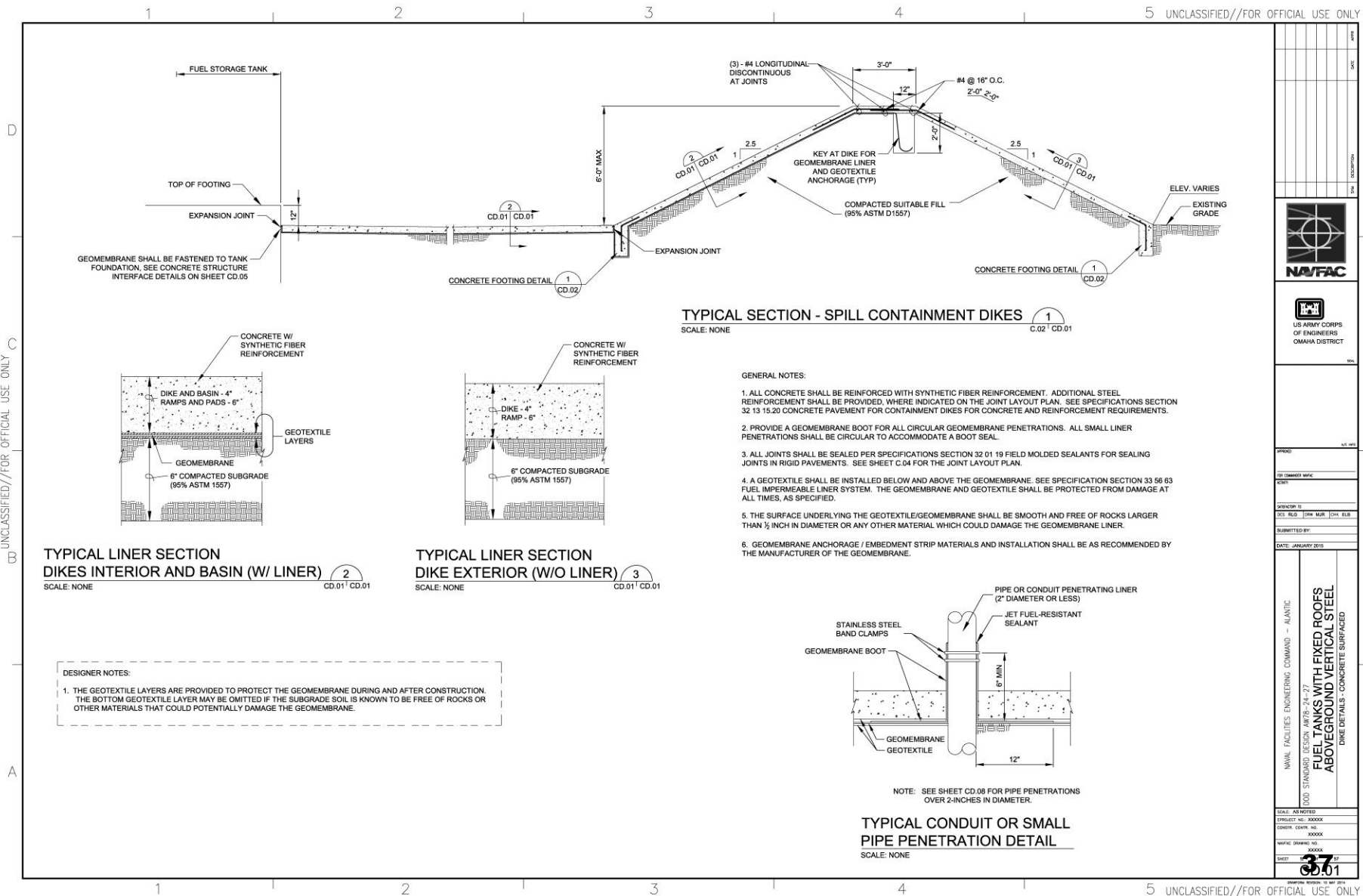
Concrete Surfacing

- UFGS 32 13 15.20 Concrete Pavement for Containment Dikes
- 10' Maximum Joint Spacing
- Synthetic Fiber Reinforcement
- Steel Reinforcement Discontinuous at Joints
- NOT Considered a Fuel Impermeable System on it's Own

Concrete Dikes



Dike Details – Concrete Surfaced



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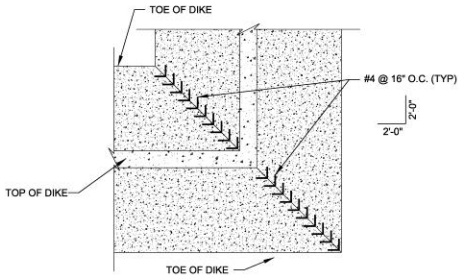
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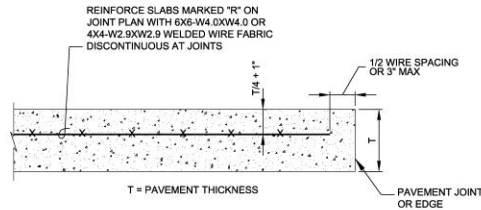
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Dike Details – Concrete Surfaced

5 UNCLASSIFIED//FOR OFFICIAL USE ONLY



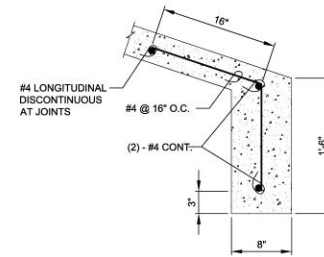
TYPICAL DIKE CORNER REINFORCEMENT DETAIL
SCALE: NONE



SLAB REINFORCING DETAIL
SCALE: NONE

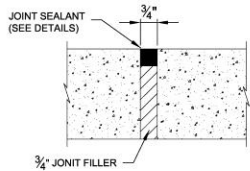
NOTE:

1. WELDED WIRE FABRIC SHALL BE OVERLAPPED FOR A DISTANCE EQUAL TO AT LEAST ONE SPACING OF THE WIRE IN THE FABRIC OR 32 WIRE DIAMETERS, WHICHEVER IS GREATER. THE WIRES IN THE LAP SHALL BE WIRED OR OTHERWISE SECURELY FASTENED TO PREVENT SEPERATION DURING CONCRETE PLACEMENT.



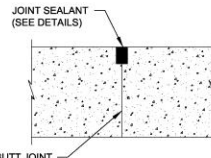
CONCRETE FOOTING DETAIL
SCALE: NONE

1
CD.01 CD.02

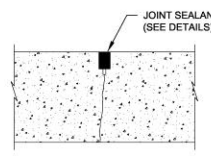


EXPANSION JOINT DETAIL
SCALE: NONE

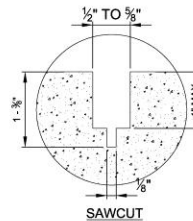
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CD.01 CD.02



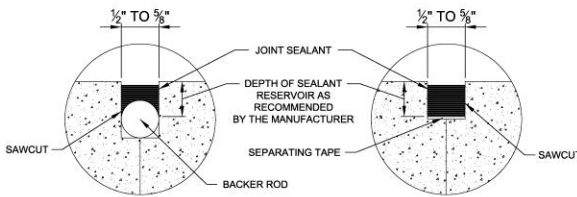
CONSTRUCTION JOINT DETAIL
SCALE: NONE



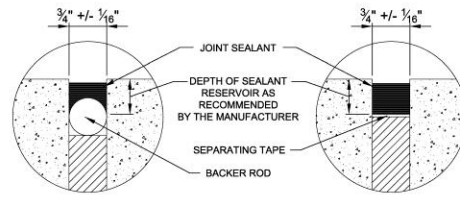
CONTRACTION JOINT DETAIL
SCALE: NONE



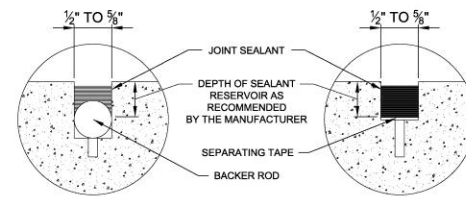
SAWCUT



COMPLETED CONSTRUCTION JOINT SEALANT DETAIL
SCALE: NONE



COMPLETED EXPANSION JOINT SEALANT DETAIL
SCALE: NONE



CONTRACTION JOINT SAWCUT DETAILS
SCALE: NONE

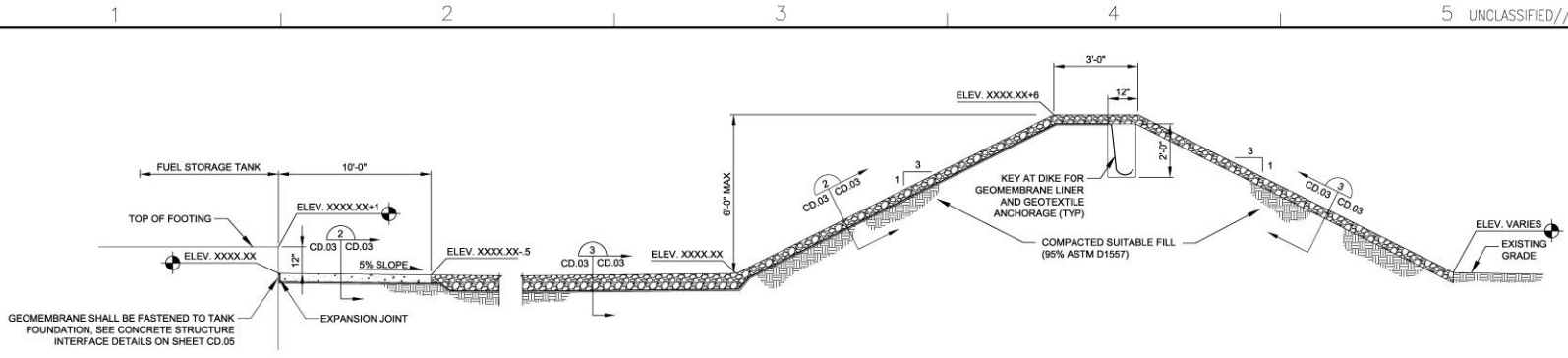
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US ARMY CORPS OF ENGINEERS OMAHA DISTRICT	
#PROJECT	
FOR COMMANDER	
CREATOR	
DESIGNER	
CHECKED	
DATE	
DATE	OCTOBER 2014
NAVAL FACILITIES ENGINEERING COMMAND - ATLANTIC FUEL TANKS WITH FIXED ROOFS ABOVEGROUND VERTICAL STEEL DIKE DETAILS - CONCRETE SURFACED	
SCALE	AS NOTED
PROJECT NO.	XXXXXX
DRAWING NO.	XXXXXX
DATE	XXXXXX
38 CD.02	

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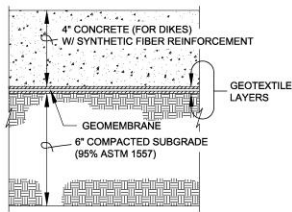
Dike Details – Gravel Ballast



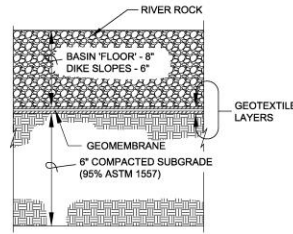
TYPICAL SECTION - SPILL CONTAINMENT DIKES
SCALE: NONE
C.02 CD.03

GENERAL NOTES:

- 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 20 CONCRETE PAVEMENT FOR CONTAINMENT DIKES FOR CONCRETE AND REINFORCEMENT REQUIREMENTS.
- PROVIDE A GEOMEMBRANE BOOT FOR ALL CIRCULAR GEOMEMBRANE PENETRATIONS. ALL SMALL LINER PENETRATIONS SHALL BE CIRCULAR TO ACCOMMODATE A BOOT SEAL.
- 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.
- A GEOTEXTILE SHALL BE INSTALLED BELOW AND ABOVE THE GEOMEMBRANE. SEE SPECIFICATION SECTION 33 56 63 FUEL IMPERMEABLE LINER SYSTEM. THE GEOMEMBRANE AND GEOTEXTILE SHALL BE PROTECTED FROM DAMAGE AT ALL TIMES, AS SPECIFIED.
- THE SURFACE UNDERLYING THE GEOTEXTILE/GEOMEMBRANE SHALL BE SMOOTH AND FREE OF ROCKS LARGER THAN 1/2" IN DIAMETER OR ANY OTHER MATERIAL WHICH WOULD DAMAGE THE GEOMEMBRANE LINER.
- GEOMEMBRANE ANCHORAGE / EMBEDMENT STRIP MATERIALS AND INSTALLATION SHALL BE AS RECOMMENDED BY THE MANUFACTURER OF THE GEOMEMBRANE.
- ROCK BALLAST MATERIAL SHALL BE CLEAN, WELL GRADED 3/8" TO 1-3/4" RIVER ROCK. THE ROCK BALLAST LAYER SHALL BE COMPACTED WITH TWO PASSES OF A WALK-BEHIND VIBRATORY ROLLER.

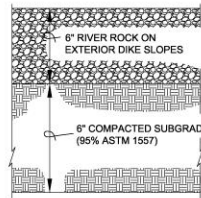


TYPICAL LINER SECTION
CONCRETE WORKING SURFACE
SCALE: NONE
CD.03 CD.05

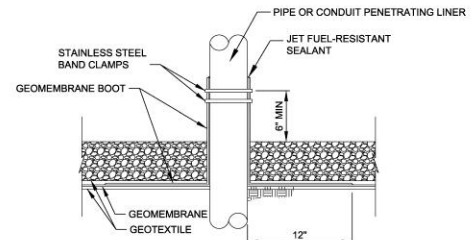


TYPICAL LINER SECTION
DIKE INTERIOR AND BASIN (W/ LINER)
SCALE: NONE
CD.03 CD.05

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.



TYPICAL LINER SECTION
DIKE EXTERIOR WALLS (W/O LINER)
SCALE: NONE
CD.03 CD.05



NOTE: SEE SHEET CD.08 FOR PIPE PENETRATIONS UNDER 2-INCHES IN DIAMETER.
TYPICAL CONDUIT OR SMALL PIPE PENETRATION DETAIL
SCALE: NONE

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NAVFAC

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

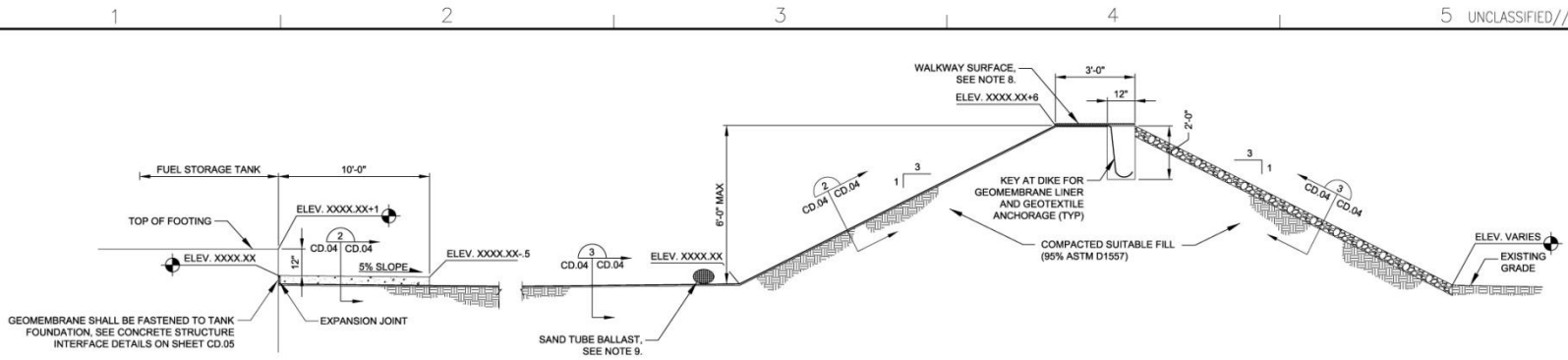
UNCLASSIFIED//FOR OFFICIAL USE ONLY

NAVAL FACILITIES ENGINEERING COMMAND - ATLANTIC
DOD STANDARD DESIGN #28-24-27
FUEL TANKS WITH FIXED ROOFS ABOVEGROUND VERTICAL STEEL
DIKE DETAILS - GRAVEL BALLAST

SCALE: AS NOTED
PROJECT NO.: XXXXXX
CONTR. DOWNS NO.: XXXXXX
NATIC DRAWING NO.: XXXXXX

39 CD.03

Dike Details – Exposed Liner



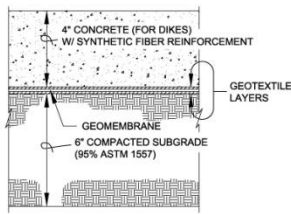
TYPICAL SECTION - SPILL CONTAINMENT DIKES
SCALE: NONE

GENERAL NOTES:

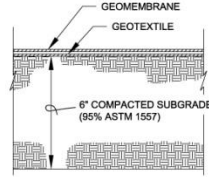
1. ALL CONCRETE SHALL BE REINFORCED WITH SYNTHETIC FIBER REINFORCEMENT. ADDITIONAL STEEL REINFORCEMENT SHALL BE PROVIDED, WHERE INDICATED ON THE JOINT LAYOUT PLAN. SEE SPECIFICATIONS SECTION 32 13 15 20 CONCRETE PAVEMENT FOR CONTAINMENT DIKES FOR CONCRETE AND REINFORCEMENT REQUIREMENTS.
2. PROVIDE A 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 SHALL 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 63 FUEL IMPERMEABLE LINER SYSTEM. THE GEOMEMBRANE AND GEOTEXTILE SHALL BE PROTECTED FROM DAMAGE AT ALL TIMES, AS SPECIFIED.
5. THE SURFACE UNDERLYING THE GEOTEXTILE/GEOMEMBRANE SHALL BE SMOOTH AND FREE OF ROCKS LARGER THAN 1/2" IN DIAMETER OR ANY OTHER MATERIAL WHICH WOULD DAMAGE THE GEOMEMBRANE LINER.
6. GEOMEMBRANE ANCHORAGE / EMBEDMENT STRIP MATERIALS AND INSTALLATION SHALL BE AS RECOMMENDED BY THE MANUFACTURER OF THE GEOMEMBRANE.
7. ROCK MATERIAL SHALL BE CLEAN, WELL GRADED 3/8" TO 1-1/2" RIVER ROCK. THE ROCK LAYER SHALL BE COMPACTED WITH TWO PASSES OF A WALK-BEHIND VIBRATORY ROLLER.
8. A SKID RESISTANT WALKWAY SHALL BE PROVIDED ALONG THE 3-FOOT TOP OF DIKE WALK PATH AND ON PATHWAYS WITHIN THE TANK BASIN, AS INDICATED ON THE SITE PLAN. SEE SPECIFICATION SECTION 33 56 63 FUEL IMPERMEABLE LINER SYSTEM, FOR WALKWAY MATERIALS.
9. SAND TUBES SHALL BE PROVIDED ON THE EXPOSED GEOMEMBRANE FOR BALLAST TO PREVENT WIND UPLIFT. SEE SPECIFICATION SECTION 33 56 63 FUEL IMPERMEABLE LINER SYSTEM FOR ADDITIONAL DETAILS.

DESIGNER NOTES:

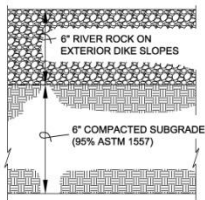
1. THE GEOTEXTILE LAYERS ARE PROVIDED TO PROTECT THE GEOMEMBRANE DURING AND AFTER CONSTRUCTION. THE BOTTOM GEOTEXTILE LAYER MAY BE OMITTED IF THE SUBGRADE SOIL IS KNOWN TO BE FREE OF ROCKS OR OTHER MATERIALS THAT COULD POTENTIALLY DAMAGE THE GEOMEMBRANE.
2. OTHER BALLAST MATERIALS MAY BE SPECIFIED. WIND UPLIFT CALCULATIONS MUST BE PERFORMED REGARDLESS OF THE BALLAST MATERIALS USED. SPECIFICATION SECTION 33 56 63 'FUEL IMPERMEABLE LINER SYSTEM' PROVIDES WIND UPLIFT DESIGN GUIDANCE.



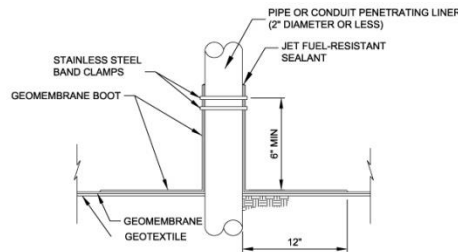
TYPICAL LINER SECTION CONCRETE WORKING SURFACE
SCALE: NONE



TYPICAL LINER SECTION
SCALE: NONE



TYPICAL LINER SECTION DIKE EXTERIOR WALLS (W/O LINER)
SCALE: NONE



TYPICAL CONDUIT OR SMALL PIPE PENETRATION DETAIL
SCALE: NONE

DATE	APR 2014
REV	DESCRIPTION
NO.	
 NAVFAC US ARMY CORPS OF ENGINEERS OMAHA DISTRICT	
APPROVED: [Signature] DATE: JANUARY 2015	
SUBMITTED BY: [Name] DATE: JANUARY 2015	
DESIGNER: [Name] CHECKED: [Name] DATE: JANUARY 2015	
NAVFAC DRAWING NO. 3000 PROJECT NO. 300000 CONTRACT NO. 300000 NAVFAC DRAWING NO. 300000	
44 CD.04	

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Walkway / Sand Tubes

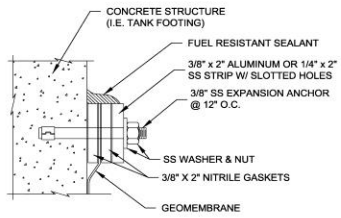


Precast Block Walkways/Ballast



Liner Fastening Details

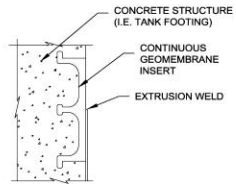
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NOTE: VARIANCES TO THIS DETAIL MAY BE MADE WHEN RECOMMENDED BY THE GEOMEMBRANE MANUFACTURER.

