PETERSON STRUCTURAL ENGINEERS

9400 SW Barnes Road
Suite 100
Portland, OR 97225
503.292.1635

Structural Design Calculations

OMIC Equipment Footing Design
Scappoose, OR

Client Information
Al Peterson
AKAAN Architecture + Design LLC
101 St. Helens St
St. Helens, OR 97051

Project Site
OMIC R&D
33701 Charles T. Parker Way
Scappoose, OR 97056
45.7682, -122.8734

Prepared By
Peterson Structural Engineers
September 3, 2025
Project No. 2501-0033

Endorsement

STRUCTURAL
REGISTERED PROFESSIONAL
ENGINEER
82232PE
OREGON
SEP. 12, 2017
EDWARD FON-HON LING
EXPIRES 12/31/26

Scope

To provide structural calculations for anchorage and mat slab design at the location given on the cover page. Elements under review include (6) unique anchorage designs and mat slab design. Analysis of the mechanical equipment or any other elements not specifically referenced in these calculations are outside the purview of these calculations and are designed by others.

References

1. 2022 Oregon Structural Specialty Code (OSSC)
2. 2021 International Building Code (IBC)
3. ASCE/SEI 7-16, Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers (ASCE)
4. 2019 Building Code Requirements for Structural Concrete, ACI 318-19, and Commentary (ACI)
5. Geotechnical Report generated by Intertek PSI, dated 01/10/2020, their report number 07041279 (Geotech)
6. ASCE 7 Hazard Tool, https://asce7hazardtool.online/
7. Drawings provided by client on 08/04/2025, generated by CHART and drawings dated 01/16/2018 (Dwgs – Nitrogen Tank)
8. Drawings provided by client on 08/04/2025, generated by CTR and drawings dated 05/23/2023 (Dwgs – P2K Pump Skid)
9. Drawings provided by client on 08/04/2025, generated by Nikkiso Cryoquip and drawings dated 07/11/2025 (Dwgs – NC Vaporizer)
10. Drawings provided by client on 08/07/2025, generated by Eleet Cryogenics, Inc. and drawings dated 09/10/2018 (Dwgs – PCM)
11. Drawings provided by client on 08/04/2025, generated by FIBA Technologies, Inc. and drawings dated 04/03/2025 (Dwgs – ASME)
12. Drawings provided by client on 08/04/2025, generated by Thermax, Inc. and drawings dated 11/11/2008 (Dwgs – T Vaporizer)

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Design Criteria

Risk Category — II

Elevation above sea level; — EL = 87 ft; — per ASCE 7 Hazard Tool

Concrete Design Information

Compressive Strength; — f'_c = 4000 psi; (for durability, minimum 2,500psi strength used for design)

Soil Design Values (per Geotechnical Report)

Allowable Soil Bearing; — $P_{b,a}$ = 1000 psf; — per Geotech

Soil Subgrade Modulus; — K = 200 lb/in^3; — per Geotech

Wind Loading

Wind Exposure — C

Basic Wind Speed; — V = 96; mph — per ASCE 7 Hazard Tool

Nitrogen Tank

Design Horiz. Wind Pressure; — $P_{wh,NT}$ = 8.96 psf; — per Wind Load Generation

Design Vert. Wind Pressure; — $P_{wv,NT}$ = 8.96 psf; — per Wind Load Generation

P2K Pump Skid

Design Horiz. Wind Pressure; — $P_{wh,PS}$ = 19.99 psf; — per Wind Load Generation

Design Vert. Wind Pressure; — $P_{wv,PS}$ = 19.99 psf; — per Wind Load Generation

Nikkiso Cryoquip Vaporizer

Design Horiz. Wind Pressure; — $P_{wh,NCV}$ = 23.22 psf; — per Wind Load Generation

Design Vert. Wind Pressure; — $P_{wv,NCV}$ = 23.22 psf; — per Wind Load Generation

Pressure Control Manifold

Design Horiz. Wind Pressure; — $P_{wh,PCM}$ = 19.99 psf; — per Wind Load Generation

Design Vert. Wind Pressure; — $P_{wv,PCM}$ = 19.99 psf; — per Wind Load Generation

ASME Tube

Design Horiz. Wind Pressure; — $P_{wh,ASME}$ = 19.99 psf; — per Wind Load Generation

Design Vert. Wind Pressure; — $P_{wv,ASME}$ = 19.99 psf; — per Wind Load Generation

Thermax Vaporizer

Design Horiz. Wind Pressure; — $P_{wh,TV}$ = 23.85 psf; — per Wind Load Generation

Design Vert. Wind Pressure; — $P_{wv,TV}$ = 23.85 psf; — per Wind Load Generation

Seismic Loading

Seismic Importance Factor;	I_e = 1.0;	per ASCE 7 Table 1.5-2
Soil Class	E	per Geotechnical Report
Seismic Design Category	D	per Geotechnical Report
Spectral Response (short);	S_s = 0.864; g	per Geotechnical Report
Spectral Response (1s);	S_1 = 0.415; g	per Geotechnical Report
Spectral Acceleration (short);	S_{DS} = 0.665; g	per Geotechnical Report
Spectral Acceleration (1s);	S_{D1} = 0.522; g	per Geotechnical Report
Vertical Seismic Coefficient;	$0.2 \times S_{DS}$ = **0.133**	

Nitrogen Tank

Seismic Response Coefficient;	$C_{s,NT}$ = 0.333;	per Seismic Load Generation

P2K Pump Skid

Seismic Response Coefficient;	$C_{s,PS}$ = 0.200;	per Seismic Load Generation

Nikkiso Cryoquip Vaporizer

Seismic Response Coefficient;	$C_{s,NCV}$ = 0.333;	per Seismic Load Generation

Pressure Control Manifold

Seismic Response Coefficient;	$C_{s,PCM}$ = 0.200;	per Seismic Load Generation

ASME Tube

Seismic Response Coefficient;	$C_{s,ASME}$ = 0.200;	per Seismic Load Generation

Thermax Vaporizer

Seismic Response Coefficient;	$C_{s,TV}$ = 0.333;	per Seismic Load Generation

Load Generation

Wind Load Generation

Nitrogen Tank

ASCE 7-16 Chapter 29: Wind Loads on Other Structures - Directional Procedure (Chimneys and Tanks)

Wind Design Criteria:

Basic Wind Speed (3 sec Gust) =	96	MPH
Exposure =	C	

Exposure Coefficient, K_z =	0.85	ASCE 7-16 Table 26.10-1
Topography Factor, K_{zt} =	1	ASCE 7-16 Sec. 26.8.2
Directionality Factor, K_d =	1.00	ASCE 7-16 Table 26.6-1
Ground Elevation Factor, K_e =	1.00	ASCE 7-16 Table 26.9-1
Gust Factor, G =	0.85	ASCE 7-16 Sec. 26.11
Velocity Pressure, q_z =	19.99	psf = $0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot K_e \cdot V^2$

Secondary Structure Information:

Secondary Structure Type =	Round	
Secondary Structure Height, H =	19	ft
Secondary Structure Diameter, D =	7.17	ft
Depth of Protruding Elements, D' =	0	ft

Primary Structure Information:

Primary Structure Height, h =	0	ft
Primary Structure Length, d =	0	ft
Primary Structure Width, b =	0	ft

Wind Pressures:

Chimney or Tank, Therefore Wind Pressure, Pw = qz·G·Cf, Per ASCE7-16 EQ. 29.4-1

Length Side Pressures:

Area of Length Side, A_1 =	136.23	ft^2 = H·D
Cf =	0.53	ASCE 7-16 29.4-1
Wind Pressure, P_{w1} =	**8.96**	psf
Total Wind Force, F_{w1} =	**1221**	lb

Width Side Pressures:

Area of Length Side, A_2 =	136.23	
Cf =	0.53	ASCE 7-16 29.4-1
Wind Pressure, P_{w2} =	**8.96**	psf
Total Wind Force, F_{w2} =	**1221**	lb

P2K Pump Skid

ASCE 7-16 Chapter 29: Wind Loads on Other Structures - Directional Procedure
(Rooftop Structures and Equipment for Buildings)

Wind Design Criteria:

Basic Wind Speed (3 sec Gust) =	96	MPH
Exposure =	C	

Exposure Coefficient, K_h =	0.85	ASCE 7-16 Table 26.10-1
Topography Factor, K_{zt} =	1	ASCE 7-16 Sec. 26.8.2
Directionality Factor, K_d =	1.00	ASCE 7-16 Tab. 26.6-1
Ground Elevation Factor, K_e =	1.00	ASCE 7-16 Table 26.9-1
Gust Factor, G =	0.85	ASCE 7-16 Sec. 26.11
Velocity Pressure, q_h =	19.99	psf = $0.00256 \cdot K_h \cdot K_{zt} \cdot K_d \cdot K_e \cdot V^2$

Secondary Structure Information:

Secondary Structure Height, H =	6.7	ft
Secondary Structure Length, L =	6	ft
Secondary Structure Width, B =	5.67	ft

Primary Structure Information:

Primary Structure Height, h =	0	ft
Primary Structure Length, d =	0	ft
Primary Structure Width, b =	0	ft

Wind Pressures:

Rooftop Structure or Equipment. Therefore Wind Pressure, Pw = qh·(GCr)·A, per ASCE7-16 EQ. 29.4-2

Length Side Pressures:

Area of Length Side, A_1 =	40.20	ft^2 = H·D
GCr =	1.00	ASCE 7-16 29.4.1
Wind Pressure, P_{w1} =	**19.99**	psf
Total Wind Force, F_{w1} =	**804**	lb

Width Side Pressures:

Area of Width Side, A_2 =	37.99	ft^2 = H·B
GCr =	1.00	ASCE 7-16 29.4.1
Wind Pressure, P_{w2} =	**19.99**	psf
Total Wind Force, F_{w2} =	**759**	lb

Uplift Pressure:

Area of Top Face, A_3 =	34.02	ft^2
GCr =	1.00	ASCE 7-16 29.4.1
Wind Pressure, P_{w3} =	**19.99**	psf
Total Wind Force, F_{w3} =	**680**	lb

Nikkiso Cryoquip Vaporizer

ASCE 7-16 Chapter 29: Wind Loads on Other Structures - Directional Procedure (Chimneys and Tanks)

Wind Design Criteria:

Basic Wind Speed (3 sec Gust) =	96	MPH
Exposure =	C	

Exposure Coefficient, K_z =	0.85	ASCE 7-16 Table 26.10-1
Topography Factor, K_{zt} =	1	ASCE 7-16 Sec. 26.8.2
Directionality Factor, K_d =	1.00	ASCE 7-16 Table 26.6-1
Ground Elevation Factor, K_e =	1.00	ASCE 7-16 Table 26.9-1
Gust Factor, G =	0.85	ASCE 7-16 Sec. 26.11
Velocity Pressure, q_z =	19.99	psf = $0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot K_e \cdot V^2$

Secondary Structure Information:

Secondary Structure Type =	Square (wind normal to face)	
Secondary Structure Height, H =	18.6	ft
Secondary Structure Length, D =	4.67	ft
Secondary Structure Width, B =	3.74	ft

Primary Structure Information:

Primary Structure Height, h =	0	ft
Primary Structure Length, d =	0	ft
Primary Structure Width, b =	0	ft

Wind Pressures:

Chimney or Tank, Therefore Wind Pressure, Pw = qz·G·Cf, Per ASCE7-16 EQ. 29.4-1

Length Side Pressures:

Area of Length Side, A_1 =	86.86	ft^2 = H·D
Cf =	1.35	ASCE 7-16 29.4-1
Wind Pressure, P_{w1} =	**22.93**	psf
Total Wind Force, F_{w1} =	**1992**	lb

Width Side Pressures:

Area of Length Side, A_2 =	69.56	sq ft = H·B
Cf =	1.37	ASCE 7-16 29.4-1
Wind Pressure, P_{w2} =	**23.22**	psf
Total Wind Force, F_{w2} =	**1615**	lb

Pressure Control Manifold

ASCE 7-16 Chapter 29: Wind Loads on Other Structures - Directional Procedure

(Rooftop Structures and Equipment for Buildings)

Wind Design Criteria:

Basic Wind Speed (3 sec Gust) =	96	MPH
Exposure =	C	
Exposure Coefficient, K_h =	0.85	ASCE 7-16 Table 26.10-1
Topography Factor, K_{zt} =	1	ASCE 7-16 Sec. 26.8.2
Directionality Factor, K_d =	1.00	ASCE 7-16 Tab. 26.6-1
Ground Elevation Factor, K_e =	1.00	ASCE 7-16 Table 26.9-1
Gust Factor, G =	0.85	ASCE 7-16 Sec. 26.11
Velocity Pressure, q_h =	19.99	psf = $0.00256 \cdot K_h \cdot K_{zt} \cdot K_d \cdot K_e \cdot V^2$

Secondary Structure Information:

Secondary Structure Height, H =	3.33	ft
Secondary Structure Length, L =	4.42	ft
Secondary Structure Width, B =	1	ft

Primary Structure Information:

Primary Structure Height, h =	0	ft
Primary Structure Length, d =	0	ft
Primary Structure Width, b =	0	ft

Wind Pressures:

Rooftop Structure or Equipment. Therefore Wind Pressure, Pw = qh·(GCr)·A, per ASCE7-16 EQ. 29.4-2

Length Side Pressures:

Area of Length Side, A_1 =	14.72	ft^2 = H·D
GCr =	1.00	ASCE 7-16 29.4.1
Wind Pressure, P_{w1} =	**19.99**	psf
Total Wind Force, F_{w1} =	**294**	lb

Width Side Pressures:

Area of Width Side, A_2 =	3.33	ft^2 = H·B
GCr =	1.00	ASCE 7-16 29.4.1
Wind Pressure, P_{w2} =	**19.99**	psf
Total Wind Force, F_{w2} =	**67**	lb

Uplift Pressure:

Area of Top Face, A_3 =	4.42	ft^2
GCr =	1.00	ASCE 7-16 29.4.1
Wind Pressure, P_{w3} =	**19.99**	psf
Total Wind Force, F_{w3} =	**88**	lb

ASME Tube

ASCE 7-16 Chapter 29: Wind Loads on Other Structures - Directional Procedure

(Rooftop Structures and Equipment for Buildings)

Wind Design Criteria:

Basic Wind Speed (3 sec Gust) =	96	MPH
Exposure =	C	
Exposure Coefficient, K_h =	0.85	ASCE 7-16 Table 26.10-1
Topography Factor, K_{zt} =	1	ASCE 7-16 Sec. 26.8.2
Directionality Factor, K_d =	1.00	ASCE 7-16 Tab. 26.6-1
Ground Elevation Factor, K_e =	1.00	ASCE 7-16 Table 26.9-1
Gust Factor, G =	0.85	ASCE 7-16 Sec. 26.11
Velocity Pressure, q_h =	19.99	psf = $0.00256 \cdot K_h \cdot K_{zt} \cdot K_d \cdot K_e \cdot V^2$

Secondary Structure Information:

Secondary Structure Height, H =	7.1	ft
Secondary Structure Length, L =	26.22	ft
Secondary Structure Width, B =	2.43	ft

Primary Structure Information:

Primary Structure Height, h =	0	ft
Primary Structure Length, d =	0	ft
Primary Structure Width, b =	0	ft

Wind Pressures:

Rooftop Structure or Equipment. Therefore Wind Pressure, Pw = qh·(GCr)·A, per ASCE7-16 EQ. 29.4-2

Length Side Pressures:

Area of Length Side, A_1 =	186.16	ft^2 = H·D
GCr =	1.00	ASCE 7-16 29.4.1
Wind Pressure, P_{w1} =	**19.99**	psf
Total Wind Force, F_{w1} =	**3722**	lb

Width Side Pressures:

Area of Width Side, A_2 =	17.25	ft^2 = H·B
GCr =	1.00	ASCE 7-16 29.4.1
Wind Pressure, P_{w2} =	**19.99**	psf
Total Wind Force, F_{w2} =	**345**	lb

Uplift Pressure:

Area of Top Face, A_3 =	63.71	ft^2
GCr =	1.00	ASCE 7-16 29.4.1
Wind Pressure, P_{w3} =	**19.99**	psf
Total Wind Force, F_{w3} =	**1274**	lb

Thermax Vaporizer

ASCE 7-16 Chapter 29: Wind Loads on Other Structures - Directional Procedure (Chimneys and Tanks)

Wind Design Criteria:

Basic Wind Speed (3 sec Gust) =	96	MPH
Exposure =	C	
Exposure Coefficient, K_z =	0.85	ASCE 7-16 Table 26.10-1
Topography Factor, K_{zt} =	1	ASCE 7-16 Sec. 26.8.2
Directionality Factor, K_d =	1.00	ASCE 7-16 Table 26.6-1
Ground Elevation Factor, K_e =	1.00	ASCE 7-16 Table 26.9-1
Gust Factor, G =	0.85	ASCE 7-16 Sec. 26.11
Velocity Pressure, q_z =	19.99	psf = $0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot K_e \cdot V^2$

Secondary Structure Information:

Secondary Structure Type =	Square (wind normal to face)	
Secondary Structure Height, H =	12.66	ft
Secondary Structure Length, D =	2.61	ft
Secondary Structure Width, B =	1.78	ft

Primary Structure Information:

Primary Structure Height, h =	0	ft
Primary Structure Length, d =	0	ft
Primary Structure Width, b =	0	ft

Wind Pressures:

Chimney or Tank, Therefore Wind Pressure, Pw = qz·G·Cf, Per ASCE7-16 EQ. 29.4-1

Length Side Pressures:

Area of Length Side, A_1 =	33.04	ft^2 = H·D
Cf =	1.36	ASCE 7-16 29.4-1
Wind Pressure, P_{w1} =	**23.18**	psf
Total Wind Force, F_{w1} =	**766**	lb

Width Side Pressures:

Area of Length Side, A_2 =	22.53	sq ft = H·B
Cf =	1.40	ASCE 7-16 29.4-1
Wind Pressure, P_{w2} =	**23.85**	psf
Total Wind Force, F_{w2} =	**538**	lb

Seismic Load Generation

Building Code Information		
Risk Category =	II	
S_s =	0.864	Fig. 22-1, 22-3,& 22-5 to 22-8
S_1 =	0.415	Fig. 22-2, 22-4, & 22-5 to 22-8
Long Transition Period, T_L =	16	Fig. 22-14 to 22-17
Soil Site Class =	E	

Design Spectral Acceleration Parameters - ASCE 7-16 Chapter 11		
Short-Period Site Coefficient, F_a =	1.2544	Table 11.4-1
Long-Period Site Coefficient, F_v =	2.37	Table 11.4-2
S_{MS} =	1.084	$S_{MS} = F_a \cdot S_S$, Eq. 11.4-1
S_{M1} =	0.984	S_{M1} = Fv·S1, Eq. 11.4-2
S_{DS} =	0.665	$S_{DS} = 2/3 \cdot S_{MS}$, Eq. 11.4-3
S_{D1} =	0.522	$S_{D1} = 2/3 \cdot S_{M1}$, Eq. 11.4-4
T_s =	0.785	$T_s = S_{D1}/S_{DS}$, Sect. 11.4.6

Seismic Design Category - ASCE 7-16 Chapter 11		
Seismic Design Category for S_{DS} =	D	Table 11.6-1
Seismic Design Category for S_{D1} =	D	Table 11.6-2
Seismic Design Category =	D	Most critical of the cases above

Exception 1 per section 11.4.8 Item 2 is applicable

Nitrogen Tank

Seismic Base Shear - Non-Building Structures - ASCE 7-16 Chapter 15

Importance Factor, I_E =	1.00	Table 1.5-2
Height, h_n =	19.00	ft.
Structure Type =	Not Similar to Buildings (Table 15.4-2): Elevated tanks, vessels, bins or hoppers on unbraced legs or asymmetrically braced legs (not similar to buildings)	
Response Mod. Coef., R =	2.00	Table 15.4-1 and 15.4-2
Overstrength Factor, Ω_o =	2.00	Table 15.4-1 and 15.4-2
Defl. Amplif. Factor, C_d =	2.5	Table 15.4-1 and 15.4-2
Building Height Limit =	100.0	ft, Table 15.4-1 and 15.4-2

Building Height Okay for Seismic Force Resisting System

Fundamental Period

Actual Calc. Period, T_c =		from analysis (calculated if blank)
Assumed Period, T_a =	0.785	sec., $T_a = T_s$, ASCE 7 Section C.15.4.4
Natural Period, T_n =	0.785	sec., T = Ta

Seismic Base Shear Coefficient Boundaries

C_s =	0.333	Cs = SDS/(R/I)
C_s(max) =	0.333	Cs = SD1/[T·(R/I)]
C_s(min) =	0.030	Cs = 0.044·SDS·I ≥ 0.03

Seismic Coefficient

Base Shear Coefficient, C_s =	0.333	g's, Eh = W·Cs, Eqn. 12.8-1
Vert. Seismic Coeff., 0.2*S_{DS} =	0.133	g's, $E_v = 0.2S_{DS}$, Section 12.4-4a

P2K Pump Skid

Seismic Base Shear - Non-Structural Components - ASCE 7-16 Chapter 13

Importance Factor, I_p =	1.00	Section 13.1.3
Height, h =	6.70	ft
Attachment Height, z =	0.00	ft
Structure Type =	Seismic Coefficients for Mechanical and Electrical Components (ASCE Table 13.6-1): Engines , turbines, pumps, compressors, and pressure vessels not supported on skirts and not within the scope of Chapter 15 (Nonbuilding structures)	
Amplification Factor, a_p =	1.0	Table 13.5-1 & Table 13.6-1
Response Mod. Coef., R_p =	2.50	Table 13.5-1 & Table 13.6-1
Overstrength Factor, Ω_o =	2.00	Table 13.5-1 & Table 13.6-1

Horizontal Component - Seismic Design Coefficients

F_{ph}/W_p =	0.106	$F_{ph} = (0.4*a_p*S_{DS}*W_p)*(1+2*z/h)/(R_p/I_p)$, Eqn. 13.3-1
$F_{ph(max)}/W_p$ =	1.064	$F_{ph} = 1.6*S_{DS}*W_p*I_p$, Eqn. 13.3-2
$F_{ph(min)}/W_p$ =	0.200	$F_{ph} = 0.3*S_{DS}*W_p*I_p$, Eqn. 13.3-3

Seismic Coefficients

F_{ph}/W_p =	0.200	
F_{pv}/W_p =	0.133	$F_{pv} = 0.2*S_{DS}*W_p$, ASCE 7 Eqn. 12.4-4

W_p = working load

multiply (F_p/W_p) by W_p to find force on component

Nikkiso Cryoquip Vaporizer

Seismic Base Shear - Non-Building Structures - ASCE 7-16 Chapter 15

Importance Factor, I_E =	1.00	Table 1.5-2
Height, h_n =	18.60	ft.
Structure Type =	Not Similar to Buildings (Table 15.4-2): Elevated tanks, vessels, bins or hoppers on unbraced legs or asymmetrically braced legs (not similar to buildings)	
Response Mod. Coef., R =	2.00	Table 15.4-1 and 15.4-2
Overstrength Factor, Ω_o =	2.00	Table 15.4-1 and 15.4-2
Defl. Amplif. Factor, C_d =	2.5	Table 15.4-1 and 15.4-2
Building Height Limit =	100.0	ft, Table 15.4-1 and 15.4-2

Building Height Okay for Seismic Force Resisting System

Fundamental Period

Actual Calc. Period, T_c =		from analysis (calculated if blank)
Assumed Period, T_a =	0.785	sec., $T_a = T_s$, ASCE 7 Section C.15.4.4
Natural Period, T_n =	0.785	sec., T = Ta

Seismic Base Shear Coefficient Boundaries

C_s =	0.333	Cs = SDS/(R/I)
C_s(max) =	N/A	N/A per 11.4.8 Item 2 Exception 1
C_s(min) =	0.030	Cs = 0.044·SDS·I ≥ 0.03

Seismic Coefficient

Base Shear Coefficient, C_s =	0.333	g's, Eh = W·Cs, Eqn. 12.8-1
Vert. Seismic Coeff., 0.2*S_{DS} =	0.133	g's, $E_v = 0.2S_{DS}$, Section 12.4-4a

Pressure Control Manifold

Seismic Base Shear - Non-Structural Components - ASCE 7-16 Chapter 13

Importance Factor, I_p =	1.00	Section 13.1.3
Height, h =	3.33	ft
Attachment Height, z =	0.00	ft
Structure Type =	Seismic Coefficients for Mechanical and Electrical Components (ASCE Table 13.6-1): Piping in accordance with ASME B31, including in-line components, constructed of high- or limited deformability materials, with joints made by threading, bonding, compression couplings, or grooved couplings	
Amplification Factor, a_p =	2.5	Table 13.5-1 & Table 13.6-1
Response Mod. Coef., R_p =	6.00	Table 13.5-1 & Table 13.6-1
Overstrength Factor, Ω_o =	2.00	Table 13.5-1 & Table 13.6-1

Horizontal Component - Seismic Design Coefficients

F_{ph}/W_p =	0.111	$F_{ph} = (0.4*a_p*S_{DS}*W_p)*(1+2*z/h)/(R_p/I_p)$, Eqn. 13.3-1
$F_{ph(max)}/W_p$ =	1.064	$F_{ph} = 1.6*S_{DS}*W_p*I_p$, Eqn. 13.3-2
$F_{ph(min)}/W_p$ =	0.200	$F_{ph} = 0.3*S_{DS}*W_p*I_p$, Eqn. 13.3-3

Seismic Coefficients

F_{ph}/W_p =	0.200	
F_{pv}/W_p =	0.133	$F_{pv} = 0.2*S_{DS}*W_p$, ASCE 7 Eqn. 12.4-4

W_p = working load

multiply (F_p/W_p) by W_p to find force on component

ASME Tube

Seismic Base Shear - Non-Structural Components - ASCE 7-16 Chapter 13

Importance Factor, I_p =	1.00	Section 13.1.3
Height, h =	7.10	ft
Attachment Height, z =	0.00	ft
Structure Type =	Seismic Coefficients for Mechanical and Electrical Components (ASCE Table 13.6-1): Engines , turbines, pumps, compressors, and pressure vessels not supported on skirts and not within the scope of Chapter 15 (Nonbuilding structures)	
Amplification Factor, a_p =	1.0	Table 13.5-1 & Table 13.6-1
Response Mod. Coef., R_p =	2.50	Table 13.5-1 & Table 13.6-1
Overstrength Factor, Ω_o =	2.00	Table 13.5-1 & Table 13.6-1

Horizontal Component - Seismic Design Coefficients

F_{ph}/W_p =	0.106	$F_{ph} = (0.4*a_p*S_{DS}*W_p)*(1+2*z/h)/(R_p/I_p)$, Eqn. 13.3-1
$F_{ph(max)}/W_p$ =	1.064	$F_{ph} = 1.6*S_{DS}*W_p*I_p$, Eqn. 13.3-2
$F_{ph(min)}/W_p$ =	0.200	$F_{ph} = 0.3*S_{DS}*W_p*I_p$, Eqn. 13.3-3

Seismic Coefficients

F_{ph}/W_p =	0.200	
F_{pv}/W_p =	0.133	$F_{pv} = 0.2*S_{DS}*W_p$, ASCE 7 Eqn. 12.4-4

W_p = working load

multiply (F_p/W_p) by W_p to find force on component

Seismic Base Shear - Non-Building Structures - ASCE 7-16 Chapter 15

Importance Factor, I_E =	1.00	Table 1.5-2
Height, h_n =	12.66	ft.
Structure Type =	Not Similar to Buildings (Table 15.4-2): Elevated tanks, vessels, bins or hoppers on unbraced legs or asymmetrically braced legs (not similar to buildings)	
Response Mod. Coef., R =	2.00	Table 15.4-1 and 15.4-2
Overstrength Factor, Ω_o =	2.00	Table 15.4-1 and 15.4-2
Defl. Amplif. Factor, C_d =	2.5	Table 15.4-1 and 15.4-2
Building Height Limit =	100.0	ft, Table 15.4-1 and 15.4-2

Building Height Okay for Seismic Force Resisting System

Fundamental Period

Actual Calc. Period, T_c =		from analysis (calculated if blank)
Assumed Period, T_a =	0.785	sec., $T_a = T_s$, ASCE 7 Section C.15.4.4
Natural Period, T_n =	0.785	sec., T = Ta

Seismic Base Shear Coefficient Boundaries

C_s =	0.333	Cs = SDS/(R/I)
C_s(max) =	N/A	N/A per 11.4.8 Item 2 Exception 1
C_s(min) =	0.030	Cs = 0.044·SDS·I ≥ 0.03

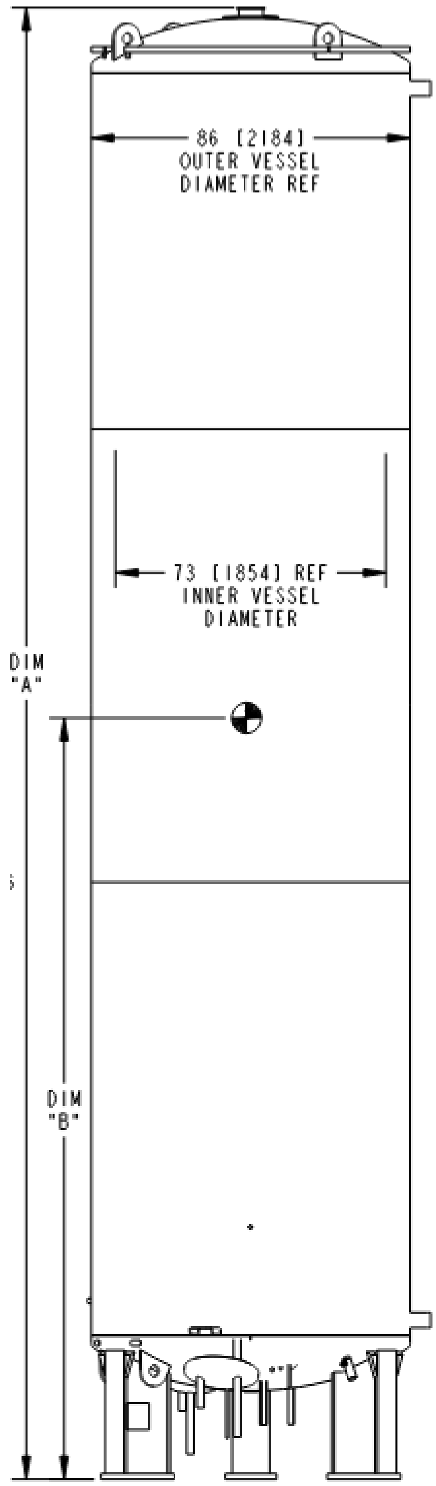
Seismic Coefficient

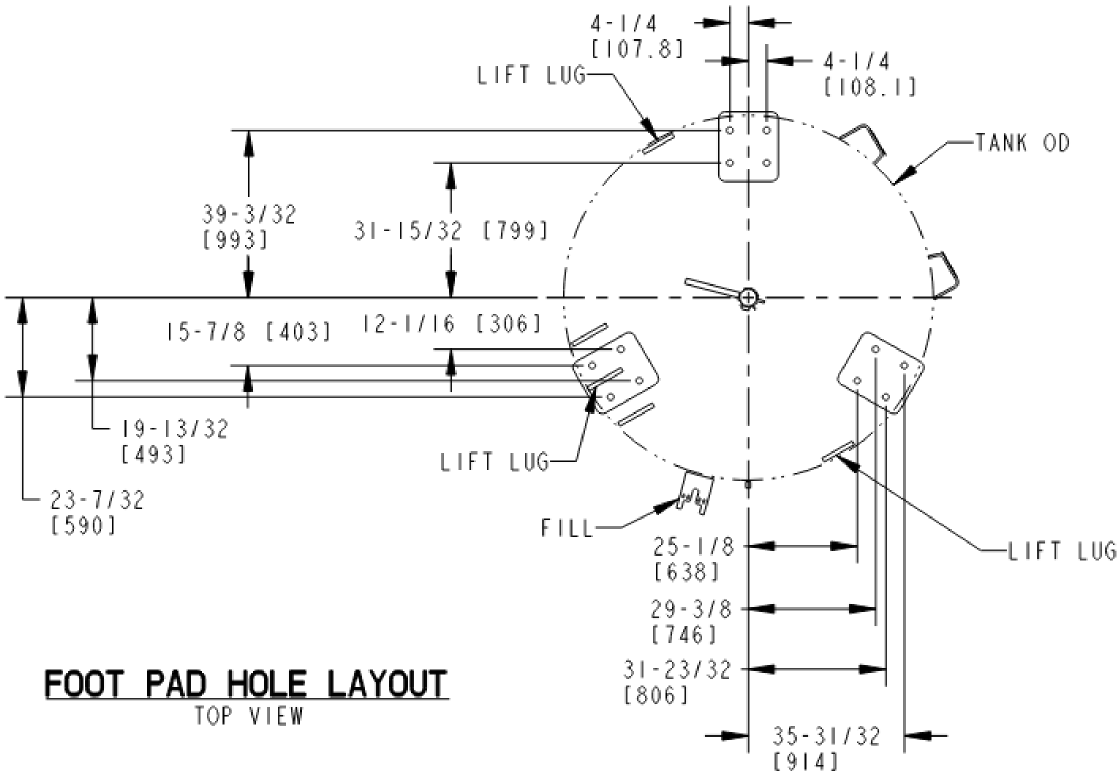
Base Shear Coefficient, C_s =	0.333	g's, Eh = W·Cs, Eqn. 12.8-1
Vert. Seismic Coeff., 0.2*S_{DS} =	0.133	g's, $E_v = 0.2S_{DS}$, Section 12.4-4a