TYPICAL GEOMEMBRANE TERMINATION DETAIL - EXISTING STRUCTURE

SCALE: NONE CD.05 1 CD.05



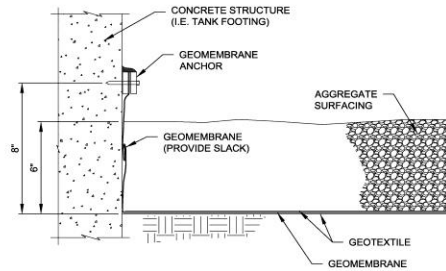
NOTE: GEOMEMBRANE INSERT TO BE MANUFACTURER'S STANDARD

TYPICAL GEOMEMBRANE TERMINATION DETAIL - NEW STRUCTURE

SCALE: NONE

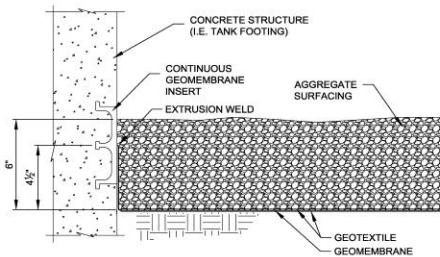
DESIGNER NOTES:

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.



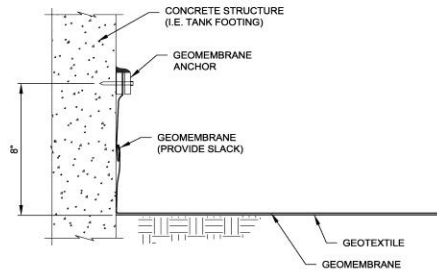
CONCRETE STRUCTURE INTERFACE DETAIL - EXISTING STRUCTURE

SCALE: NONE



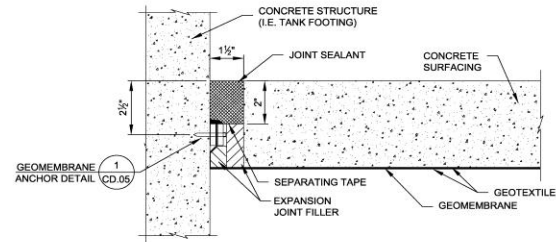
CONCRETE STRUCTURE INTERFACE DETAIL - NEW STRUCTURE

SCALE: NONE



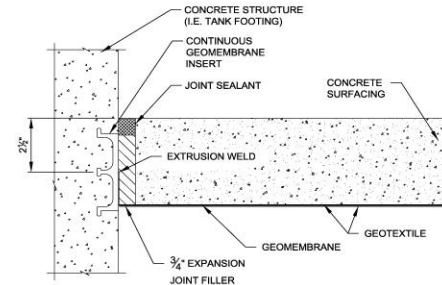
CONCRETE STRUCTURE INTERFACE DETAIL - EXISTING STRUCTURE

SCALE: NONE



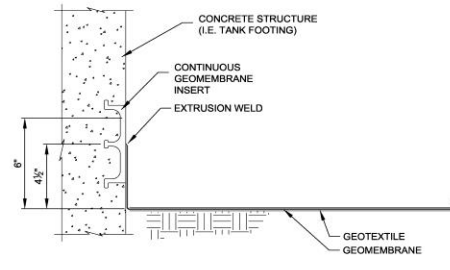
CONCRETE STRUCTURE INTERFACE DETAIL - EXISTING STRUCTURE

SCALE: NONE



CONCRETE STRUCTURE INTERFACE DETAIL - NEW STRUCTURE

SCALE: NONE



CONCRETE STRUCTURE INTERFACE DETAIL - NEW STRUCTURE

SCALE: NONE

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PROJECT: CD.05 1 CD.05	DATE: OCTOBER 2014
SUBMITTED BY:	DATE: OCTOBER 2014
NAVFAC DESIGN: CD.05 1 CD.05	NAVFAC DRAWING NO: CD.05
UNCLASSIFIED//FOR OFFICIAL USE ONLY	UNCLASSIFIED//FOR OFFICIAL USE ONLY

1

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C

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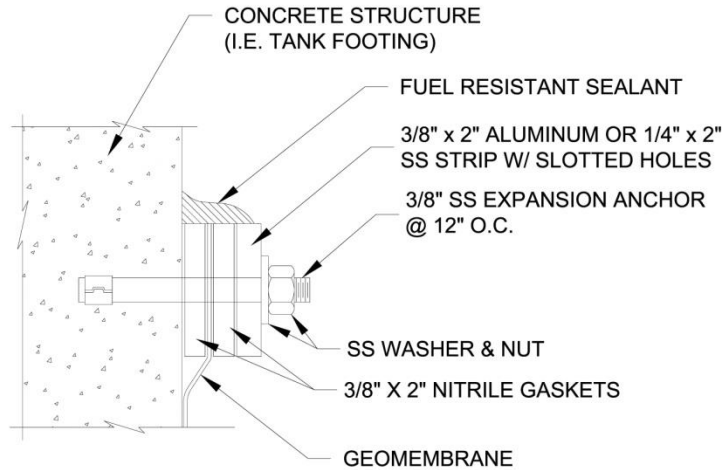
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Liner Termination Details

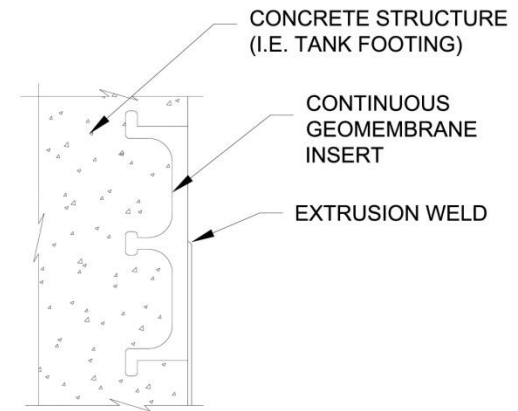


NOTE: VARIANCES TO THIS DETAIL MAY BE MADE WHEN RECOMMENED BY THE GEOMEMBRANE MANUFACTURER.

TYPICAL GEOMEMBRANE TERMINATION DETAIL - EXISTING STRUCTURE

SCALE: NONE

1
CD.05 | CD.05

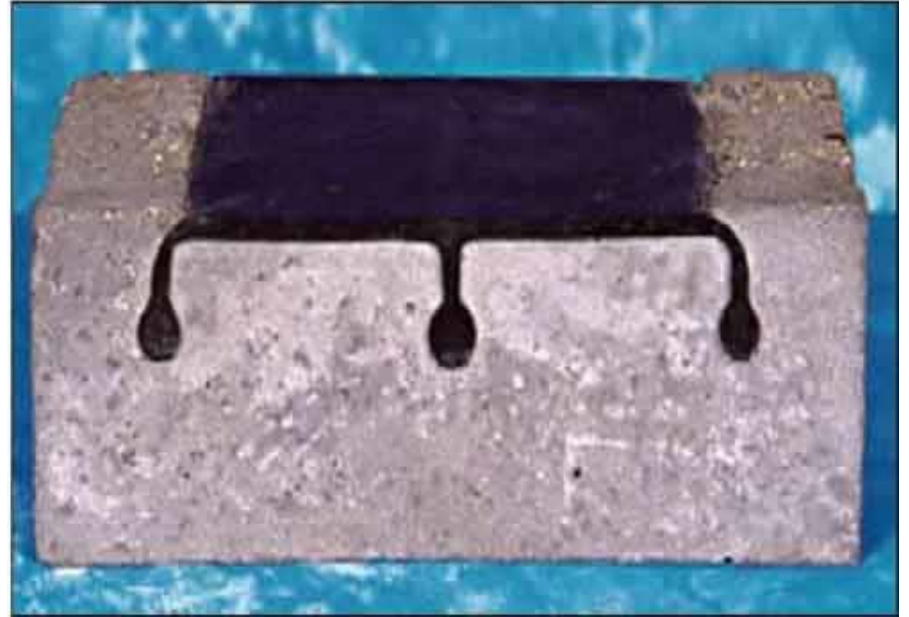


NOTE:
GEOMEMBRANE INSERT TO BE MANUFACTURER'S STANDARD

TYPICAL GEOMEMBRANE TERMINATION DETAIL - NEW STRUCTURE

SCALE: NONE

Embed Strips



Concrete Stairway Details

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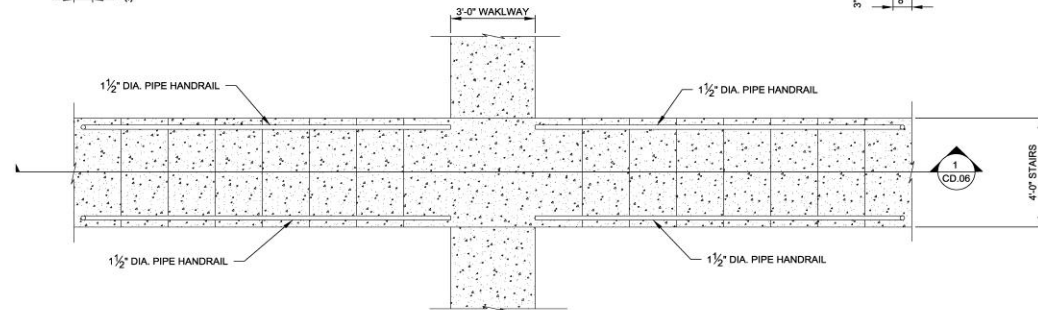
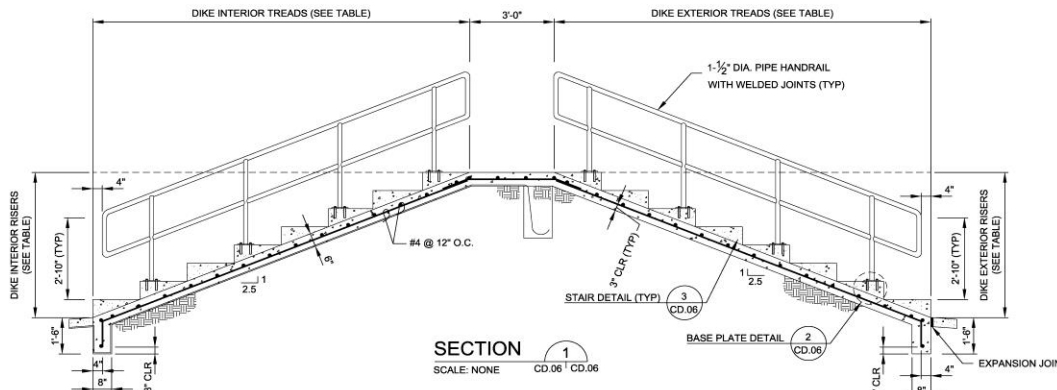
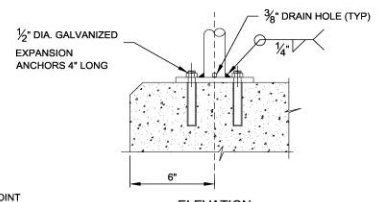
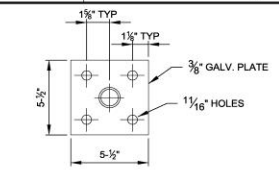


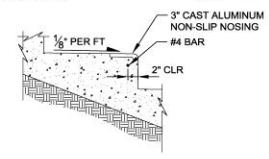
TABLE OF STAIR DIMENSIONS				
STAIR NUMBER	INTERIOR TREADS	INTERIOR RISERS	EXTERIOR TREADS	EXTERIOR RISERS
1	#T @ #" = #'-#"	#R @ #" = #'-#"	#T @ #" = #'-#"	#R @ #" = #'-#"
2	#T @ #" = #'-#"	#R @ #" = #'-#"	#T @ #" = #'-#"	#R @ #" = #'-#"
3	#T @ #" = #'-#"	#R @ #" = #'-#"	#T @ #" = #'-#"	#R @ #" = #'-#"
4	#T @ #" = #'-#"	#R @ #" = #'-#"	#T @ #" = #'-#"	#R @ #" = #'-#"
5	#T @ #" = #'-#"	#R @ #" = #'-#"	#T @ #" = #'-#"	#R @ #" = #'-#"

DESIGNER NOTES:

- PER IBC AND ADA GUIDELINES RISERS HAVE A MINIMUM HEIGHT OF 4" AND A MAXIMUM HEIGHT OF 7".
- PER ADA GUIDELINES, TREADS SHALL HAVE A MINIMUM WIDTH OF 11", AS MEASURED FROM RISER TO RISER.
- HANDRAILS SHALL BE EXPOSED GALVANIZED UNLESS PAINTED. RAILS ARE REQUIRED BY THE INSTALLATION. IF PAINTING IS REQUIRED, THE RAILS SHOULD STILL BE GALVANIZED BEFORE FABRICATION.



BASE PLATE DETAIL 2
SCALE: NONE
CD.06 1 CD.06



NOTES:
1. PIPE HANDRAIL SHALL HAVE WELDS GROUNDED SMOOTH AND BE HOT DIPPED GALVANIZED AFTER FABRICATION.

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US ARMY CORPS OF ENGINEERS OMAHA DISTRICT

NAVAL FACILITIES ENGINEERING COMMAND - ATLANTIC

300 STANDARD DESIGN WORK 24-27

FUEL TANKS WITH FIXED ROOFS ABOVEGROUND VERTICAL STEEL

CONCRETE STAIRWAY DETAILS

SCALE: AS SHOWN
ENGINEER: MC. 30000X
CONSTR. CONTR. NO. 30000X

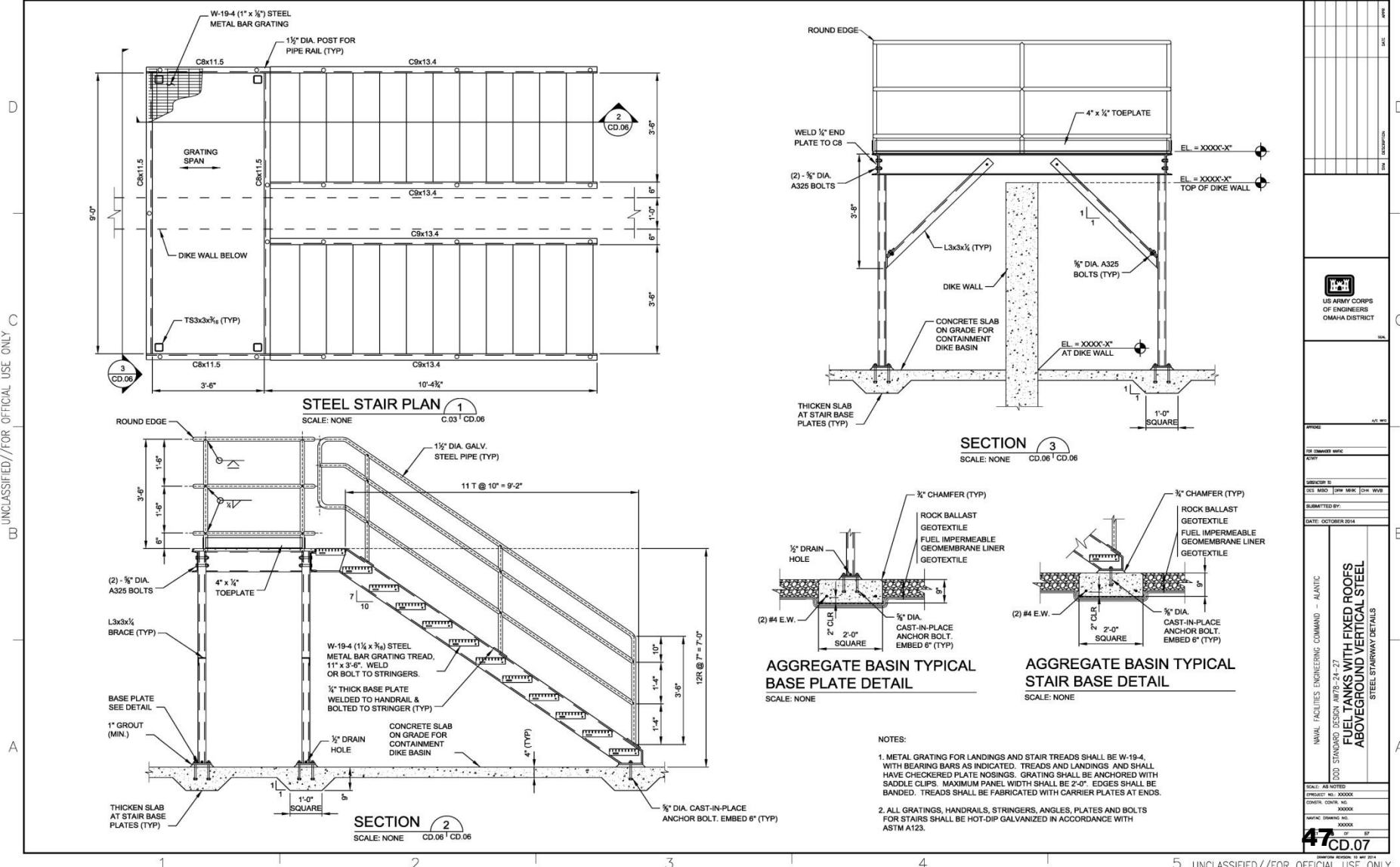
NAVAC DRAWING NO. 112 (Rev. 06/01/01)

46 CD.06

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Steel Stairway Details

5 UNCLASSIFIED//FOR OFFICIAL USE ONLY



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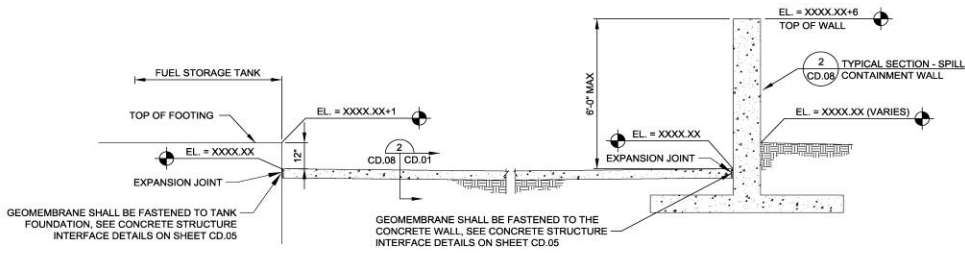
- NOTES:
1. METAL GRATING FOR LANDINGS AND STAIR TREADS SHALL BE W-19-4, WITH BEARING BARS AS INDICATED. TREADS AND LANDINGS AND SHALL HAVE CHECKERED PLATE NOSINGS. GRATING SHALL BE ANCHORED WITH SADDLE CLIPS. MAXIMUM PANEL WIDTH SHALL BE 2'-0". EDGES SHALL BE BANDED. TREADS SHALL BE FABRICATED WITH 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.

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 US ARMY CORPS OF ENGINEERS OMAHA DISTRICT	
PROJECT:	
DESIGNER:	
DATE:	OCTOBER 2014
STAIRWAY DETAILS	
FUEL TANKS WITH FIXED ROOFS ABOVEGROUND VERTICAL STEEL	
SCALE:	AS NOTED
PROJECT NO.:	XXXXXX
DRAWING NO.:	XXXXXX
DATE:	10/20/14
BY:	CD.07
CD.07	

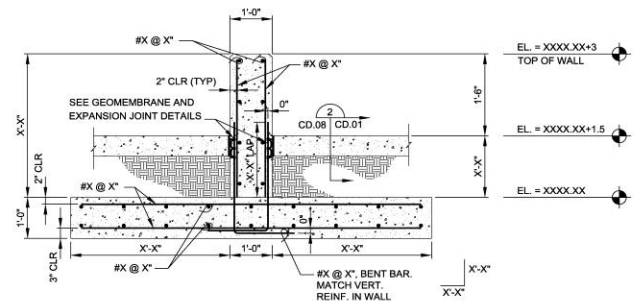
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Containment Wall Details

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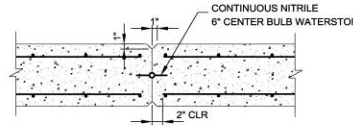


TYPICAL SECTION - SPILL CONTAINMENT WALLS
SCALE: NONE

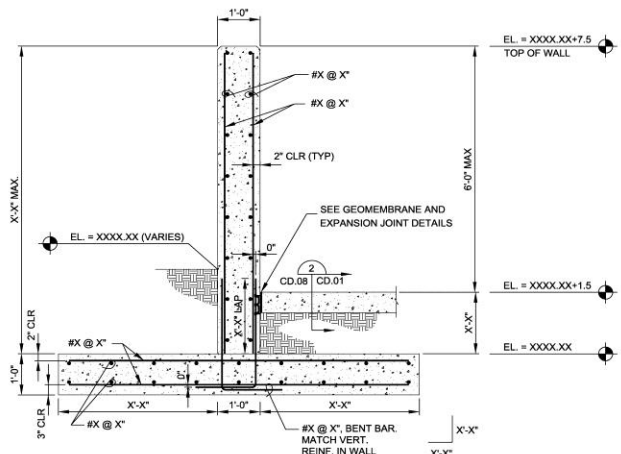


TYPICAL SECTION - SPILL CONTAINMENT INTERMEDIATE WALL
SCALE: NONE

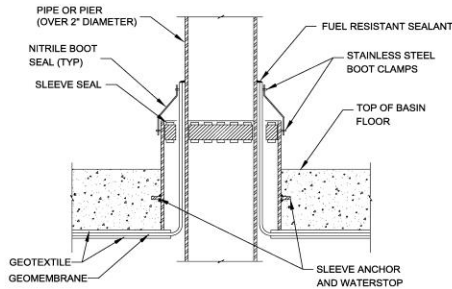
- DESIGNER NOTES:**
1. CONTAINMENT WALLS SHALL BE DESIGNED BY A STRUCTURAL ENGINEER BASED UPON REQUIRED HEIGHTS AND SOIL CONDITIONS.
 2. PROVIDE VERTICAL ROUTED JOINTS AS NECESSARY TO CONTROL CRACKING.



WALL CONTROL JOINT DETAIL
SCALE: NONE

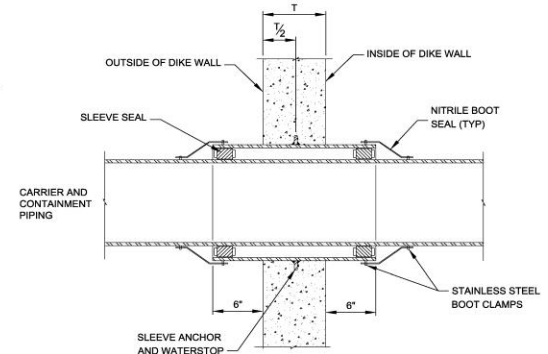


TYPICAL SECTION - SPILL CONTAINMENT WALL
SCALE: NONE



NOTE: FOR PIPES 2" IN DIAMETER OR LESS, SEE DETAIL ON SHEET CD.01.