Structural Calculations

Nitrogen Tank Anchorage

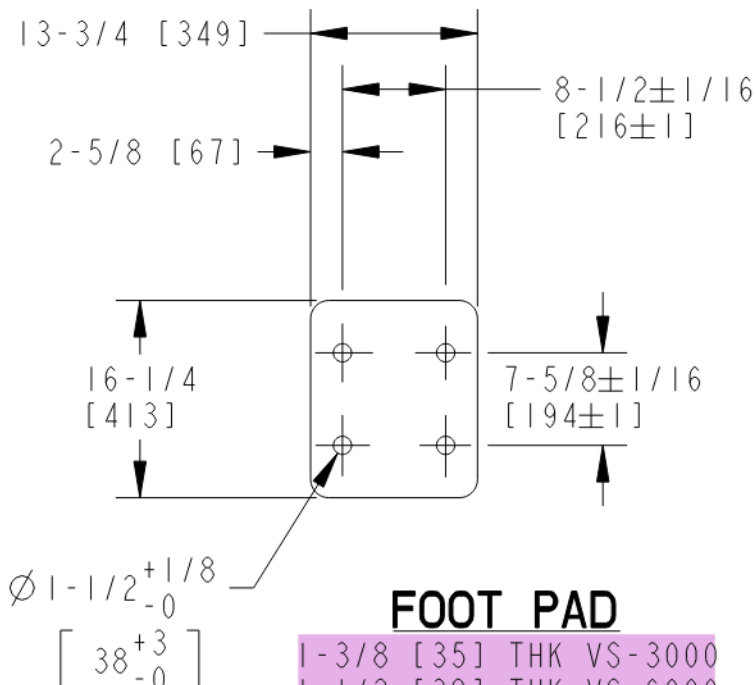
Drawings





FOOT PAD HOLE LAYOUT

TOP VIEW



FOOT PAD

1-3/8 [35] THK VS-3000

1-1/2 [38] THK VS-6000

TYP 3 PLCS

SCALE 1/16

WEIGHTS AND SHIPPING DATA										
MODEL:			VS-3000				VS-6000			
MAWP	PSIG		175	250	400	500	175	250	400	500
	barg		12.07	17.24	27.58	34.47	12.07	17.24	27.58	34.47
WEIGHT EMPTY	POUNDS		11,100	12,800	15,100	15,100	19,900	21,500	27,000	27,100
	KILOGRAMS		4,990	5,806	6,849	6,849	9,026	9,752	12,247	12,292
WEIGHT FULL	OXYGEN	POUNDS	40,600	42,400	44,700	44,700	76,400	78,000	83,500	83,600
		KILOGRAMS	18,416	19,232	20,276	20,276	34,654	35,380	37,875	37,920
	NITROGEN	POUNDS	32,000	33,800	36,100	36,100	59,900	61,500	67,000	67,100
		KILOGRAMS	14,514	15,331	16,375	16,375	27,170	27,896	30,391	30,436
	ARGON	POUNDS	47,200	49,000	51,300	51,300	88,900	90,500	96,000	96,100
		KILOGRAMS	21,410	22,226	23,269	23,269	40,324	41,050	43,545	43,590
SHIPPING DIMENSIONS	INCHES (L * W * H)		228 x 86 x 86				383 x 86 x 86			
	MM'S (L * W * H)		5,791 x 2,184 x 2,184				9,728 x 2,184 x 2,184			

TANK HEIGHT		
MODEL	DIM "A" REF	DIM "B" REF
VS-3000	228 [5791]	131 [3315]
VS-6000	383 [9728]	206 [5236]

Geometry & Weight

Dry/Shipping Weight;	W_D = 12800 lb;	per Dwgs – Nitrogen Tank
Wet/Operating Weight;	W_W = 33800 lb;	per Dwgs – Nitrogen Tank
Tank Outer Diameter;	D = 86 in = **7.17** ft;	per Dwgs – Nitrogen Tank
Tank Height;	H = 228 in = **19.00** ft;	per Dwgs – Nitrogen Tank
Vertical Center of Gravity;	CG_z = 131 in = **10.92** ft;	per Dwgs – Nitrogen Tank
Horizontal Center of Gravity;	CG_x = D /2 = **3.58** ft;	assumed
Horizontal Center of Gravity;	CG_y = D /2 = **3.58** ft;	assumed
Vertical Center of Area;	CA_z = H / 2 = **9.50** ft;	
Horizontal Eccentricity x;	e_x = abs[D / 2 - CG_x] = **0.00** in; (parallel to x)	
Horizontal Eccentricity y;	e_y = abs[D / 2 - CG_y] = **0.00** in; (parallel to y)	
Leg Circle Diameter;	d = 71.384 in = **5.95** ft;	per Dwgs – Nitrogen Tank
Number of Legs;	N_L = 3;	per Dwgs – Nitrogen Tank
Anchors per Leg;	N_{aL} = 6;	
Anchor Diameter;	D_a = 1; in	

Dead Loads

Dry Dead Load;	W_D = **12800** lb;	(1.0D)
Dry Dead Load Moment;	$M_{Dx,D} = W_D \times (d / 2 + e_y)$ = **38071** lb_ft;	(1.0D)
Dry Dead Load per Leg;	$D_{a,D} = W_D / N_L$ = **4267** lb;	(1.0D)
Wet Dead Load;	W_W = **33800** lb;	(1.0D)
Wet Dead Load Moment;	$M_{Dx,W} = W_W \times (d / 2 + e_y)$ = **100532** lb_ft;	(1.0D)
Wet Dead Load per Leg;	$D_{a,W} = W_W / N_L$ = **11267** lb;	(1.0D)

Seismic Loads

Design Seismic Coefficient;	$C_{s,NT}$ = **0.333**;	
Overstrength Factor;	Ω_0 = 2.0;	
Seismic Vertical Load;	$F_{pv} = W_W \times 0.2 \times S_{DS}$ = **4495** lb;	(1.0E)
Seismic Horizontal Load;	$F_{ph} = W_W \times C_{s,NT}$ = **11255** lb;	(1.0E)
Seismic Overturning Moment;	$M_{Ex} = F_{ph} \times CG_z + F_{pv} \times (d / 2 + e_y)$ = **136242** lb_ft;	(1.0E)
Seismic Horizontal Load w/ Ω_o;	$V_{E\Omega} = \Omega_0 \times F_{ph}$ = **22511** lb;	($\Omega_o E_h$)
Overturning Moment w/ Ω_o;	$M_{Ex\Omega} = \Omega_0 \times F_{ph} \times CG_z + F_{pv} \times (d / 2 + e_y)$	
	$M_{Ex\Omega}$ = **259114** lb_ft; (about x)	($\Omega_o E_h + 1.0E_v$)
Seismic Shear per Leg w/ Ω_o;	$V_{Ea,\Omega} = V_{E\Omega} / N_L$ = **7504** lb;	($\Omega_o E_h$)
Seismic Tension per Leg w/ Ω_o;	$T_{Ea,\Omega} = 4 \times \Omega_0 \times F_{ph} \times CG_z / (N_L \times d) + F_{pv} / N_L$;	
	$T_{Ea,\Omega}$ = **56579** lb;	($\Omega_o E_h + 1.0E_v$)

Wind Loads

Wind Vertical Load; $F_{Wv} = P_{wv} \times \pi \times (D / 2)^2 =$ **0** lb; (1.0W)

Wind Horizontal Load; $F_{Wh} = P_{wh} \times D \times H =$ **1220** lb; (1.0W)

Wind Overturning Moment; $M_{Wx} = F_{Wh} \times CA_z + F_{Wv} \times d / 2 =$ **11591** lb_ft; (1.0W)

Wind Shear per Leg; $V_{Wa} = F_{Wh} / N_L =$ **407** lb ; (1.0W)

Wind Tension per Leg; $T_{Wa} = 4 \times F_{Wh} \times CA_z / (N_L \times d) + F_{Wv} / N_L$;

$T_{Wa} =$ **2598** lb; (1.0W)

Factored Loads

Seismic

Required Base Shear; $V_{u,E\Omega} = V_{E\Omega} =$ **22511** lb; $(\Omega_o E_h)$

Required Base Moment; $M_{u,Ex\Omega} = M_{Ex\Omega} - 0.9 \times M_{Dx,W}$

$M_{u,Ex\Omega} =$ **168634** lb_ft; $(0.9D + \Omega_o E_h + 1.0E_v)$

$M_{u,Ex\Omega} > 0$, therefore consider overturning & anchor tension.

Req' Shear per Leg; $V_{u,Ea,\Omega} = V_{Ea,\Omega} =$ **7504** lb; $(\Omega_o E_h)$

Req' Tension per Leg; $T_{u,Ea,\Omega} = T_{Ea,\Omega} - 0.9 \times D_{a,W} =$ **46439** lb; $(0.9D + \Omega_o E_h + 1.0E_v)$

$T_{u,Ea,\Omega} > 0$, therefore consider anchor tension.

Wind

Required Base Shear; $V_{u,W} = F_{Wh} =$ **1220** lb; (1.0W)

Required Base Moment; $M_{u,Wx} = M_{Wx} - 0.9 \times M_{Dx,D}$

$M_{u,Wx} =$ **-22674** lb_ft; (0.9D+ 1.0W)

$M_{u,Wx} < 0$, therefore no overturning or anchor tension.

Req' Shear per Leg; $V_{u,Wa} = V_{Wa} =$ **407** lb; (1.0W)

Req' Tension per Leg; $T_{u,Wa} = T_{Wa} - 0.9 \times D_{a,D} =$ **-1242** lb; (0.9D + 1.0W)

$T_{u,Wa} < 0$, therefore no anchor tension.

Anchor Design

Horizontal Eccentricity x; e_x = **0** in; (parallel to x)

Horizontal Eccentricity y; e_y = **0** in; (parallel to y)

Required Base Shear; $V_u = \max(V_{u,E\Omega}, V_{u,W})$ = **22511** lb; $(\Omega_o E_h)$

Required Base Moment; $M_u = \max(0 \text{ lb\_in}, M_{u,Ex\Omega}, M_{u,Wx})$

M_u = **2023614** lb_in; $(0.9D + \Omega_o E_h + 1.0E_v)$

Seismic Loads control both shear and moment.

Required Shear per Leg; $V_u = \max(V_{u,Ea,\Omega}, V_{u,Wa})$ = **7504** lb; $(\Omega_o E_h)$

Required Tension per Leg; $T_u = \max(0 \text{ lb}, T_{u,Ea,\Omega}, T_{u,Wa})$ = **46439** lb; $(0.9D + \Omega_o E_h + 1.0E_v)$

Seismic loads control both shear and tension.

Anchor Side Edge Distance; $S_{a,1} = \pi \times d / N_L / 2 - 2.625 \text{ in}$ = **35** in;

Anchor Interior Edge Distance; $S_{a,i} = d / 2 - 7.625 \text{ in} / 2$ = **32** in;

(6) 1-inch diameter ASTM A 108 Type A AWS Headed Studs per tank leg, (18) anchors total. Anchor locations per drawings.
Anchor Embedment: 21-inches
Minimum Concrete Strength, f'c: ;2500 psi ;
Minimum Slab/Housekeeping Pad Thickness: 24-inches
Minimum Edge Distance: 11.5-inches

Notes:

- Concrete must be continuous under unit.
- Anchors shall not be bent after being installed.
- The use of permanent shims is not permitted.
- Nuts, washers, and other hardware used with anchors shall have a material or alloy designation that is compatible with the anchor rod/alloy. Contact between dissimilar metals shall be isolated using phenolic or otherwise approved isolation hardware.
- Anchors shall be galvanized or stainless steel for fastening galvanized steel to concrete/masonry.
- Anchors shall be stainless steel for fastening aluminum or stainless steel to concrete/masonry.

*See Appendix A for DeWalt Design Assist Outputs

Embedded Plate Weld Connection Design

Weld Size; $D = (2/16)$ in = **0.125** in;

Effective Throat Size; $t_e = D \times \sqrt{(2)} / 2$ = **0.088** in;

Minimum Weld Length; $l_w = 6$ in; (conservative)

Loading

Required Seismic Shear; $V_{u,E} = F_{ph} / N_L$ = **3752** lb; (1.0E)

Required Seismic Tension; $T_{u,E} = (4 \times F_{ph} \times CG_z / (N_L \times d) + F_{pv} / N_L) - (0.9 \times D_{a,W})$;

$T_{u,E}$ = **18899** lb; (0.9D + 1.0E)

Shear Strength

Weld Resistance Factor; $\phi = 0.75$;

Factored Strength; $\phi R_{n,v} = \phi \times (0.6 \times 70\text{ksi}) \times t_e \times l_w$ = **16705** lb; per AISC Eq. J2-4

$\phi R_{n,v} > V_{u,E}$, OK

Tensile Strength

Weld Resistance Factor; $\phi = 0.75$;

Factored Strength; $\phi R_{n,t} = \phi \times (0.6 \times 70\text{ksi} \times (1.0+0.5\times(\sin(90))^{1.5})) \times t_e \times l_w$;