BASIN FLOOR LARGE PIPE PENETRATION DETAIL
SCALE: NONE



CONCRETE WALL PENETRATION DETAIL
SCALE: NONE

NO.	DATE	BY	REVISION



US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

PROJECT	
FOR DRAWING INFO	
DATE	
DESIGNED BY	
CDS MEO	
DATE	
SUBMITTED BY	
DATE	

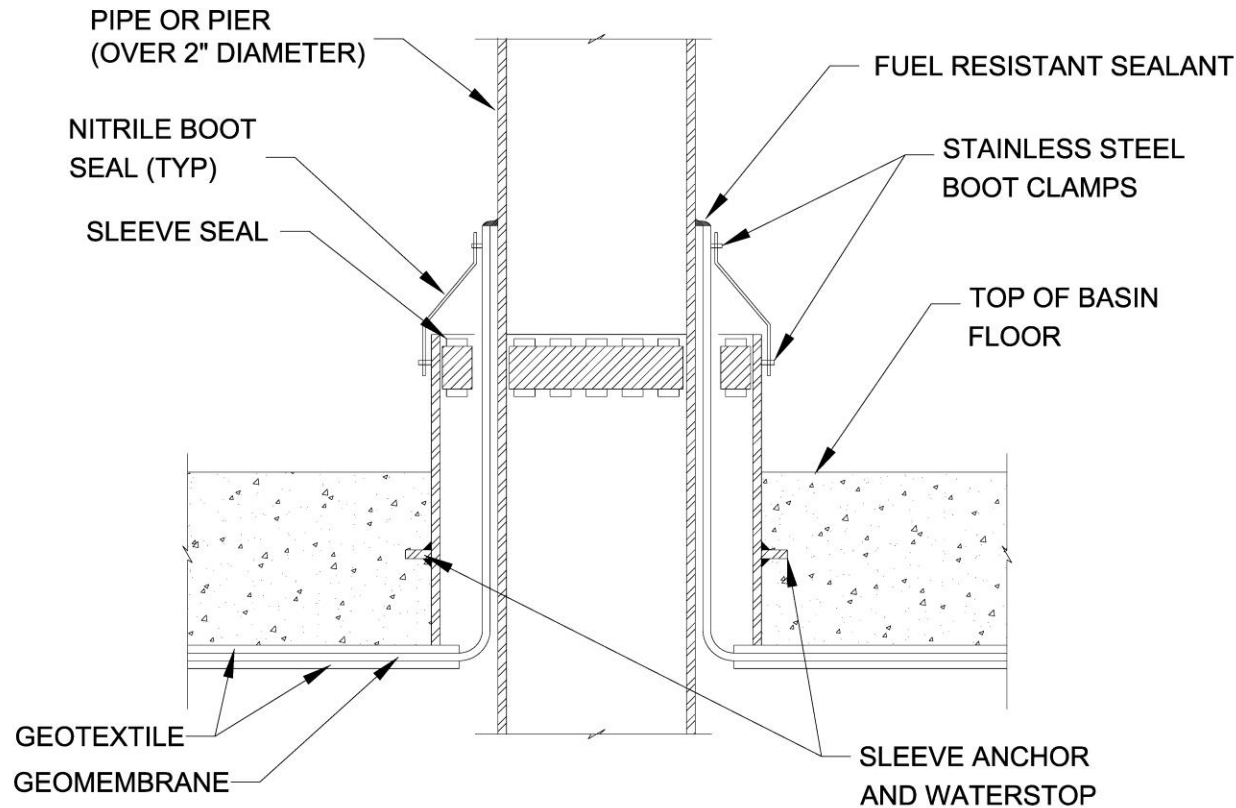
NAVAL FACILITIES ENGINEERING COMMAND - ATLANTIC
CD STANDARD DESIGN NUMBER 24-27
FUEL TANKS WITH FIXED ROOFS ABOVEGROUND VERTICAL STEEL CONTAINMENT WALL DETAILS

SCALE	AS NOTED
PROJECT NO.	XXXXXX
CONSTR. CONTR. NO.	XXXXXX
DRAWING NO.	XXXXXX
DATE	
BY	
CHECKED BY	

48
CD.08

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Basin Floor Penetration Detail

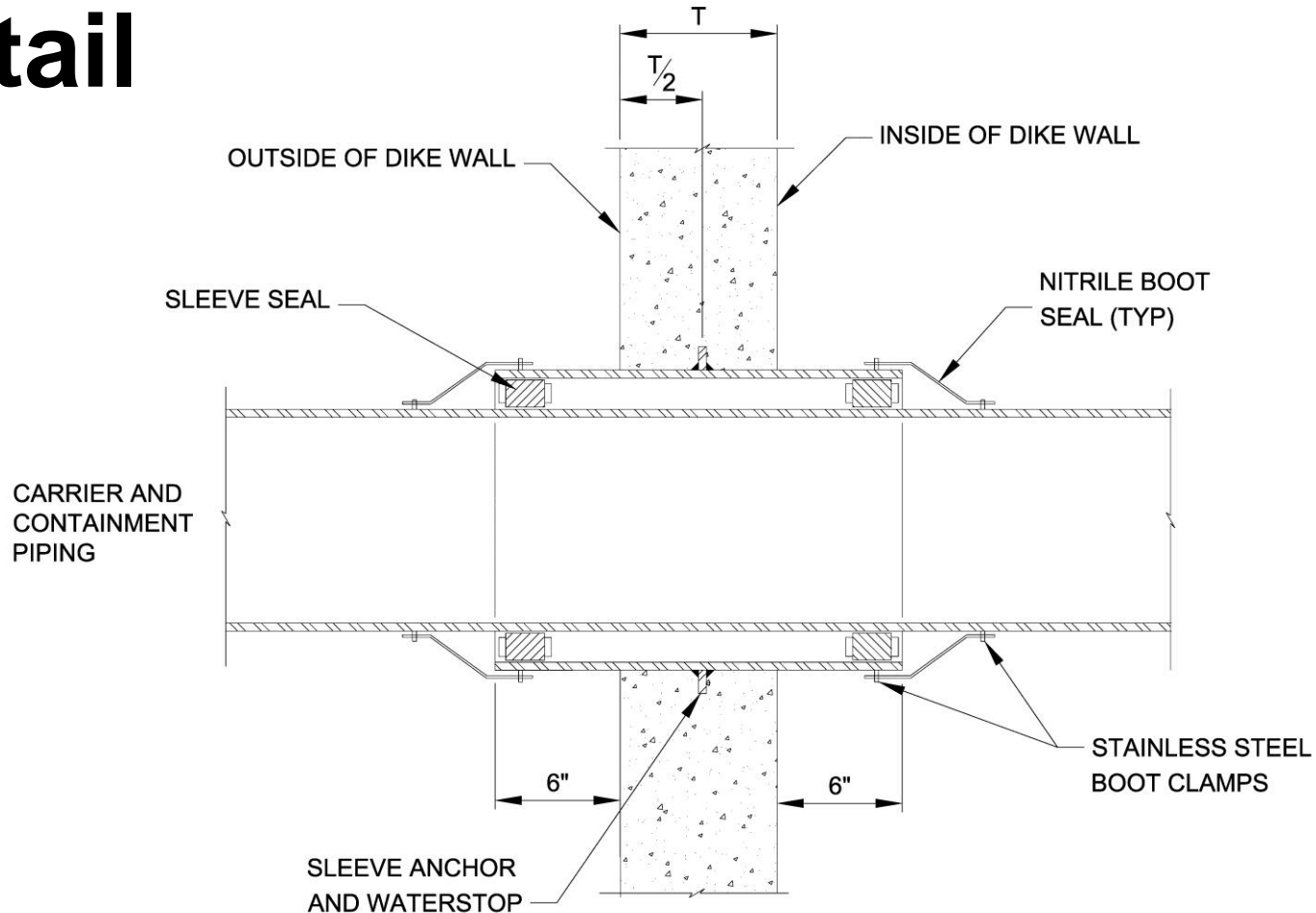


NOTE: FOR PIPES 2" IN DIAMETER OR LESS, SEE DETAIL ON SHEET CD.01.

BASIN FLOOR LARGE PIPE PENETRATION DETAIL

SCALE: NONE

Containment Wall Penetration Detail



CONCRETE WALL PENETRATION DETAIL

SCALE: NONE

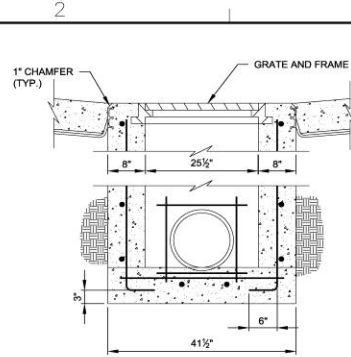
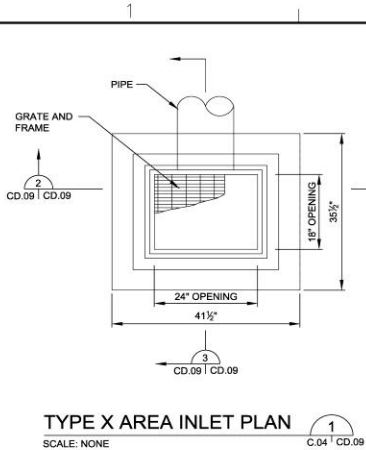
Containment Wall Penetration



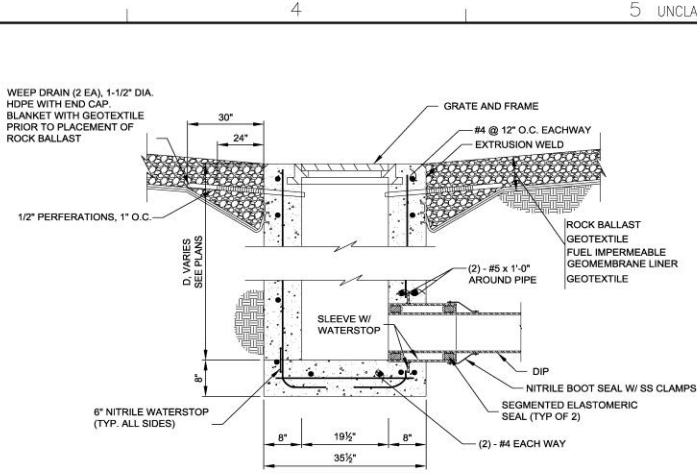
Containment Wall Control Joint



Containment Drainage Details



SECTION 2
SCALE: NONE CD.09 CD.09

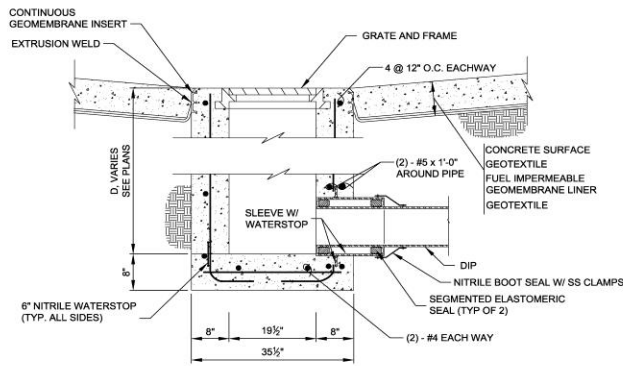


SECTION 3
SCALE: NONE CD.09 CD.09

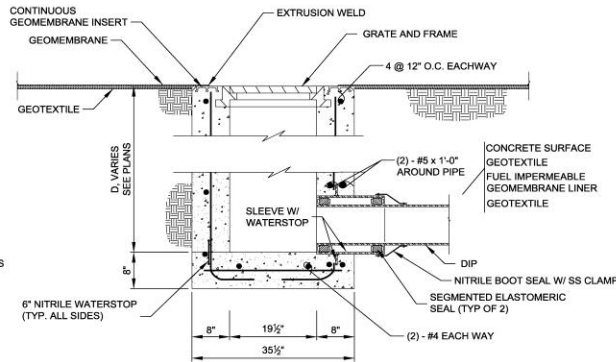
INLET CONSTRUCTION GENERAL NOTES:

- STANDARD CONSTRUCTION SHALL BE CAST IN PLACE REINFORCED CONCRETE. PRECAST CONSTRUCTION SHALL NOT BE ALLOWED.
- REINFORCING STEEL FY = 60 KSI.
- MINIMUM CLEAR COVER OF CONCRETE OVER REINFORCING STEEL SHALL BE 3 INCHES FOR CONCRETE PLACED AGAINST THE SOIL.
- CAST IRON GRATE AND FRAME SHALL BE HEAVY-DUTY NEEHAH R-1878-B3G OR LIGHT-DUTY NEEHAH R-1879-B3G (WHERE NOT SUBJECT TO POSSIBLE WHEEL LOADS), OR APPROVED EQUAL.
- MINIMUM 6" COMPACTED (95%) SUBGRADE REQUIRED UNDER INLETS.

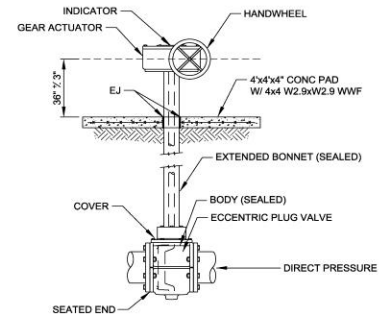
- DESIGNER NOTES:
- A PIV OR GATE VALVE IS NOT ALLOWED FOR CONTAINMENT DRAINS.
 - DO NOT APPROVE PRECAST INLETS AS THE JOINTS AND CONNECTIONS ARE SUSCEPTIBLE TO LEAKS.
 - SELECT THE APPROPRIATE CROSS-SECTIONS FOR THE SELECTED LINER COVER MATERIAL.



SECTION 3
SCALE: NONE CD.09 CD.09



SECTION 3
SCALE: NONE CD.09 CD.09



NOTE: 100% PORT ECCENTRIC PLUG VALVE SHALL CONFORM TO API 6D AND BE RESISTANT TO HYDROCARBONS (NITRILE RUBBER SEALS). GEAR ACTUATOR BOX WITH HANDWHEEL SHALL BE LOCKABLE.

CONTAINMENT DRAIN VALVE DETAIL
SCALE: NONE

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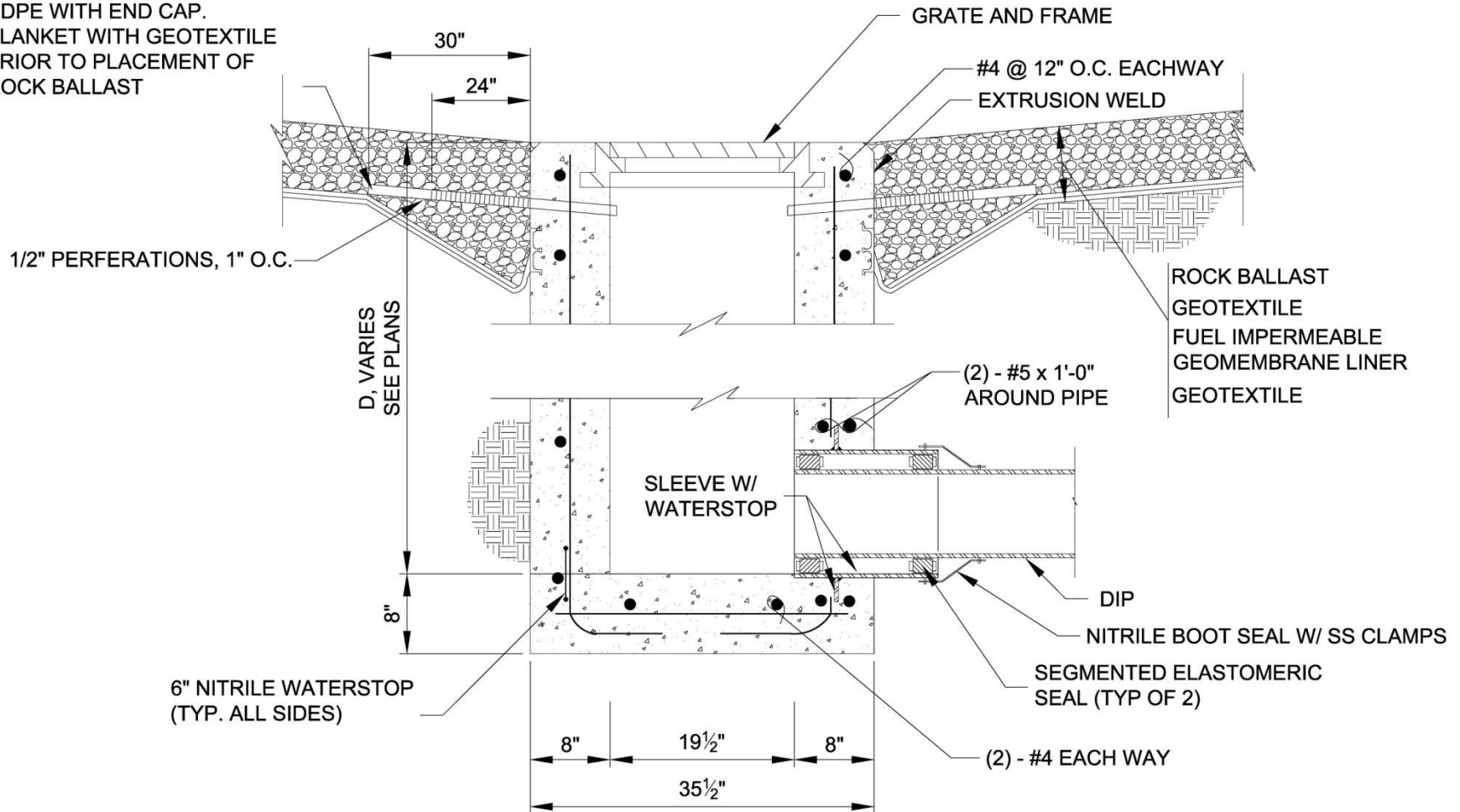
DATE	
REV	
DESCRIPTION	
PROJ	AV-103
DESIGNED BY	
CHECKED BY	
DRAWN BY	
DATE	SEPTEMBER 14

AVIATION FACILITIES ENGINEERING COMMAND - ATLANTIC
 STANDARD DESIGN WP-24-26-27
FUEL TANKS WITH FIXED ROOFS ABOVEGROUND VERTICAL STEEL
 CONTAINMENT DRAINAGE DETAILS
 SCALE: AS SHOWN
 PROJECT NO. 30000
 CONTR. CONTR. NO. 3000X
 NAVFAC DRAWING NO. 53-CD.09
 53-CD.09
 (UNCLASSIFIED//FOR OFFICIAL USE ONLY)