$\phi R_{n,t}$ = **25058** lb; per AISC Eq. J2-4

$\phi R_{n,t} > T_{u,E}$, OK

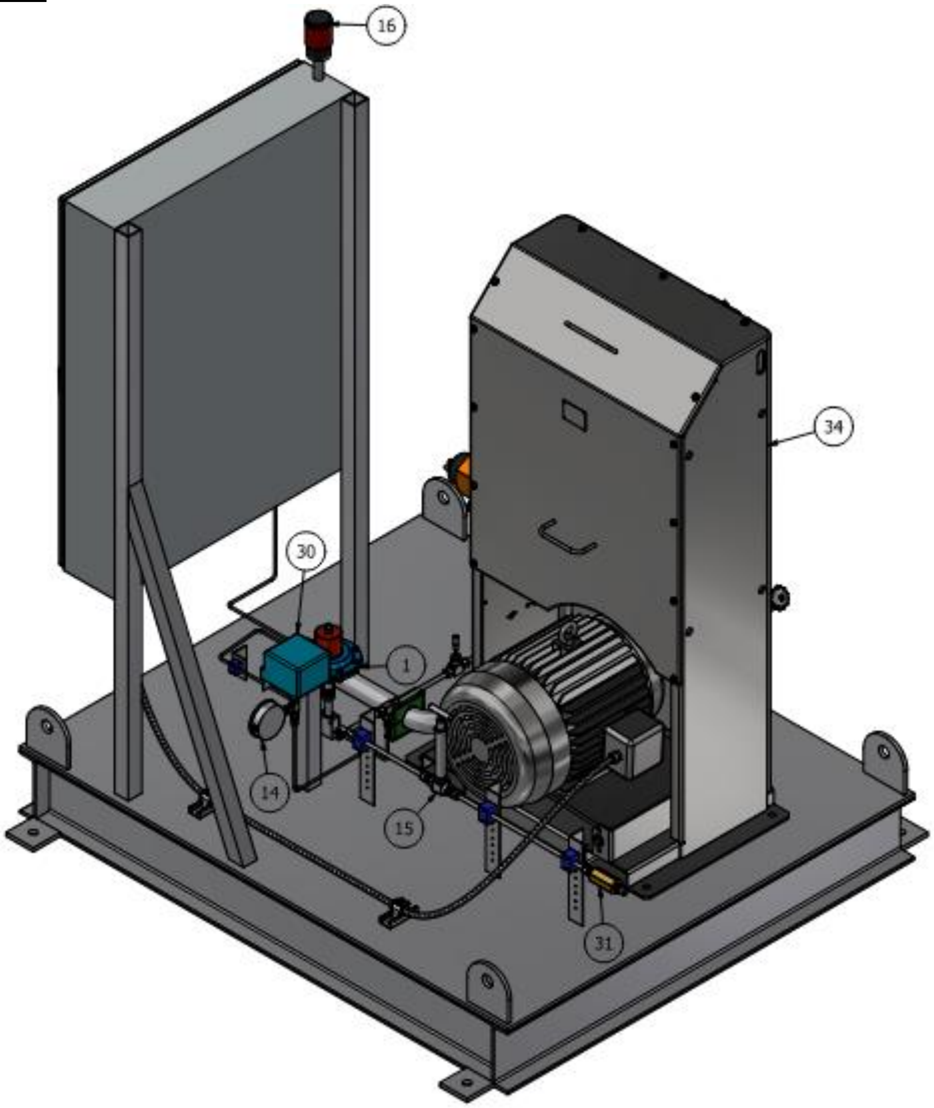
Combined Strength Check

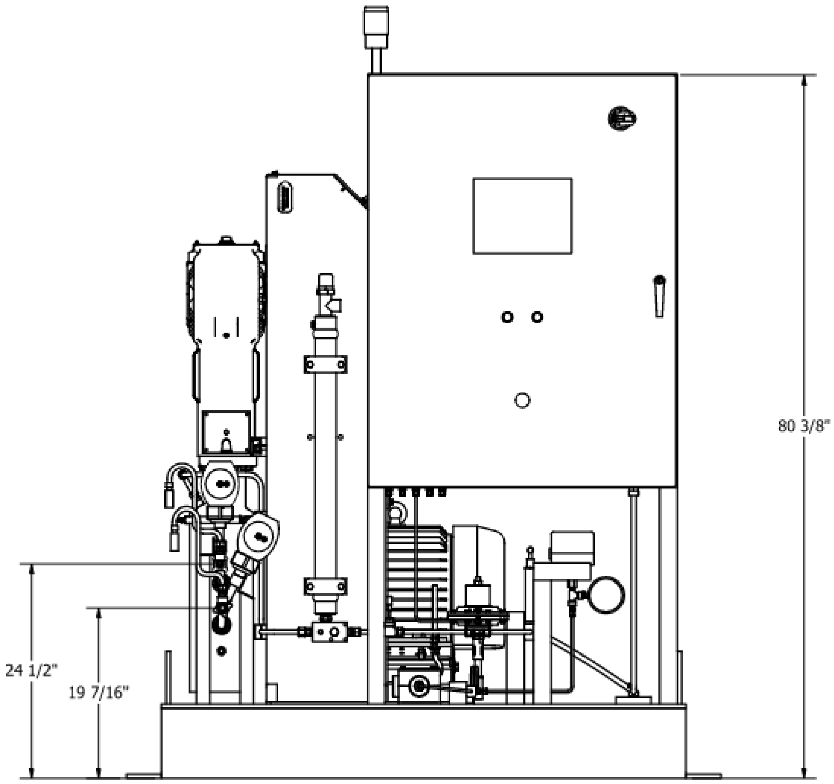
Combined Capacity; $\sqrt{((V_{u,E} / \phi R_{n,v})^2 + (T_{u,E} / \phi R_{n,t})^2)}$ = **0.79**; < 1.0, OK

Use a 1/8" Fillet Weld all around Tank Leg Baseplate to Embedded Plate Connection

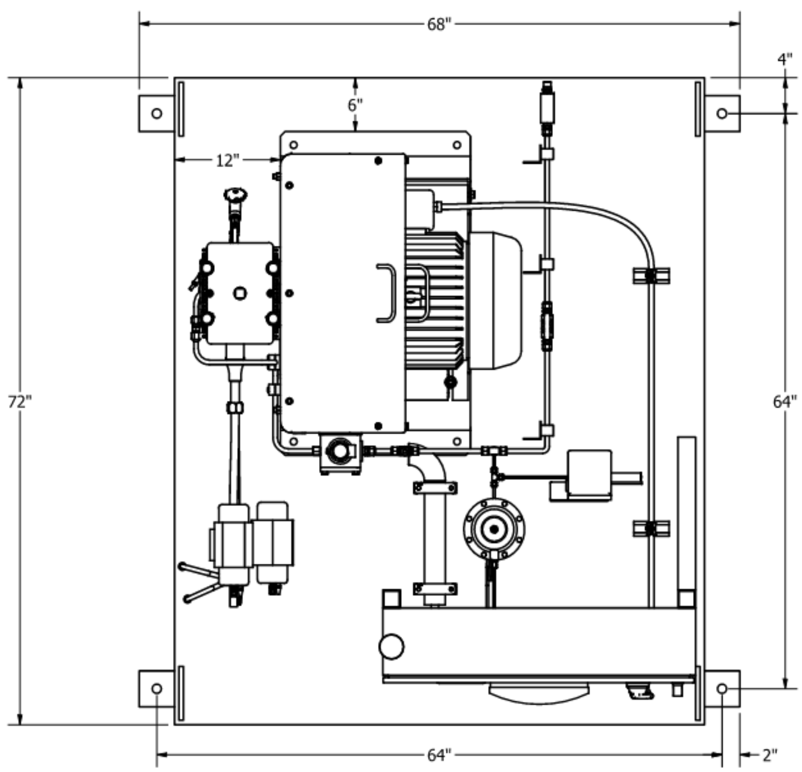
P2K Pump Skid

Drawings





80 3/8"
24 1/2"
19 7/16"



68"
4"
6"
12"
72"
64"
64"
2"

Geometry & Weight

Dry/Shipping Weight;	W_D = 2235.749 lb;	per Dwgs – P2K Pump Skid
Wet/Operating Weight;	W_W = 2435.749 lb;	per Client
Skid Length;	L = 72 in = **6.00** ft; (parallel to x)	per Dwgs – P2K Pump Skid
Skid Width;	W = 68 in = **5.67** ft; (parallel to y)	per Dwgs – P2K Pump Skid
Skid Height;	H = 80.375 in = **6.70** ft; (parallel to z)	per Dwgs – P2K Pump Skid

In these calculations, the x-axis is parallel to the length, the y-axis is parallel to the width and the z-axis is parallel to the height. Length, width and height are all defined above.

Vertical Center of Gravity;	$CG_z = 2/3 \times H$ = **4.47** ft; (parallel to z)	assumed
Horizontal Center of Gravity;	$CG_x = 0.6 \times L$ = **3.60** ft; (parallel to x)	assumed
Horizontal Center of Gravity;	$CG_y = 0.6 \times W$ = **3.40** ft; (parallel to y)	assumed
Vertical Center of Area;	$CA_z = 1/2 \times H$ = **3.35** ft	
Horizontal Eccentricity x;	$e_x = abs[L / 2 - CG_x]$ = **7.20** in; (parallel to x)	
Horizontal Eccentricity y;	$e_y = abs[W / 2 - CG_y]$ = **6.80** in; (parallel to y)	
Number of Anchors;	N_a = 4;	per Dwgs – P2K Pump Skid
Anchor Diameter;	D_a = 0.375; in	per Dwgs – P2K Pump Skid
Anchor Spacing Length;	l = 64 in = **5.33** ft;	per Dwgs – P2K Pump Skid
Anchor Spacing Width;	w = 64 in = **5.33** ft;	per Dwgs – P2K Pump Skid

Dead Loads

Dry Dead Load; W_D = **2236** lb; (parallel to z) (1.0D)

Dry Dead Load Moment; $M_{Dx,D} = W_D \times (w / 2 + e_y)$ = **7229** lb_ft; (about x) (1.0D)

Dry Dead Load per Anchor; $D_{a,D} = W_D / N_a$ = **559** lb; (1.0D)

Wet Dead Load; W_W = **2436** lb; (parallel to z) (1.0D)

Wet Dead Load Moment; $M_{Dx,W} = W_W \times (w / 2 + e_y)$ = **7876** lb_ft; (about x) (1.0D)

Wet Dead Load per Anchor; $D_{a,W} = W_W / N_a$ = **609** lb; (1.0D)

Seismic Loads

Design Seismic Coefficient; $C_{s,PS}$ = **0.200**;

Overstrength Factor; $\Omega_0 = 2.0$;

Seismic Vertical Load; $F_{pv} = W_W \times 0.2 \times S_{DS}$ = **324** lb; (parallel to z) (1.0E)

Seismic Horizontal Load; $F_{ph} = W_W \times C_{s,PS}$ = **487** lb; (1.0E)

Seismic Overturning Moment; $M_{Ex} = F_{ph} \times CG_z + F_{pv} \times (w / 2 + e_y)$ = **3223** lb_ft; (about x) (1.0E)

Seismic Horizontal Load w/ Ω_o; $V_{E\Omega} = \Omega_0 \times F_{ph}$ = **974** lb; ($\Omega_o E_h$)

Overturning Moment w/ Ω_o; $M_{Ex\Omega} = \Omega_0 \times F_{ph} \times CG_z + F_{pv} \times (w / 2 + e_y)$

$M_{Ex\Omega}$ = **5398** lb_ft; (about x) ($\Omega_o E_h + 1.0E_v$)

Seismic Shear per Anchor; $V_{Ea,\Omega} = \Omega_0 \times F_{ph} / N_a$ = **244** lb; ($\Omega_o E_h$)

Seismic Tension per Anchor; $T_{Ea,\Omega} = M_{Ex\Omega} / [w \times N_a / 2]$ = **506** lb; ($\Omega_o E_h + 1.0E_v$)

Wind Load

Wind Vertical Load; $F_{Wv} = P_{wv,PS} \times L \times W$ = **680** lb; (parallel to z) (1.0W)

Wind Horizontal Load; $F_{Wh} = P_{wh,PS} \times L \times H$ = **803** lb; (parallel to y) (1.0W)

Wind Overturning Moment; $M_{Wx} = F_{Wh} \times CA_z + F_{Wv} \times w / 2$ = **4503** lb_ft; (about x) (1.0W)

Wind Horizontal per Anchor; $V_{Wa} = F_{Wh} / N_a$ = **201** lb; (1.0W)

Wind Tension per Anchor; $T_{Wa} = M_{Wx} / [w \times N_a / 2]$ = **422** lb; (1.0W)

Factored Loads

Seismic

Required Base Shear w/ Ω_o; $V_{u,E\Omega} = V_{E\Omega} =$ **974** lb; ($\Omega_o E_h$)

Required Base Moment w/ Ω_o; $M_{u,Ex\Omega} = M_{Ex\Omega} - 0.9 \times M_{Dx,W}$

$M_{u,Ex\Omega} =$ **-1690** lb_ft; (about x) ($0.9D + \Omega_o E_h + 1.0E_v$)

$M_{u,Ex\Omega} < 0$, therefore no skid overturning or anchor tension.

Req' Shear per Anchor; $V_{u,Ea,\Omega} = V_{Ea,\Omega} =$ **244** lb; ($\Omega_o E_h$)

Req' Tension per Anchor; $T_{u,Ea,\Omega} = T_{Ea,\Omega} - 0.9 \times D_{a,W} =$ **-42** lb; ($0.9D + \Omega_o E_h + 1.0E_v$)

$T_{u,Ea,\Omega} < 0$, therefore no anchor tension.

Wind

Required Base Shear; $V_{u,W} = F_{Wh} =$ **803** lb; (parallel to y) (1.0W)

Required Base Moment; $M_{u,Wx} = M_{Wx} - 0.9 \times M_{Dx,D} =$ **-2003** lb_ft; (about x) (0.9D+ 1.0W)

$M_{u,Wx} < 0$, therefore no skid overturning or anchor tension.

Req' Shear per Anchor; $V_{u,Wa} = V_{Wa} =$ **201** lb; (1.0W)

Req' Tension per Anchor; $T_{u,Wa} = T_{Wa} - 0.9 \times D_{a,D} =$ **-81** lb; (0.9D + 1.0W)

$T_{u,Wa} < 0$, therefore no anchor tension.

Anchor Design

Required Shear per Anchor; V_{uy} = max($V_{u,Ea,\Omega}$, $V_{u,Wa}$) = **244** lb; (parallel to y);

Required Shear per Anchor; V_{ux} = if(l/w < 2, 0.3 × V_{uy}, 0 lb) = **73** lb; (parallel to x);

Required Tension per Anchor; T_u = max(0 lb, $T_{u,Ea,\Omega}$, $T_{u,Wa}$) = **0** lb; (parallel to z);

Anchor Side Edge Distance; $S_{a,1}$ = l / 2 – 2in = **30** in; (parallel to x)

Anchor Interior Edge Distance; $S_{a,i}$ = w / 2 – 2in = **30** in; (parallel to y)

(;4;) ;0.375;-inch diameter ASTM F593 Stainless Steel Group 1 or 2 threaded rods per skid. Anchor locations per drawings.
Anchor Embedment: 3-inches
Epoxy: DeWalt Pure 110+ or Hilti HIT-RE 500 V3
Minimum Concrete Strength, f'c: 2500 psi
Minimum Slab/Housekeeping Pad Thickness: 24-inches
Minimum Edge Distance: 4-inches
Optional Grout Pad Maximum Thickness: 2-inch
Minimum Grout Strength, f'_c: 5000 psi
Grout shall be non-shrink conforming to ASTM C1107.

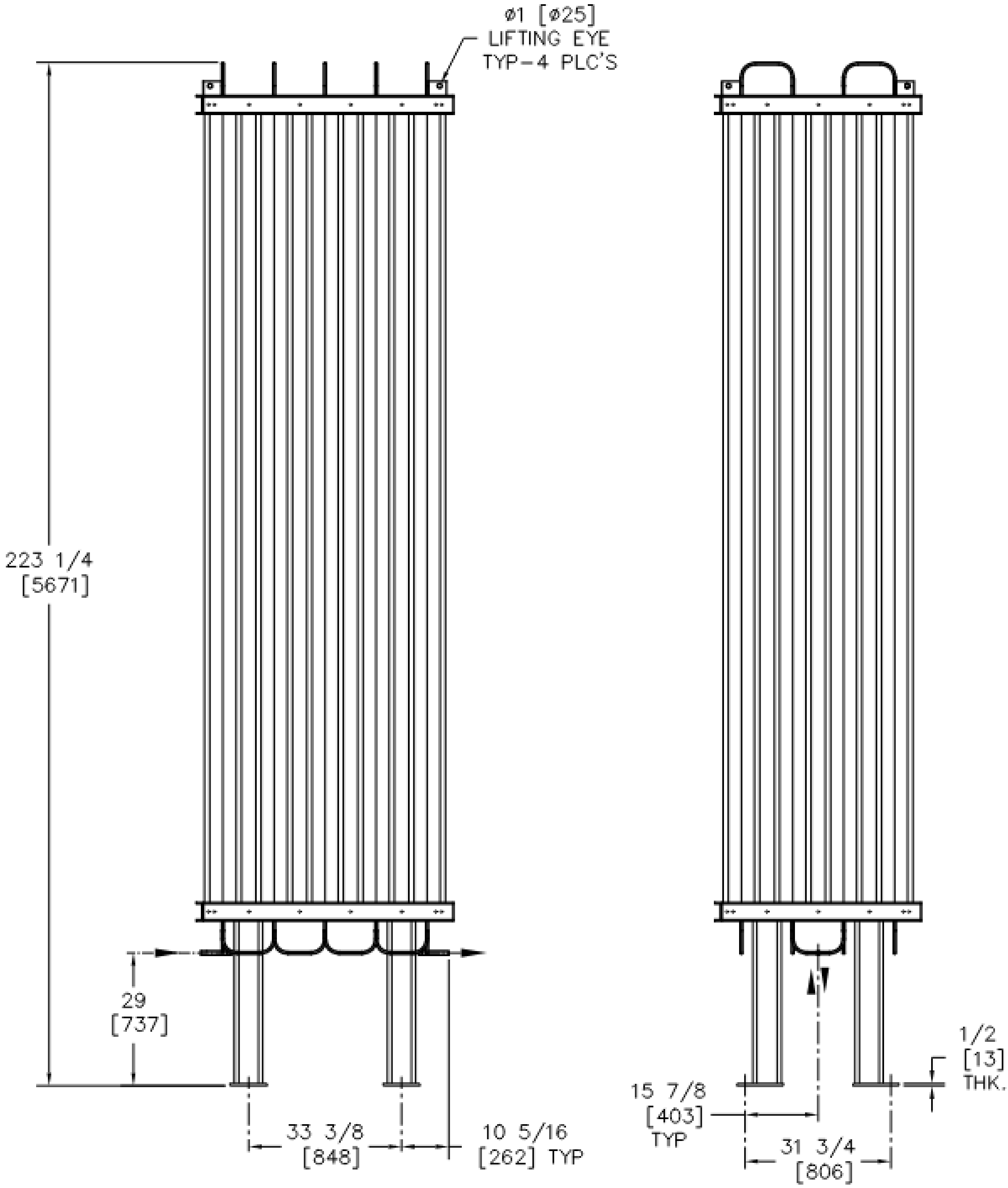
Notes:

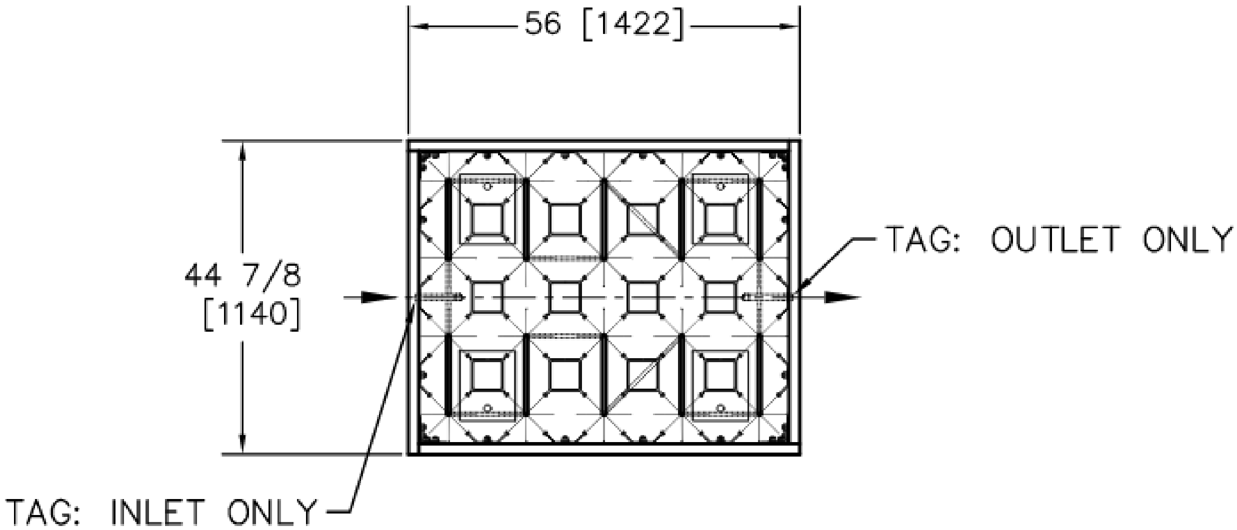
- Concrete must be continuous under unit.
- Anchors shall not be bent after being installed.
- The use of permanent shims is not permitted.
- Nuts, washers, and other hardware used with anchors shall have a material or alloy designation that is compatible with the anchor rod/alloy. Contact between dissimilar metals shall be isolated using phenolic or otherwise approved isolation hardware.
- Anchors shall be galvanized or stainless steel for fastening galvanized steel to concrete/masonry.
- Anchors shall be stainless steel for fastening aluminum or stainless steel to concrete/masonry.

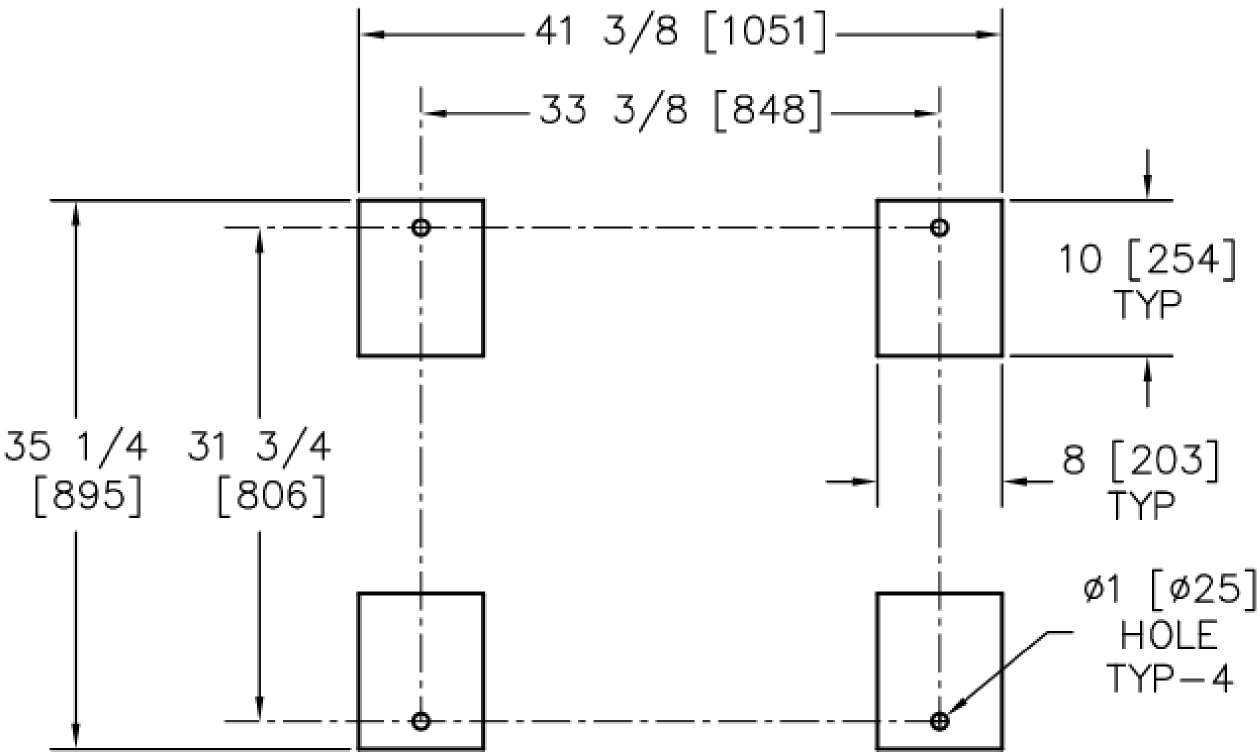
*See Appendix A for DeWalt Design Assist Outputs

Nikkiso Cryoquip Vaporizer

Drawings







ANCHOR BOLT PATTERN

Geometry & Weight

Dry/Shipping Weight;	W_D = 1500 lb;	per Dwgs – NC Vaporizer
Wet/Operating Weight;	W_W = 4500 lb;	per Dwgs – NC Vaporizer
Skid Length;	L = 56 in = **4.67** ft; (parallel to x)	per Dwgs – NC Vaporizer
Skid Width;	W = 44.875 in = **3.74** ft; (parallel to y)	per Dwgs – NC Vaporizer
Skid Height;	H = 223.25 in = **18.60** ft; (parallel to z)	per Dwgs – NC Vaporizer

In these calculations, the x-axis is parallel to the length, the y-axis is parallel to the width and the z-axis is parallel to the height. Length, width and height are all defined above.

Vertical Center of Gravity;	$CG_z = 2/3 \times H$ = **12.40** ft; (parallel to z)	assumed
Horizontal Center of Gravity;	$CG_x = 0.5 \times L$ = **2.33** ft; (parallel to x)	assumed
Horizontal Center of Gravity;	$CG_y = 0.5 \times W$ = **1.87** ft; (parallel to y)	assumed
Vertical Center of Area;	$CA_z = 1/2 \times H$ = **9.30** ft	
Horizontal Eccentricity x;	$e_x = abs[L / 2 - CG_x]$ = **0.00** in; (parallel to x)	
Horizontal Eccentricity y;	$e_y = abs[W / 2 - CG_y]$ = **0.00** in; (parallel to y)	

Number of Anchors;	N_a = 4;	per Dwgs – NC Vaporizer
Anchor Diameter;	D_a = 0.875; in	per Dwgs – NC Vaporizer
Anchor Spacing Length;	l = 33.375 in = **2.78** ft;	per Dwgs – NC Vaporizer
Anchor Spacing Width;	w = 31.75 in = **2.65** ft;	per Dwgs – NC Vaporizer

Dead Loads

Dry Dead Load;	W_D = **1500** lb; (parallel to z)	(1.0D)
Dry Dead Load Moment;	$M_{Dx,D} = W_D \times (w / 2 + e_y)$ = **1984** lb_ft; (about x)	(1.0D)
Dry Dead Load per Anchor;	$D_{a,D} = W_D / N_a$ = **375** lb;	(1.0D)
Wet Dead Load;	W_W = **4500** lb; (parallel to z)	(1.0D)
Wet Dead Load Moment;	$M_{Dx,W} = W_W \times (w / 2 + e_y)$ = **5953** lb_ft; (about x)	(1.0D)
Wet Dead Load per Anchor;	$D_{a,W} = W_W / N_a$ = **1125** lb;	(1.0D)

Seismic Loads

Design Seismic Coefficient;	$C_{s,NCV}$ = **0.333**	
Overstrength Factor;	$\Omega_0 = 2.0$;	
Seismic Vertical Load;	$F_{pv} = W_W \times 0.2 \times S_{DS}$ = **599** lb; (parallel to z)	(1.0E)
Seismic Horizontal Load;	$F_{ph} = W_W \times C_{s,NCV}$ = **1499** lb;	(1.0E)
Seismic Overturning Moment;	$M_{Ex} = F_{ph} \times CG_z + F_{pv} \times (w / 2 + e_y)$ = **19377** lb_ft; (about x)	(1.0E)
Seismic Horizontal Load w/ Ω_o;	$V_{E\Omega} = \Omega_0 \times F_{ph}$ = **2997** lb;	($\Omega_o E_h$)
Overturning Moment w/ Ω_o;	$M_{Ex\Omega} = \Omega_0 \times F_{ph} \times CG_z + F_{pv} \times (w / 2 + e_y)$	
	$M_{Ex\Omega}$ = **37963** lb_ft; (about x)	($\Omega_o E_h + 1.0E_v$)
Seismic Shear per Anchor;	$V_{Ea,\Omega} = \Omega_0 \times F_{ph} / N_a$ = **749** lb;	($\Omega_o E_h$)
Seismic Tension per Anchor;	$T_{Ea,\Omega} = M_{Ex\Omega} / [w \times N_a / 2]$ = **7174** lb ;	($\Omega_o E_h + 1.0E_v$)

Wind Load

Wind Vertical Load;	$F_{Wv} = P_{wv,NCV} \times L \times W$ = **405** lb; (parallel to z)	(1.0W)
Wind Horizontal Load;	$F_{Wh} = P_{wh,NCV} \times L \times H$ = **2016** lb; (parallel to y)	(1.0W)
Wind Overturning Moment;	$M_{Wx} = F_{Wh} \times CA_z + F_{Wv} \times w / 2$ = **19289** lb_ft; (about x)	(1.0W)
Wind Horizontal per Anchor;	$V_{Wa} = F_{Wh} / N_a$ = **504** lb;	(1.0W)
Wind Tension per Anchor;	$T_{Wa} = M_{Wx} / [w \times N_a / 2]$ = **3645** lb;	(1.0W)

Factored Loads

Seismic

Required Base Shear w/ Ω_o; $V_{u,E\Omega} = V_{E\Omega} =$ **2997** lb; ($\Omega_o E_h$)

Required Base Moment w/ Ω_o; $M_{u,Ex\Omega} = M_{Ex\Omega} - 0.9 \times M_{Dx,W}$

$M_{u,Ex\Omega} =$ **32605** lb_ft; (about x) ($0.9D + \Omega_o E_h + 1.0E_v$)

$M_{u,Ex\Omega} > 0$, therefore consider overturning & anchor tension.

Req' Shear per Anchor; $V_{u,Ea,\Omega} = V_{Ea,\Omega} =$ **749** lb; ($\Omega_o E_h$)

Req' Tension per Anchor; $T_{u,Ea,\Omega} = T_{Ea,\Omega} - 0.9 \times D_{a,W} =$ **6162** lb; ($0.9D + \Omega_o E_h + 1.0E_v$)

$T_{u,Ea,\Omega} > 0$, therefore consider anchor tension.

Wind

Required Base Shear; $V_{u,W} = F_{Wh} =$ **2016** lb; (parallel to y) (1.0W)

Required Base Moment; $M_{u,Wx} = M_{Wx} - 0.9 \times M_{Dx,D} =$ **17503** lb_ft; (about x) (0.9D+ 1.0W)

$M_{u,Wx} > 0$, therefore consider overturning & anchor tension.

Req' Shear per Anchor; $V_{u,Wa} = V_{Wa} =$ **504** lb; (1.0W)

Req' Tension per Anchor; $T_{u,Wa} = T_{Wa} - 0.9 \times D_{a,D} =$ **3308** lb; (0.9D + 1.0W)

$T_{u,Wa} > 0$, therefore consider anchor tension.

Anchor Design

Required Shear per Anchor; V_{uy} = max($V_{u,Ea,\Omega}$, $V_{u,Wa}$) = **749** lb; (parallel to y);

Required Shear per Anchor; V_{ux} = if(l/w < 2, 0.3 × V_{uy}, 0 lb) = **225** lb; (parallel to x);

Required Tension per Anchor; T_u = max(0 lb, $T_{u,Ea,\Omega}$, $T_{u,Wa}$) = **6162** lb; (parallel to z);

(;4;) ;0.875;-inch diameter ASTM F593 Stainless Steel Group 1 or 2 threaded rods per skid. Anchor locations per drawings.
Anchor Embedment: 7-inches
Epoxy: DeWalt Pure 110+ or Hilti HIT-RE 500 V3
Minimum Concrete Strength, f'c: 2500 psi
Minimum Slab/Housekeeping Pad Thickness: 24-inches
Minimum Edge Distance: 10-inches
Optional Grout Pad Maximum Thickness: 2-inch
Minimum Grout Strength, f'_c: 5000 psi
Grout shall be non-shrink conforming to ASTM C1107.