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Inlet Section

WEEP DRAIN (2 EA), 1-1/2" DIA.
 HDPE WITH END CAP.
 BLANKET WITH GEOTEXTILE
 PRIOR TO PLACEMENT OF
 ROCK BALLAST



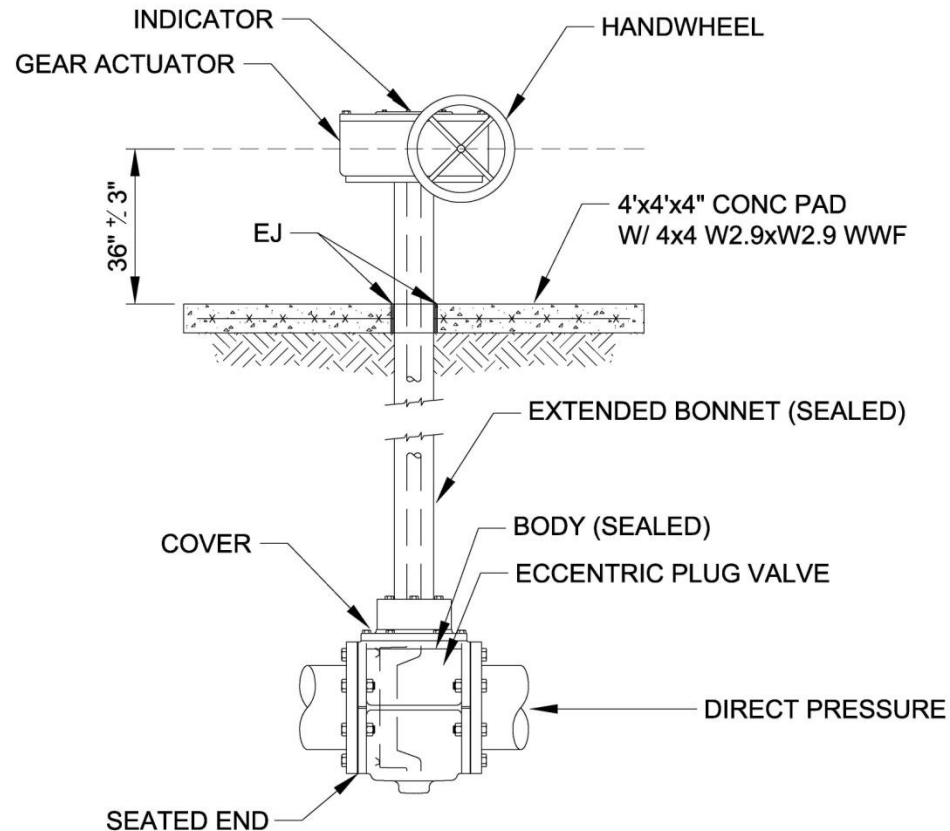
SECTION

3

Precast Inlet

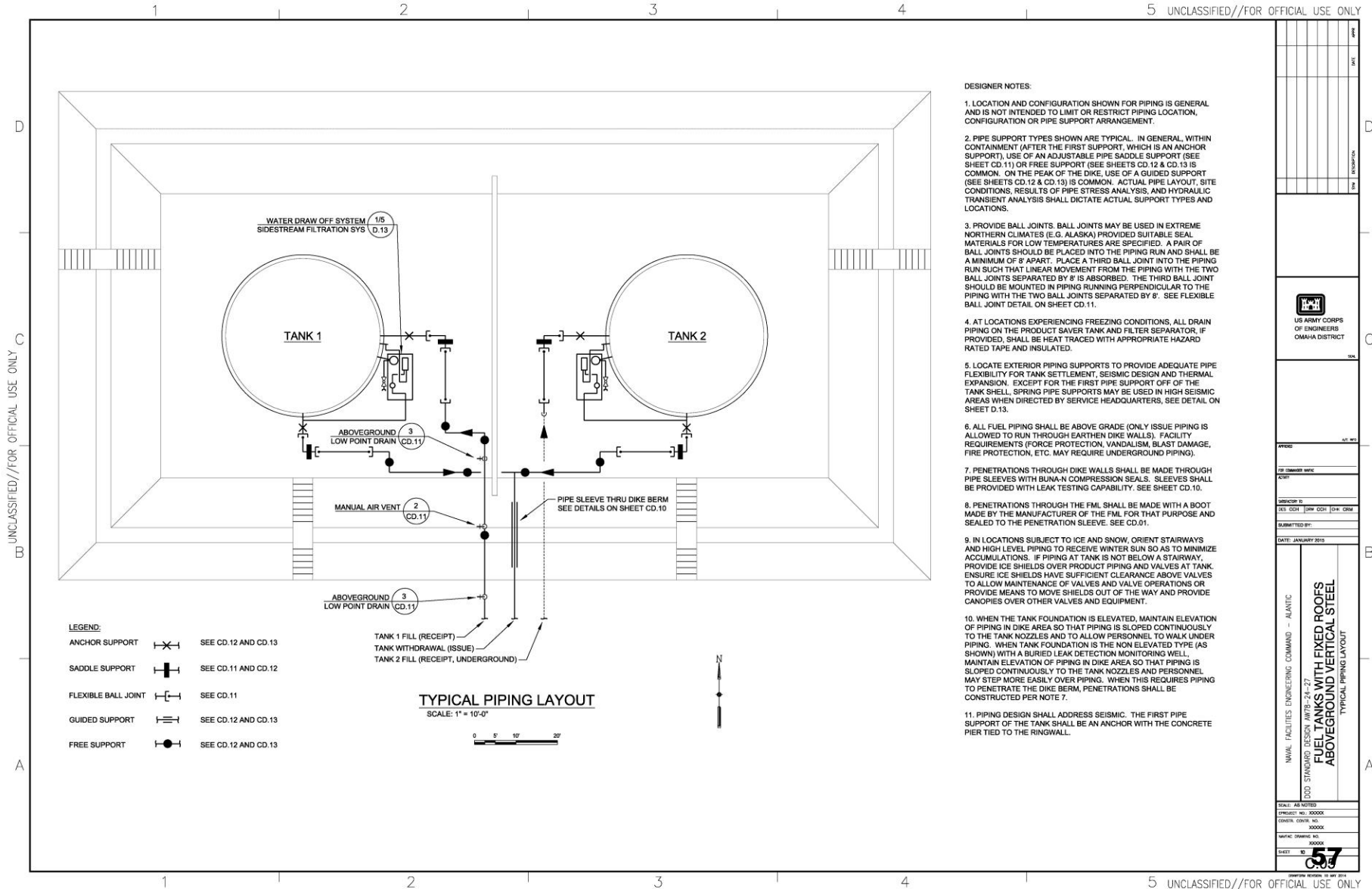


Containment Drain Valve Detail



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.

Typical Piping Layout



Miscellaneous Details

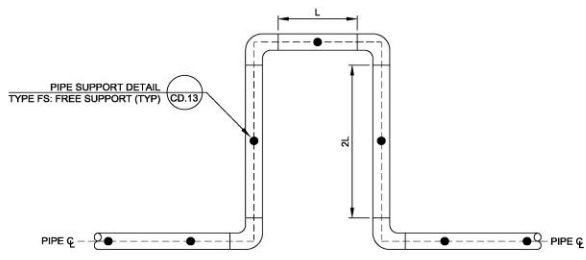
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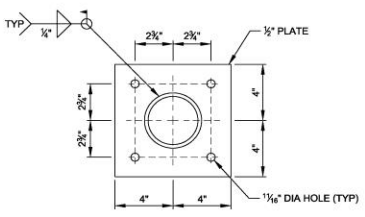
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DESIGNER NOTES:
1. OTHER PIPE SUPPORTS AND SUPPORT LOCATIONS SHALL BE CALCULATED BY A PIPE STRESS ANALYSIS AND HYDRAULIC TRANSIENT COMPUTATIONS.

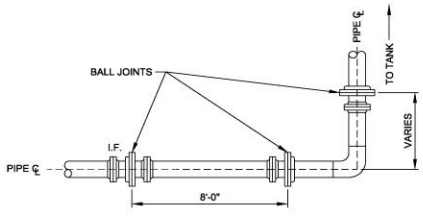
TYPICAL EXPANSION LOOP

SCALE: NONE



BASE PLATE

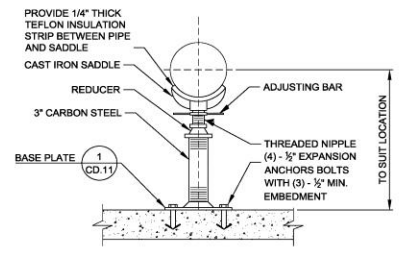
SCALE: NONE CD.11 CD.11



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.

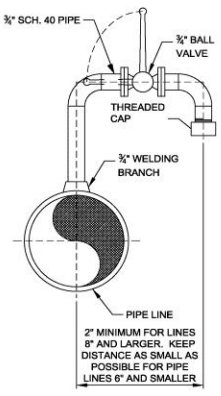
FLEXIBLE BALL JOINTS

SCALE: NONE



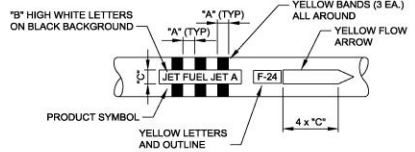
ADJUSTABLE PIPE SADDLE SUPPORT DETAIL (PS-1)

SCALE: NONE



MANUAL AIR VENT

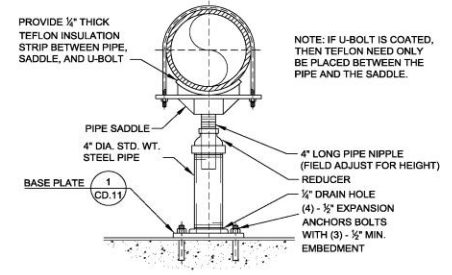
SCALE: NONE C.05 CD.11



DESIGNER NOTES:
THE EXAMPLE MARKINGS SHOWN ARE FOR JET A TURBINE FUEL, FOR OTHER FUEL TYPES, REFER TO MIL-STD-161G.

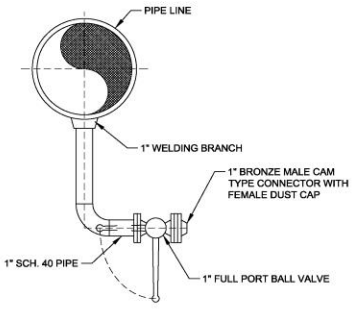
PRODUCT FLOW SYMBOL DETAIL

SCALE: NONE



ADJUSTABLE PIPE SUPPORT DETAIL (PS-2)

SCALE: NONE



DESIGNER NOTES:
1. ENSURE THAT THE ABOVEGROUND LOW POINT DRAIN HAS ADEQUATE CLEARANCE TO ALLOW FOR FULL ROTATION OF THE BALL VALVE HANDLE.

ABOVEGROUND LOW POINT DRAIN

SCALE: NONE C.05 CD.11

SIZES OF LETTERS AND BANDS			
PIPE DIAMETER (IN)	A BAND WIDTH AND SPACING (IN)	B TITLE LETTER SIZE (IN)	C BACKGROUND AND ARROWS (IN)
UNDER 3	3	0.5	1
3 TO 6	3	1	2
6 TO 9	3	2	3
OVER 9	4	3	4.5

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PROJECT NO. 0000X
CONTRACTOR CONTROL NO. 0000X
DRAWING NO. 0000X

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Pipe Support Notes & Details

A. CONCRETE NOTES:

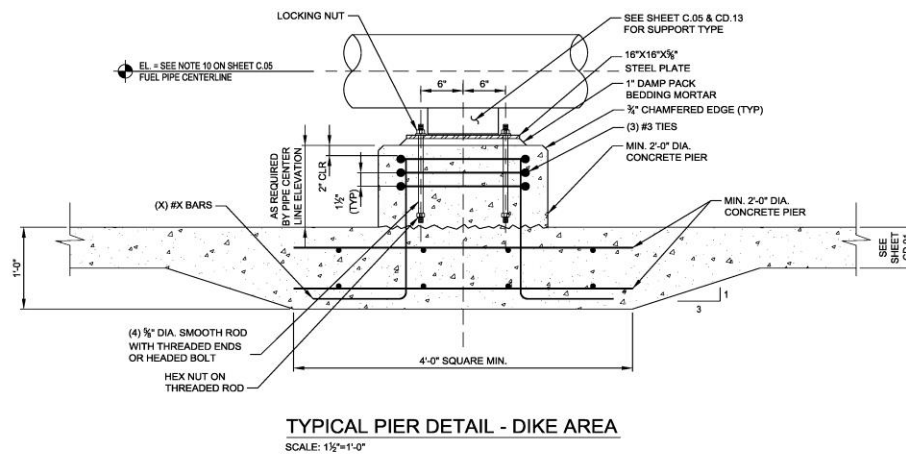
- CAST-IN-PLACE CONCRETE SHALL CONFORM TO AMERICAN CONCRETE INSTITUTE "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE", ACI 318.
- SPECIFIED COMPRESSIVE STRENGTH: $f_c = 4,000$ PSI AT 28 DAYS TYP.
- REINFORCING MATERIALS:
REINFORCING BARS: SHALL CONFORM TO ASTM A615 OR ASTM A706, GRADE 60
- LAP SPLICES AND CONCRETE COVER OF REINFORCEMENT SHALL CONFORM TO ACI 318 USING CLASS B TENSION SPLICES UNLESS OTHERWISE NOTED.
- REINFORCING BARS SHALL BE SUPPORTED AT 2'-0" O.C., EACH WAY, MAX.
- ALL REINFORCING STEEL AND EMBEDDED ITEMS SUCH AS ANCHOR RODS AND WELD PLATES SHALL BE ACCURATELY PLACED IN THE POSITIONS SHOWN AND ADEQUATELY TIED AND SUPPORTED BEFORE CONCRETE IS PLACED TO PREVENT DISPLACEMENT BEYOND PERMITTED TOLERANCES.
- DETAIL BARS IN ACCORDANCE WITH "ACI DETAILING MANUAL", PUBLICATION SP-66, ACI 318, AND ACI 315.
- PROVIDE ACCESSORIES NECESSARY TO PROPERLY SUPPORT REINFORCING AT POSITIONS SHOWN ON DRAWINGS.
- EXPOSED EDGES OF CONCRETE SHALL BE CHAMFERED $\frac{3}{8}$ ".
- 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:
I. No. 6 THROUGH No. 18 BARS: 2"
II. No. 5 BAR, W31 OR D31 WIRE, AND SMALLER: 1½"
C. CONCRETE NOT EXPOSED TO WEATHER OR IN CONTACT WITH GROUND:
I. SLABS, WALLS, JOISTS: ½"
II. BEAMS, COLUMNS (PRIMARY REIN, TIES, STIRRUPS): 1½"

B. CARBON STRUCTURAL STEEL:

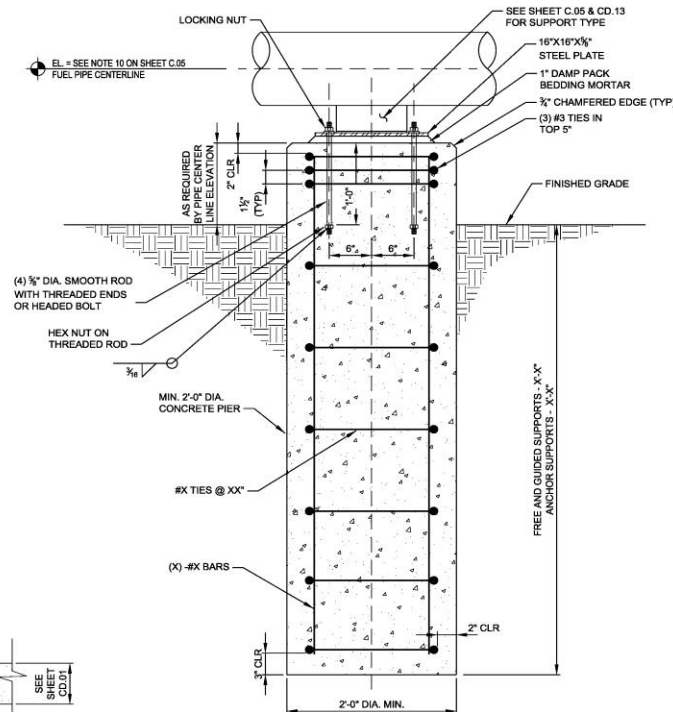
- STRUCTURAL STEEL SHALL CONFORM TO LATEST EDITION OF THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION "STEEL CONSTRUCTION MANUAL".
- WIDE FLANGE SHAPES: SHALL CONFORM TO ASTM A992, $F_y = 50$ KSI.
- ROLLED PLATES AND SHAPES: SHALL CONFORM TO ASTM A36, $F_y = 36$ KSI.
- STRUCTURAL TUBING: SHALL CONFORM TO ASTM A500, GRADE B, $F_y = 46$ KSI.
- ANCHOR BOLTS: SHALL CONFORM TO ASTM F1554, $F_y = 36$ KSI.
- WELDING SHALL CONFORM WITH SPECIFICATION 33 52 43.13.
- DO NOT WELD CARBON STEEL PLATES OR TEES TO STAINLESS STEEL PIPE.
- DO NOT WELD GALVANIZED CARBON STEEL PLATES OR TEES TO STAINLESS STEEL OR CARBON STEEL PIPE.

C. SOILS & FOUNDATION NOTES:

- MAX ALLOWABLE NET SOIL BEARING PRESSURE: XXXX PSF
A. ONE-THIRD OVERSTRESS MAY BE ALLOWED FOR TEMPORARY WIND/SEISMIC LOADING.
- LATERAL BEARING PRESSURE: XXX PSF/FT BELOW FINISHED GRADE
- FRICITION ANGLE: $\phi = XX^\circ$
- LATERAL EARTH PRESSURE COEFFICIENTS:
A. ACTIVE: $K_a = XXX$
B. AT-REST: $K = XXX$
C. PASSIVE: $K_p = XXX$
- COEFFICIENT OF FRICTION: $\mu = XXX$
- FROST PENETRATION: XX'



TYPICAL PIER DETAIL - DIKE AREA
SCALE: 1½"=1'-0"



TYPICAL PIER DETAIL - CENTERLINE
ELEVATION LESS THAN 3'-0" ABOVE GRADE
SCALE: 1½"=1'-0"

NO.	REV.	DESCRIPTION

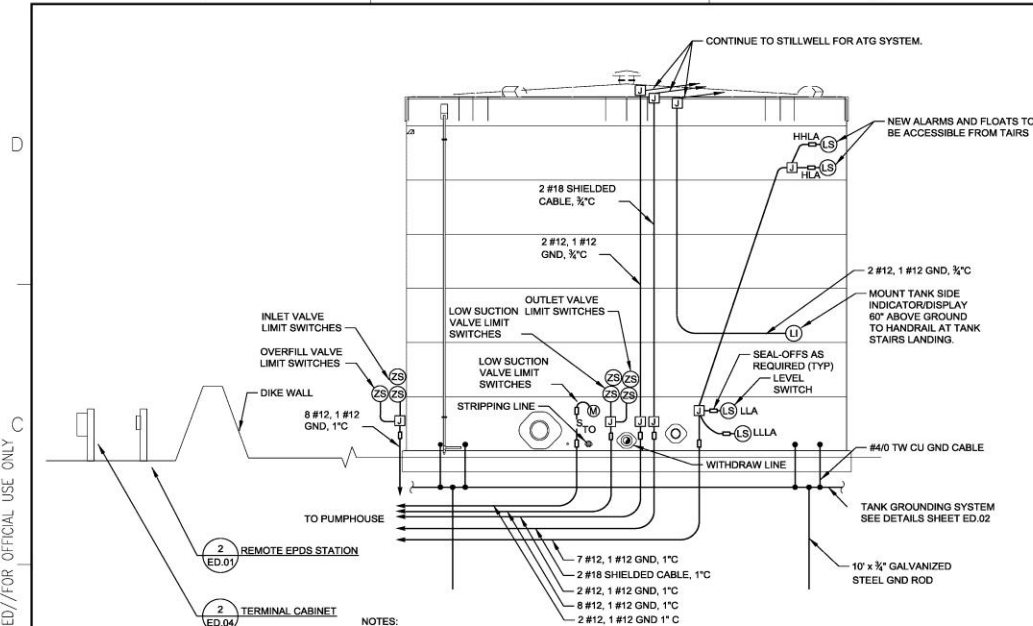
US ARMY CORPS OF ENGINEERS OMAHA DISTRICT

DATE: OCTOBER 2014

59 CD.12

Typical Electrical Details

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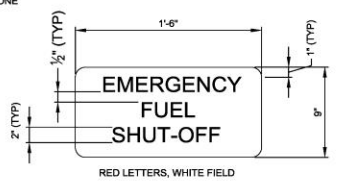


- NOTES:
1. SEE TANK DRAWINGS FOR EXACT LOCATION OF LEVEL SWITCHES AND PRODUCT RETURN PUMP.
 2. WELD CONDUIT SUPPORT STRUCTURES (UNISTRUT OR EQUAL) TO TANK WALL.
 3. REMOTE EPDS STATION TO BE PLACED IMMEDIATELY OUTSIDE OF CONTAINMENT AREA. SEE THIS SHEET FOR DETAILS.
 4. CATHODIC PROTECTION TERMINAL CABINET TO BE PLACED OUTSIDE OF CONTAINMENT AND HAZARDOUS LOCATIONS. IT MAY BE PLACED IMMEDIATELY OUTSIDE OF CONTAINMENT AREA OR NEAR RECEPTOR. SEE SHEET ED.04 FOR DETAILS.

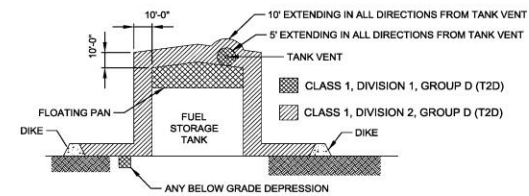
STORAGE TANK ELECTRICAL ELEVATION
SCALE: NONE

DESIGNER NOTE:

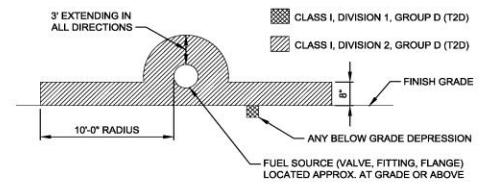
1. IF ELECTRONIC TYPE LEVEL ALARMS ARE TO BE USED INSTEAD OF THE MECHANICAL FLOAT TYPE INDICATED ON THE STORAGE TANK ELECTRICAL ELEVATION DETAIL, THEN MODIFY THE DETAIL WITH REQUIREMENTS APPROPRIATE TO THE ELECTRONIC LEVEL ALARMS.
2. IF AN ATG SYSTEM OTHER THAN THE ENRAF 854 TYPE DEPICTED HERE IS TO BE USED, THE STORAGE TANK ELECTRICAL ELEVATION DETAIL SHALL BE MODIFIED TO SHOW APPROPRIATE CONDUITS AND CONDUCTORS FOR THAT TYPE OF ATG SYSTEM.



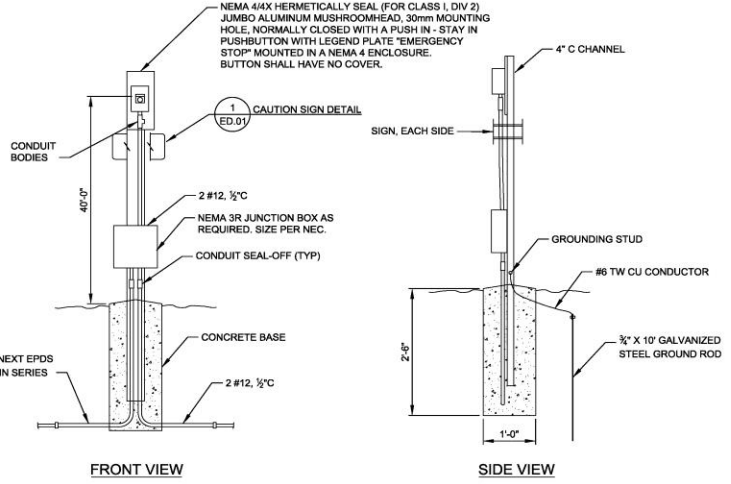
CAUTION SIGN DETAIL 1
SCALE: NONE ED.01 ED.01



FUEL STORAGE TANK HAZARDOUS AREA DETAIL
SCALE: NONE



EXTERIOR FUEL PIPING HAZARDOUS AREA DETAIL
SCALE: NONE



FRONT VIEW

SIDE VIEW

REMOTE EPDS STATION 2
SCALE: NONE ED.01 ED.01

NO.	REV.	DATE	BY	CHKD.
 US ARMY CORPS OF ENGINEERS OMAHA DISTRICT				
PROJECT:				
DESIGNER:				
CHECKED:				
DATE:	OCTOBER 2014			
MINOR FACILITIES ENGINEERING COMMAND - ALAINT 500 STANDARD DESIGN WITH-24-27 FUEL TANKS WITH FIXED ROOFS ABOVEGROUND VERTICAL STEEL TYPICAL ELECTRICAL SITE PLAN				
SCALE:	AS NOTED			
PROJECT NO.:	XXXXXX			
CONTRACT NO.:	XXXXXX			
DRAWING NO.:	XXXXXX			
64 ED.01				

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Criteria Libraries

- **UFCs and Specifications (UFGSs) available at:
The Whole Building Design Guide**

<http://www.wbdg.org>

- **Standard Designs available at:**

<http://www.hnd.usace.army.mil/std dgn/>



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