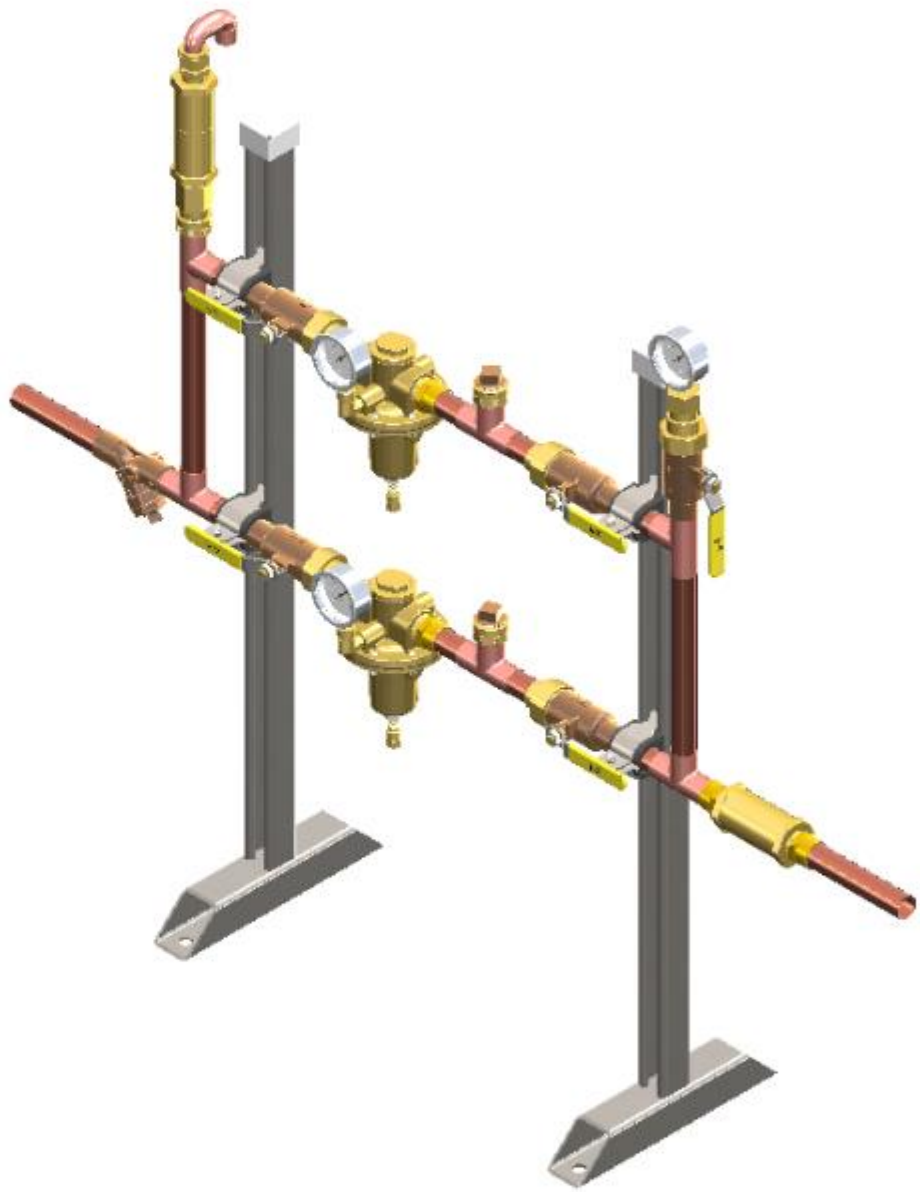
Notes:

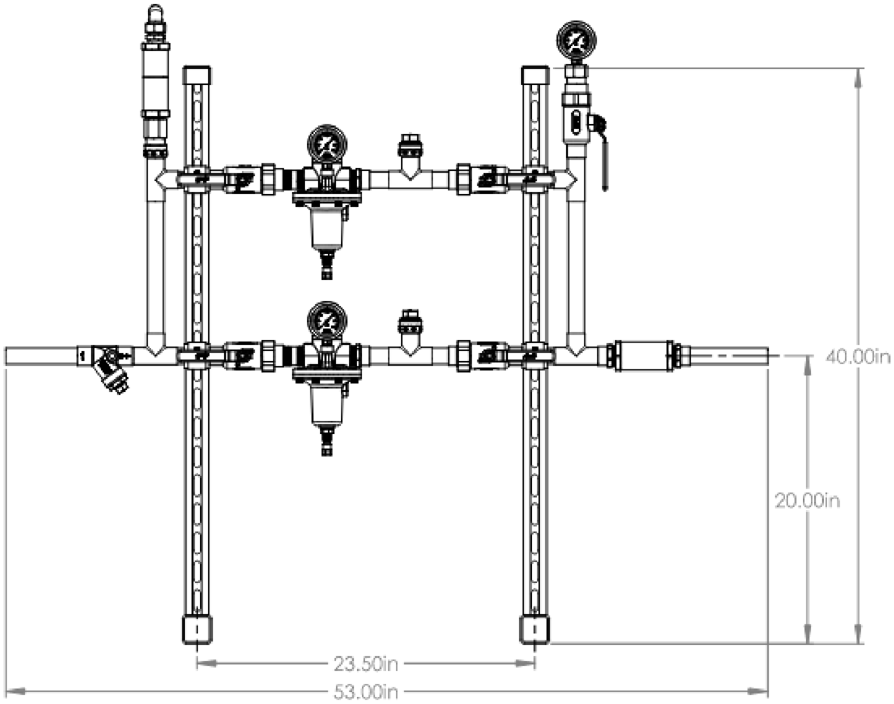
- Concrete must be continuous under unit.
- Anchors shall not be bent after being installed.
- The use of permanent shims is not permitted.
- Nuts, washers, and other hardware used with anchors shall have a material or alloy designation that is compatible with the anchor rod/alloy. Contact between dissimilar metals shall be isolated using phenolic or otherwise approved isolation hardware.
- Anchors shall be galvanized or stainless steel for fastening galvanized steel to concrete/masonry.
- Anchors shall be stainless steel for fastening aluminum or stainless steel to concrete/masonry.

*See Appendix A for DeWalt Design Assist Outputs

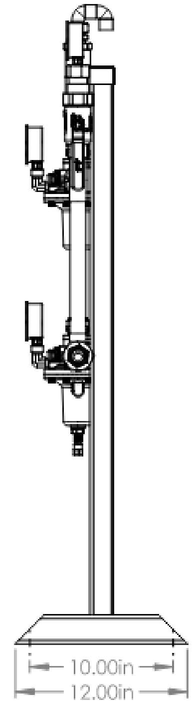
Pressure Control Manifold

Drawings





40.00in
20.00in
23.50in
53.00in



10.00in
12.00in

Geometry & Weight

Dry/Shipping Weight;	W_D = 500 lb;	per Client
Wet/Operating Weight;	W_W = 500 lb;	per Client
Pipe Rack Length;	L = 53 in = **4.42** ft; (parallel to x)	per Dwgs - PCM
Pipe Rack Width;	W = 12 in = **1.00** ft; (parallel to y)	per Dwgs - PCM
Pipe Rack Height;	H = 40 in = **3.33** ft; (parallel to z)	per Dwgs - PCM

In these calculations, the x-axis is parallel to the length, the y-axis is parallel to the width and the z-axis is parallel to the height. Length, width and height are all defined above.

Vertical Center of Gravity;	$CG_z = 3/4 \times H$ = **2.50** ft; (parallel to z)	assumed
Horizontal Center of Gravity;	$CG_x = 0.5 \times L$ = **2.21** ft; (parallel to x)	assumed
Horizontal Center of Gravity;	$CG_y = 0.5 \times W$ = **0.50** ft; (parallel to y)	assumed
Vertical Center of Area;	$CA_z = 1/2 \times H$ = **1.67** ft	
Horizontal Eccentricity x;	$e_x = abs[L / 2 - CG_x]$ = **0.00** in; (parallel to x)	
Horizontal Eccentricity y;	$e_y = abs[W / 2 - CG_y]$ = **0.00** in; (parallel to y)	
Number of Columns;	N_C = 2;	per Dwgs - PCM
Anchors per Column;	N_{aC} = 2;	per Dwgs - PCM
Anchor Diameter;	D_a = 0.375; in	per Dwgs - PCM
Leg Spacing Length;	l = 23.5 in = **1.96** ft;	per Dwgs - PCM
Leg Spacing Width;	w = 10 in = **0.83** ft;	per Dwgs - PCM

Dead Loads

Dry Dead Load;	W_D = **500** lb; (parallel to z)	(1.0D)
Dry Dead Load Moment;	$M_{Dx,D} = W_D \times (w / 2 + e_y)$ = **208** lb_ft;	(1.0D)
Dry Dead Load per Column;	$D_{a,D} = W_D / N_C$ = **250** lb;	(1.0D)
Wet Dead Load;	W_W = **500** lb; (parallel to z)	(1.0D)
Wet Dead Load Moment;	$M_{Dx,W} = W_W \times (w / 2 + e_y)$ = **208** lb_ft;	(1.0D)
Wet Dead Load per Column;	$D_{a,W} = W_W / N_C$ = **250** lb;	(1.0D)

Seismic Loads

Design Seismic Coefficient;	$C_{s,PCM}$ = **0.200**;	
Overstrength Factor;	$\Omega_0 = 2.0$;	
Seismic Vertical Load;	$F_{pv} = W_W \times 0.2 \times S_{DS}$ = **67** lb; (parallel to z)	(1.0E)
Seismic Horizontal Load;	$F_{ph} = W_W \times C_{s,PCM}$ = **100** lb; (parallel to y)	(1.0E)
Seismic Overturning Moment;	$M_{Ex} = F_{ph} \times CG_z + F_{pv} \times (w / 2 + e_y)$ = **278** lb_ft; (about x)	(1.0E)
Seismic Horizontal Load w/ Ω_o;	$V_{E\Omega} = \Omega_0 \times F_{ph}$ = **200** lb; (parallel to y)	($\Omega_o E_h$)
Overturning Moment w/ Ω_o;	$M_{Ex\Omega} = \Omega_0 \times F_{ph} \times CG_z + F_{pv} \times (w / 2 + e_y)$	
	$M_{Ex\Omega}$ = **528** lb_ft; (about x)	($\Omega_o E_h + 1.0E_v$)
Seismic Shear per Column;	$V_{Ea,\Omega} = \Omega_0 \times F_{ph} / N_C$ = **100** lb;	($\Omega_o E_h$)
Seismic Tension per Anchor;	$T_{Ea,\Omega} = M_{Ex\Omega} / [w \times N_C / 2]$ = **633** lb;	($\Omega_o E_h + 1.0E_v$)

Wind Load

Wind Vertical Load;	$F_{Wv} = P_{wv,PCM} \times L \times W$ = **88** lb; (parallel to z)	(1.0W)
Wind Horizontal Load;	$F_{Wh} = P_{wh,PCM} \times L \times H$ = **294** lb; (parallel to y)	(1.0W)
Wind Overturning Moment;	$M_{Wx} = F_{Wh} \times CA_z + F_{Wv} \times w / 2$ = **527** lb_ft; (about x)	(1.0W)
Seismic Horizontal per Column;	$V_{Wa} = F_{Wh} / N_C$ = **147** lb;	(1.0W)
Seismic Tension per Anchor;	$T_{Wa} = M_{Wx} / [w \times N_C / 2]$ = **633** lb;	(1.0W)

Factored Loads

Seismic

Required Base Shear w/ Ω_o; $V_{u,E\Omega} = V_{E\Omega} =$ **200** lb; ($\Omega_o E_h$)

Required Base Moment w/ Ω_o; $M_{u,Ex\Omega} = M_{Ex\Omega} - 0.9 \times M_{Dx,W}$

$M_{u,Ex\Omega} =$ **340** lb_ft; (about x) ($0.9D + \Omega_o E_h + 1.0E_v$)

$M_{u,Ex\Omega} > 0$, therefore consider overturning & anchor tension.

Req' Shear per Column; $V_{u,Ea,\Omega} = V_{Ea,\Omega} =$ **100** lb; ($\Omega_o E_h$)

Req' Tension per Column; $T_{u,Ea,\Omega} = T_{Ea,\Omega} - 0.9 \times D_{a,W} =$ **408** lb; ($0.9D + \Omega_o E_h + 1.0E_v$)

$T_{u,Ea,\Omega} > 0$, therefore consider anchor tension.

Wind

Required Base Shear; $V_{u,W} = F_{Wh} =$ **294** lb; (parallel to y) (1.0W)

Required Base Moment; $M_{u,Wx} = M_{Wx} - 0.9 \times M_{Dx,D} =$ **340** lb_ft; (about x) (0.9D+ 1.0W)

$M_{u,Wx} > 0$, therefore consider overturning & anchor tension.

Req' Shear per Column; $V_{u,Wa} = V_{Wa} =$ **147** lb; (1.0W)

Req' Tension per Column; $T_{u,Wa} = T_{Wa} - 0.9 \times D_{a,D} =$ **408** lb; (0.9D + 1.0W)

$T_{u,Wa} > 0$, therefore consider anchor tension.

Anchor Design

Required Shear per Column; $V_{uy} = \max(V_{u,Ea,\Omega}, V_{u,Wa})$ = **147** lb; (parallel to y);

Required Shear per Column; $V_{ux} = \text{if}(l/w < 2, 0.3 \times V_{uy}, 0 \text{ lb})$ = **0** lb; (parallel to x);

Required Tension per Column; $T_u = \max(0 \text{ lb}, T_{u,Ea,\Omega}, T_{u,Wa})$ = **408** lb; (parallel to z);

Anchor Side Edge Distance; $S_{a,1} = l / 2 - 1\text{in}$ = **11** in; (parallel to x)

(;2;) ;0.375;-inch diameter ASTM F593 Stainless Steel Group 1 or 2 threaded rods per column, (4) anchors per pipe rack. Anchor locations per drawings.
Anchor Embedment: 4-inches
Epoxy: DeWalt Pure 110+ or Hilti HIT-RE 500 V3
Minimum Concrete Strength, f'c: 2500 psi
Minimum Slab/Housekeeping Pad Thickness: 24-inches
Minimum Edge Distance: 4-inches
Optional Grout Pad Maximum Thickness: 2-inch
Minimum Grout Strength, f'_c: 5000 psi
Grout shall be non-shrink conforming to ASTM C1107.

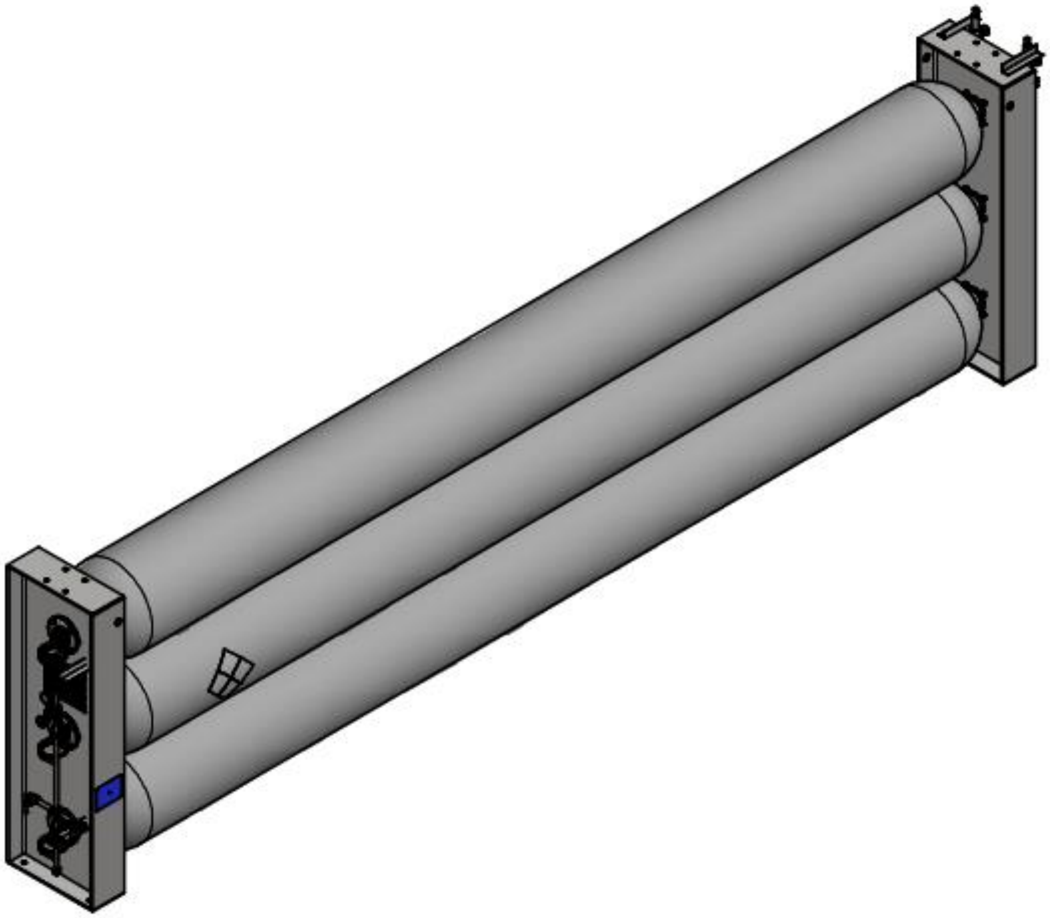
Notes:

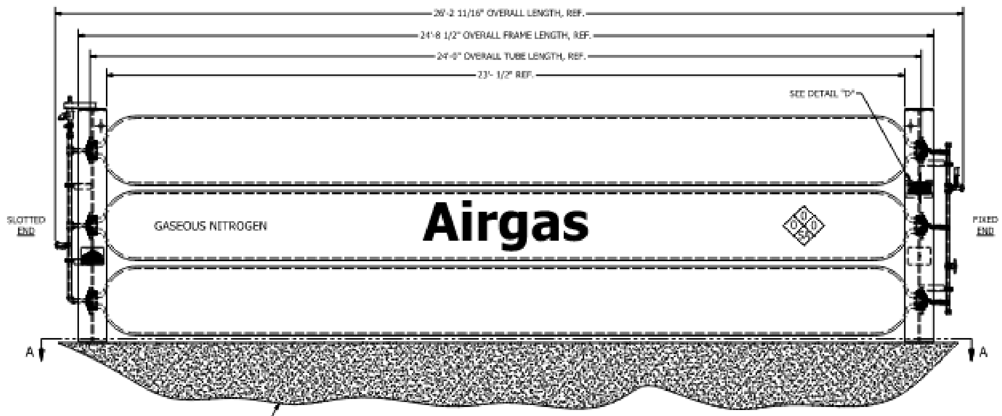
- Concrete must be continuous under unit.
- Anchors shall not be bent after being installed.
- The use of permanent shims is not permitted.
- Nuts, washers, and other hardware used with anchors shall have a material or alloy designation that is compatible with the anchor rod/alloy. Contact between dissimilar metals shall be isolated using phenolic or otherwise approved isolation hardware.
- Anchors shall be galvanized or stainless steel for fastening galvanized steel to concrete/masonry.
- Anchors shall be stainless steel for fastening aluminum or stainless steel to concrete/masonry.

*See Appendix A for DeWalt Design Assist Outputs

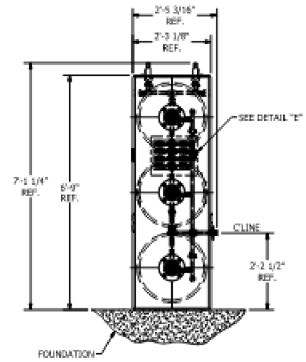
ASME Tube

Drawings

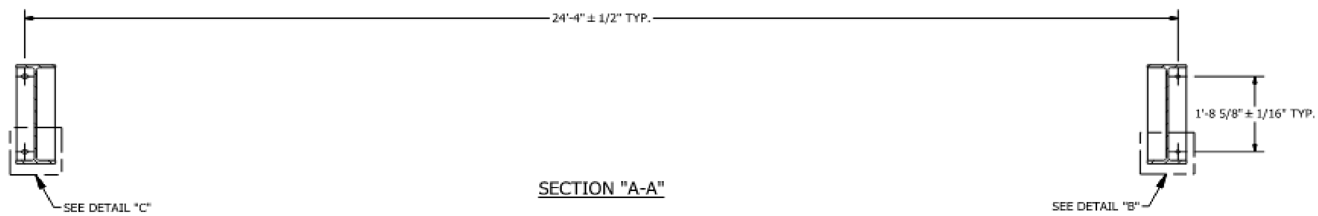




SIDE VIEW



FIXED END VIEW



SECTION "A-A"

Geometry & Weight

Dry/Shipping Weight;	W_D = 18619 lb;	per Dwgs - ASME
Wet/Operating Weight;	W_W = 21009 lb;	per Dwgs - ASME
Skid Length;	L = 314.69 in = **26.22** ft; (parallel to x)	per Dwgs - ASME
Skid Width;	W = 29.19 in = **2.43** ft; (parallel to y)	per Dwgs - ASME
Skid Height;	H = 85.25 in = **7.10** ft; (parallel to z)	per Dwgs - ASME

In these calculations, the x-axis is parallel to the length, the y-axis is parallel to the width and the z-axis is parallel to the height. Length, width and height are all defined above.

Vertical Center of Gravity;	CG_z = 2/3 × H = **4.74** ft; (parallel to z)	assumed
Horizontal Center of Gravity;	CG_x = 0.5 × L = **13.11** ft; (parallel to x)	assumed
Horizontal Center of Gravity;	CG_y = 0.5 × W = **1.22** ft; (parallel to y)	assumed
Vertical Center of Area;	CA_z = 1/2 × H = **3.55** ft	
Horizontal Eccentricity x;	e_x = abs[L / 2 - CG_x] = **0.00** in; (parallel to x)	
Horizontal Eccentricity y;	e_y = abs[W / 2 - CG_y] = **0.00** in; (parallel to y)	
Number of Anchors;	N_a = 4;	per Dwgs - ASME
Anchor Diameter;	D_a = 0.875; in	per Dwgs - ASME
Anchor Spacing Length;	l = 292 in = **24.33** ft;	per Dwgs - ASME
Anchor Spacing Width;	w = 20.625 in = **1.72** ft;	per Dwgs - ASME

Dead Loads

Dry Dead Load; W_D = **18619** lb; (parallel to z) (1.0D)

Dry Dead Load Moment; $M_{Dx,D} = W_D \times (w / 2 + e_y)$ = **16001** lb_ft; (about x) (1.0D)

Dry Dead Load per Anchor; $D_{a,D} = W_D / N_a$ = **4655** lb; (1.0D)

Wet Dead Load; W_W = **21009** lb; (parallel to z) (1.0D)

Wet Dead Load Moment; $M_{Dx,W} = W_W \times (w / 2 + e_y)$ = **18055** lb_ft; (about x) (1.0D)

Wet Dead Load per Anchor; $D_{a,W} = W_W / N_a$ = **5252** lb; (1.0D)

Seismic Loads

Design Seismic Coefficient; $C_{s,ASME}$ = **0.200**

Overstrength Factor; $\Omega_0 = 2.0$;

Seismic Vertical Load; $F_{pv} = W_W \times 0.2 \times S_{DS}$ = **2794** lb; (parallel to z) (1.0E)

Seismic Horizontal Load; $F_{ph} = W_W \times C_{s,ASME}$ = **4202** lb; (1.0E)

Seismic Overturning Moment; $M_{Ex} = F_{ph} \times CG_z + F_{pv} \times (w / 2 + e_y)$ = **22301** lb_ft; (about x) (1.0E)

Seismic Horizontal Load w/ Ω_o; $V_{E\Omega} = \Omega_0 \times F_{ph}$ = **8404** lb; ($\Omega_o E_h$)

Overturning Moment w/ Ω_o; $M_{Ex\Omega} = \Omega_0 \times F_{ph} \times CG_z + F_{pv} \times (w / 2 + e_y)$

$M_{Ex\Omega}$ = **42202** lb_ft; (about x) ($\Omega_o E_h + 1.0E_v$)

Wind Load

Wind Vertical Load; $F_{Wv} = P_{wv,ASME} \times L \times W$ = **1275** lb; (parallel to z) (1.0W)

Wind Horizontal Load; $F_{Wh} = P_{wh,ASME} \times L \times H$ = **3724** lb; (parallel to y) (1.0W)

Wind Overturning Moment; $M_{Wx} = F_{Wh} \times CA_z + F_{Wv} \times w / 2$ = **14324** lb_ft; (about x) (1.0W)

Factored Loads

Seismic

Required Base Shear w/ Ω_o; $V_{u,E\Omega} = V_{E\Omega}$ = **8404** lb; ($\Omega_o E_h$)

Required Base Moment w/ Ω_o; $M_{u,Ex\Omega} = M_{Ex\Omega} - 0.9 \times M_{Dx,W}$

$M_{u,Ex\Omega}$ = **25952** lb_ft; (about x) ($0.9D + \Omega_o E_h + 1.0E_v$)

$M_{u,Ex\Omega} > 0$, therefore consider overturning & anchor tension.

Wind

Required Base Shear; $V_{u,W} = F_{Wh}$ = **3724** lb; (parallel to y) (1.0W)

Required Base Moment; $M_{u,Wx} = M_{Wx} - 0.9 \times M_{Dx,D}$ = **-76** lb_ft; (about x) (0.9D+ 1.0W)

$M_{u,Wx} < 0$, therefore no skid overturning or anchor tension.

Anchor Design

Horizontal Eccentricity x; e_x = **0.00** in; (parallel to x)
Horizontal Eccentricity y; e_y = **0.00** in; (parallel to y)

Required Base Shear; $V_{uy} = \max(V_{u,E\Omega}, V_{u,W})$ = **8404** lb; (parallel to y);
Required Base Shear; $V_{ux} = \text{if}(l/w < 2, 0.3 \times V_{uy}, 0 \text{ lb})$ = **0** lb; (parallel to x);

Required Base Moment; $M_{ux} = \max(0 \text{ lb\_in}, M_{u,Ex\Omega}, M_{u,Wx})$
M_{ux} = **311430** lb_in; (about x);
Required Base Moment; $M_{uy} = \text{if}(l/w < 2, 0.3 \times M_{ux}, 0 \text{ lb\_in})$
M_{uy} = **0** lb_in; (about y);

(;4;) ;0.875;-inch diameter ASTM F593 Stainless Steel Group 1 or 2 threaded rods per skid. Anchor locations per drawings.
Anchor Embedment: 7-inches
Epoxy: DeWalt Pure 110+ or Hilti HIT-RE 500 V3
Minimum Concrete Strength, f'c: 2500 psi
Minimum Slab/Housekeeping Pad Thickness: 24-inches
Minimum Edge Distance: 12-inches
Optional Grout Pad Maximum Thickness: 2-inch
Minimum Grout Strength, f'_c: 5000 psi
Grout shall be non-shrink conforming to ASTM C1107.

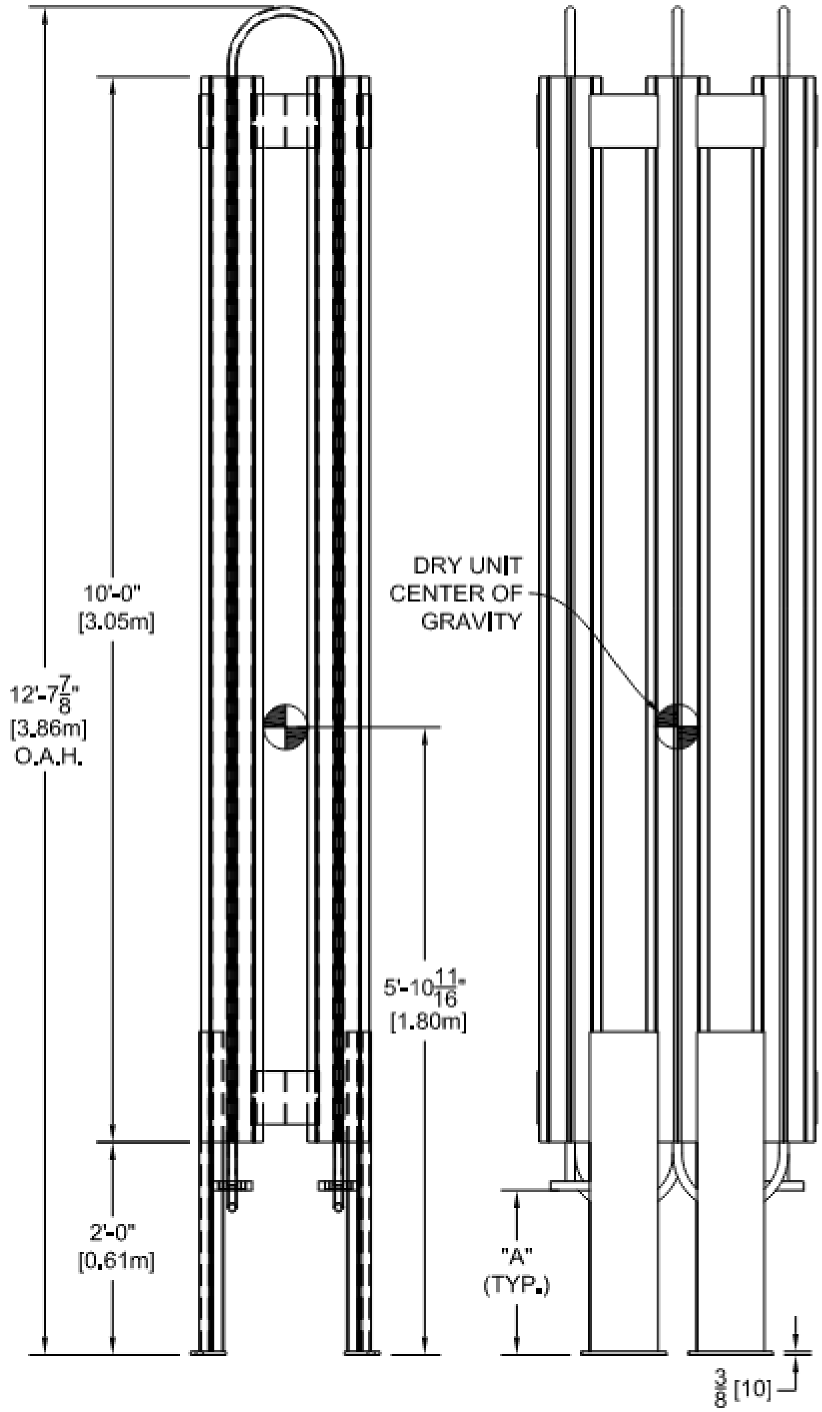
Notes:

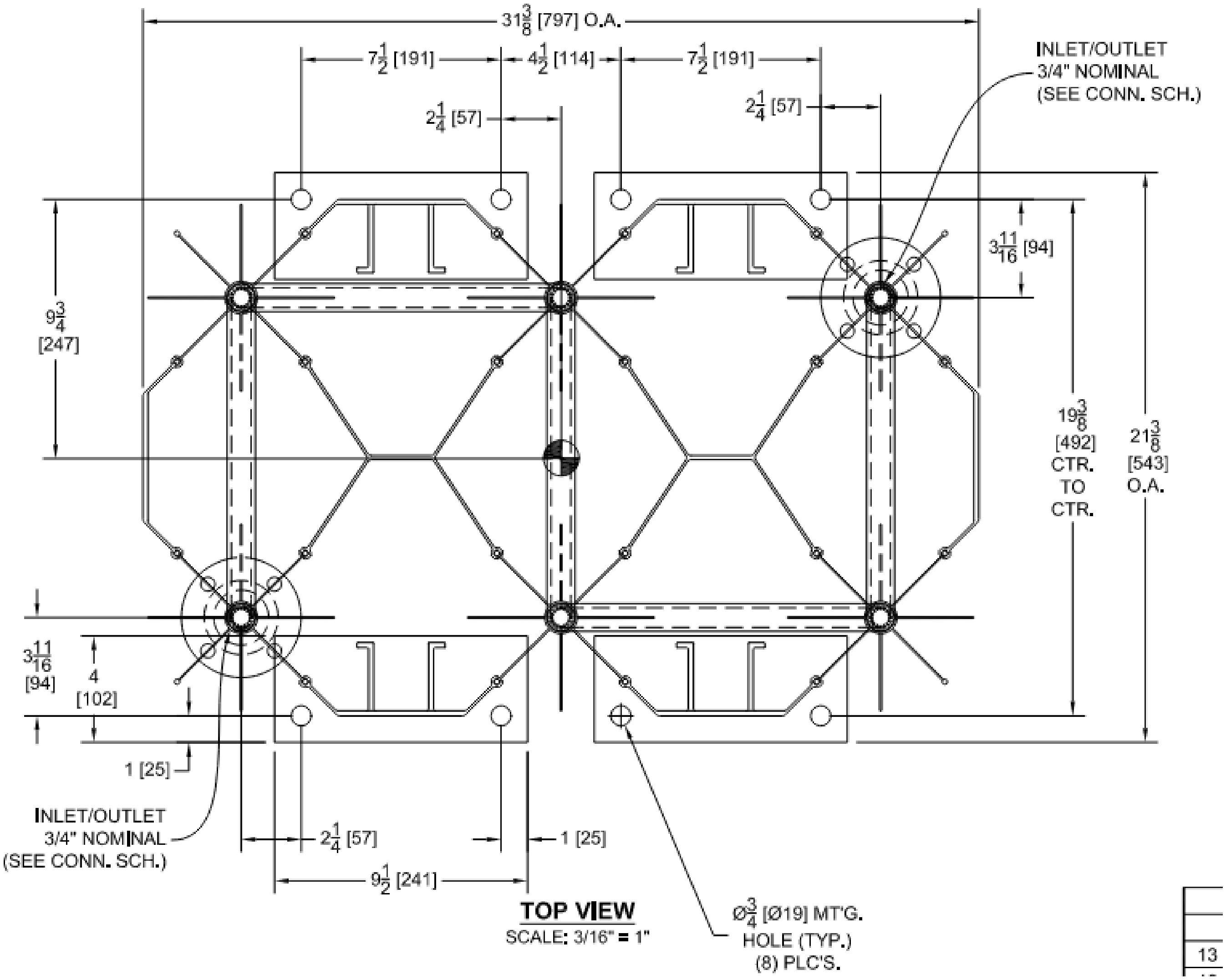
- Concrete must be continuous under unit.
- Anchors shall not be bent after being installed.
- The use of permanent shims is not permitted.
- Nuts, washers, and other hardware used with anchors shall have a material or alloy designation that is compatible with the anchor rod/alloy. Contact between dissimilar metals shall be isolated using phenolic or otherwise approved isolation hardware.
- Anchors shall be galvanized or stainless steel for fastening galvanized steel to concrete/masonry.
- Anchors shall be stainless steel for fastening aluminum or stainless steel to concrete/masonry.

*See Appendix A for DeWalt Design Assist Outputs

Thermax Vaporizer

Drawings





TOP VIEW
SCALE: 3/16" = 1"

Geometry & Weight

Dry/Shipping Weight;	W_D = 205 lb;	per Dwgs – T Vaporizer
Wet/Operating Weight;	W_W = 205 lb;	per Dwgs – T Vaporizer
Skid Length;	L = 31.375 in = **2.61** ft; (parallel to x)	per Dwgs – T Vaporizer
Skid Width;	W = 21.375 in = **1.78** ft; (parallel to y)	per Dwgs – T Vaporizer
Skid Height;	H = 151.875 in = **12.66** ft; (parallel to z)	per Dwgs – T Vaporizer

In these calculations, the x-axis is parallel to the length, the y-axis is parallel to the width and the z-axis is parallel to the height. Length, width and height are all defined above.

Vertical Center of Gravity;	CG_z = 70.6875 in = **5.89** ft; (parallel to z)	per Dwgs – T Vaporizer
Horizontal Center of Gravity;	$CG_x = 0.5 \times L$ = **1.31** ft; (parallel to x)	assumed
Horizontal Center of Gravity;	$CG_y = 0.5 \times W$ = **0.89** ft; (parallel to y)	assumed
Vertical Center of Area;	$CA_z = 1/2 \times H$ = **6.33** ft	
Horizontal Eccentricity x;	$e_x = abs[L / 2 - CG_x]$ = **0.00** in; (parallel to x)	
Horizontal Eccentricity y;	$e_y = abs[W / 2 - CG_y]$ = **0.00** in; (parallel to y)	
Number of Anchors;	N_a = 8;	per Dwgs – T Vaporizer
Anchor Diameter;	D_a = 0.625; in	per Dwgs – T Vaporizer
Anchor Spacing Length;	l = 19.5 in = **1.62** ft;	per Dwgs – T Vaporizer
Anchor Spacing Width;	w = 19.375 in = **1.61** ft;	per Dwgs – T Vaporizer

Dead Loads

Dry Dead Load; $W_D = \mathbf{205}$ lb; (parallel to z) (1.0D)

Dry Dead Load Moment; $M_{Dx,D} = W_D \times (w / 2 + e_y) = \mathbf{165}$ lb_ft; (about x) (1.0D)

Dry Dead Load per Anchor; $D_{a,D} = W_D / N_a = \mathbf{26}$ lb; (1.0D)

Wet Dead Load; $W_W = \mathbf{205}$ lb; (parallel to z) (1.0D)

Wet Dead Load Moment; $M_{Dx,W} = W_W \times (w / 2 + e_y) = \mathbf{165}$ lb_ft; (about x) (1.0D)

Wet Dead Load per Anchor; $D_{a,W} = W_W / N_a = \mathbf{26}$ lb; (1.0D)

Seismic Loads

Design Seismic Coefficient; $C_{s,TV} = \mathbf{0.333}$;

Overstrength Factor; $\Omega_0 = 2.0$;

Seismic Vertical Load; $F_{pv} = W_W \times 0.2 \times S_{DS} = \mathbf{27}$ lb; (parallel to z) (1.0E)

Seismic Horizontal Load; $F_{ph} = W_W \times C_{s,TV} = \mathbf{68}$ lb; (1.0E)

Seismic Overturning Moment; $M_{Ex} = F_{ph} \times CG_z + F_{pv} \times (w / 2 + e_y) = \mathbf{424}$ lb_ft; (about x) (1.0E)

Seismic Horizontal Load w/ Ω_o; $V_{E\Omega} = \Omega_0 \times F_{ph} = \mathbf{137}$ lb; ($\Omega_o E_h$)

Overturning Moment w/ Ω_o; $M_{Ex\Omega} = \Omega_0 \times F_{ph} \times CG_z + F_{pv} \times (w / 2 + e_y)$

$M_{Ex\Omega} = \mathbf{826}$ lb_ft; (about x) ($\Omega_o E_h + 1.0E_v$)

Wind Load

Wind Vertical Load; $F_{Wv} = P_{wv,TV} \times L \times W = \mathbf{111}$ lb; (parallel to z) (1.0W)

Wind Horizontal Load; $F_{Wh} = P_{wh,TV} \times L \times H = \mathbf{789}$ lb; (parallel to y) (1.0W)

Wind Overturning Moment; $M_{Wx} = F_{Wh} \times CA_z + F_{Wv} \times w / 2 = \mathbf{5084}$ lb_ft; (about x) (1.0W)

Factored Loads

Seismic

Required Base Shear w/ Ω_o; $V_{u,E\Omega} = V_{E\Omega} = \mathbf{137}$ lb; ($\Omega_o E_h$)

Required Base Moment w/ Ω_o; $M_{u,Ex\Omega} = M_{Ex\Omega} - 0.9 \times M_{Dx,W}$

$M_{u,Ex\Omega} = \mathbf{677}$ lb_ft; (about x) ($0.9D + \Omega_o E_h + 1.0E_v$)

$M_{u,Ex\Omega} > 0$, therefore consider overturning & anchor tension.

Wind

Required Base Shear; $V_{u,W} = F_{Wh} = \mathbf{789}$ lb; (parallel to y) (1.0W)

Required Base Moment; $M_{u,Wx} = M_{Wx} - 0.9 \times M_{Dx,D} = \mathbf{4935}$ lb_ft; (about x) (0.9D+ 1.0W)

$M_{u,Wx} > 0$, therefore consider overturning & anchor tension.

Anchor Design

Horizontal Eccentricity x; e_x = **0.00** in; (parallel to x)

Horizontal Eccentricity y; e_y = **0.00** in; (parallel to y)

Required Base Shear; $V_{uy} = max(V_{u,E\Omega}, V_{u,W})$ = **789** lb; (parallel to y);

Required Base Shear; V_{ux} = if(l/w < 2, 0.3 × V_{uy}, 0 lb) = **237** lb; (parallel to x);

Required Base Moment; M_{ux} = max(0 lb_in, $M_{u,Ex\Omega}$, $M_{u,Wx}$)

M_{ux} = **59220** lb_in; (about x);

Required Base Moment; M_{uy} = if(l/w < 2, 0.3 × M_{ux}, 0 lb_in)

M_{uy} = **17766** lb_in; (about y);

(;8;) ;0.625;-inch diameter ASTM F593 Stainless Steel Group 1 or 2 threaded rods per skid. Anchor locations per drawings.
Anchor Embedment: 5-inches
Epoxy: DeWalt Pure 110+ or Hilti HIT-RE V3
Minimum Concrete Strength, f'c: 2500 psi
Minimum Slab/Housekeeping Pad Thickness: 24-inches
Minimum Edge Distance: 5-inches
Optional Grout Pad Maximum Thickness: 2-inch
Minimum Grout Strength, f'_c: 5000 psi
Grout shall be non-shrink conforming to ASTM C1107.

Notes:

- Concrete must be continuous under unit.
- Anchors shall not be bent after being installed.
- The use of permanent shims is not permitted.
- Nuts, washers, and other hardware used with anchors shall have a material or alloy designation that is compatible with the anchor rod/alloy. Contact between dissimilar metals shall be isolated using phenolic or otherwise approved isolation hardware.
- Anchors shall be galvanized or stainless steel for fastening galvanized steel to concrete/masonry.
- Anchors shall be stainless steel for fastening aluminum or stainless steel to concrete/masonry.

*See Appendix A for DeWalt Design Assist Outputs

Mat Slab Design

Note: Per the geotechnical report, differential settlement of up to 2" is possible.

Slab Length; L_{slab} = 30 ft;
Slab Width; B_{slab} = 16 ft;
Slab Depth; d_{slab} = 24 in = **2** ft;

Loading

Note: All equipment weights and overturning moments will be added together and applied to the center of the mat slab for the purpose of design. An eccentricity of 5% of the slab width will be applied to the location of loading per ASCE 7-16 Section 12.9.2.2.2.

Sum of Equipment Weights; W_{tot} = 33800lb + 2435.749lb + 4500lb + 500lb + 21009lb + 205lb;
W_{tot} = **62450** lb; per dwgs

Sum of Total Wind Shear; $V_{W,tot}$ = 1220lb + 803lb + 2016lb + 294lb + 3724lb + 789lb;
$V_{W,tot}$ = **8846** lb;

Sum of Total Seismic Shear; $V_{E,tot}$ = 11255lb + 487lb + 1499lb + 100lb + 4202lb + 68lb;
$V_{E,tot}$ = **17611** lb;

Sum of Wind Overturning Moments;
$M_{W,tot}$ = 11591 lb_ft + 4503 lb_ft + 19289 lb_ft + 527 lb_ft + 14324 lb_ft + 5084 lb_ft;
$M_{W,tot}$ = **55318** lb_ft;

Sum of Seismic Overturning Moments;
$M_{E,tot}$ = 136242 lb_ft + 3223 lb_ft + 19377 lb_ft + 278 lb_ft + 22301 lb_ft + 424 lb_ft;
$M_{E,tot}$ = **181845** lb_ft;

Additional Overturning Moment from Settlement
Weighted Average C.O.G.; $CG_{z,avg}$ = ((33800lb × 10.92ft) + (2435.749lb × 4.47ft) + (4500lb × 12.4ft) + (500lb × 2.5ft) + (21009lb × 4.74ft) + (205lb × 5.89ft)) / W_{tot} = **8.61** ft;

Assumed Weighted Avg, C.O.G.; $CG_{z,avg}$ = 10 ft; (conservative)
Assumed Eccentricity; e = 6 in; (conservative)

Add. Overturning Moment; $M_{D,add}$ = W_{tot} × e = **31225** lb_ft;

Design

See Appendix B for Enercalc Ouput

Use a 30'x16'x2' mat slab with #6 @ 10" o.c. reinforcing each way, T&B

Appendix A – Dewalt Design Assist

Nitrogen Tank

DEWALT DESIGN ASSIST 1.7.6.0 — Page 1

Nitrogen Tank Anchorage - AWS Headed Stud 2501-0033

8/28/2025

1.Project Information

Company:	Peterson Structural Engineers
Project Engineer:	CTN
Address:	
Phone:	M: P:
Email:	cabe.nieth@psengineers.com
Project Name:	2501-0033
Project Address:	Scappoose, Oregon
Notes:	

2.Selected Anchor Information

Selected Anchor :	AWS Headed Stud
Brand:	Generic
Material:	1" Ø Headed Stud ASTM A 108 Type A
Embedment:	h_{ef} 20.50 in h_{nom} 21 in
Approval:	- -
Issued/Revision:	- -

3.Design Principles

Design Method:	ACI 318-19				
Load Combinations:	Section 5.3	User Defined Loads			
Seismic Loading:	Tension	17.10.5.3(d)	Shear	17.10.6.3(c)	Ω_o= 2

4.Base Material Information

Concrete:

Type:	Cracked	Normal Weight Concrete		
Strength	2500 psi			

Reinforcement:

Edge Reinforcement	None or < #4 Rebar			
Spacing	Tension	No (Condition B)	Shear	No (Condition B)
Controls Breakout	Tension	False	Shear	False

Base Plate:

Sizing	Thickness 0.5 in	Length 21.3 in	Width 28 in
Standoff	None	Height 0 in	
Strength	36000 psi		

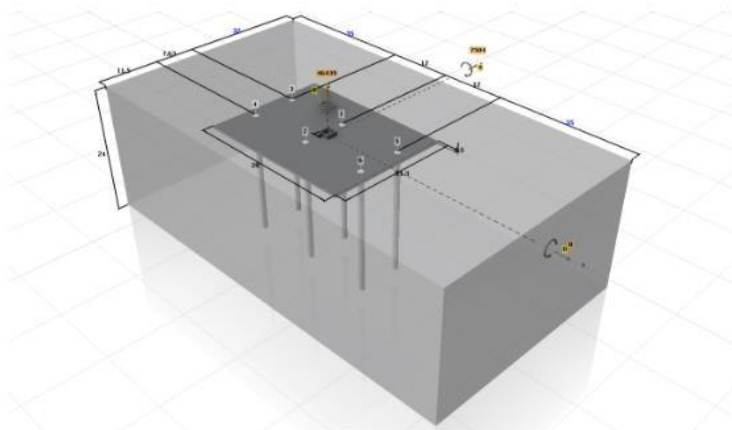
Profile: HSS Rectangular 2 X 2 X 0.125

Torqued Anchor Bolt:

Concrete Covers: Base Cover: 3 in End Cover: 2 in

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	24	in	h_{min}	24.000	in
Edge Cx-	35	in	c_{min}	2.813	in
Edge Cx+	35	in	c_{ac}	30.750	in
Edge Cy-	11.5	in	s_{min}	4.000	in
Edge Cy+	32	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	8707.31	35932.00	0.242	OK	
Concrete Breakout Strength:	46439.00	57202.00	0.812	OK	Controls
Pullout Strength:	8707.00	13545.00	0.643	OK	

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	1387.00	31141.00	0.045	OK	
Concrete Breakout Strength:	7505.00	17347.00	0.433	OK	Controls
Pryout Strength	7509.00	153173.00	0.049	OK	

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

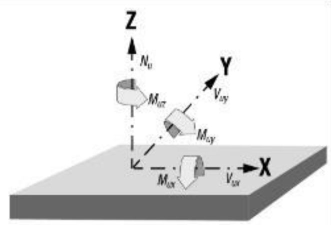
- The results of the calculations carried out by means of the DDA Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an design professional/engineer, particularly with regard to compliance with applicable standards, norms and permits, prior to using them for your specific project. The DDA Software serves only as an aid to interpret standards, norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- Calculations including seismic design requirements in accordance with ACI 318 are required for anchors in structures assigned to seismic design categories C, D, E and F.
- Under these seismic conditions, the direction of shear may not be predictable. In accordance with ACI 318 the full shear force should be assumed also in reverse direction for a safe design. Load reversal may influence the direction of the controlling concrete breakout strength.

8.Load Condition

Design Loads / Actions

Nu	46439.0	lb	Vux	0.0	lb	Vuy	7504.0	lb
Muz	0.0	in-lb	Mux	0.0	in-lb	Muy	0.0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

9.Load Distribution

Max. concrete compressive strain:	0.000	%	Anchor Eccentricity					
Max. concrete compressive stress:	0.000	psi	ex	0	in	ey	0	in
Resulting tension force:	46439.000	lb	Profile Eccentricity					
Resulting compression force:	0.000	lb	ex	1	in	ey	0	in

Resulting anchor forces / Load distribution

Anchor	Tension Load (lb)	Shear Load (lb)	Component Shear Load (lb) Shear X	Shear Y	Anchor Coordinates (in) X	Y
1	7739.83	1251.4	-43.2	1250.7	0.000	3.815
2	7739.83	1251.4	43.2	1250.7	0.000	-3.815
3	6772.35	1115.7	-43.2	1114.9	-12.000	3.815
4	6772.35	1115.7	43.2	1114.9	-12.000	-3.815
5	8707.31	1387.1	-43.2	1386.4	12.000	3.815
6	8707.31	1387.1	43.2	1386.4	12.000	-3.815

P2K Pump Skid

DEWALT

DEWALT DESIGN ASSIST 1.7.6.0 | Page 1

P2K Pump Skid Anchorage 2501-0033

8/12/2025

1.Project Information

Company:	Peterson Structural Engineers
Project Engineer:	CTN
Address:	
Phone:	M: P:
Email:	cabe.nieth@psengineers.com
Project Name:	2501-0033
Project Address:	Scappoose, Oregon
Notes:	

2.Selected Anchor Information

Selected Anchor :	HIT-RE 500 V3
Brand:	Hilti®
Material:	3/8" Ø Threaded Rod ASTM F593 Group 1 - CW1
Embedment:	h_{ef} 3.00 in h_{nom} 3 in
Approval:	ICC-ES ESR-3814
Issued/Revision:	Jan,2025 -
Drill method:	Hammer Drilled

3.Design Principles

Design Method:	ACI 318-19				
Load Combinations:	Section 5.3	User Defined Loads			
Seismic Loading:	Tension	17.10.5.3(d)	Shear	17.10.6.3(c)	Ω_o= 2

4.Base Material Information

Concrete:

Type:	Cracked	Normal Weight Concrete		
Strength	2500 psi			

Reinforcement:

Edge Reinforcement	None or < #4 Rebar			
Spacing	Tension	No (Condition B)	Shear	No (Condition B)
Controls Breakout	Tension	False	Shear	False

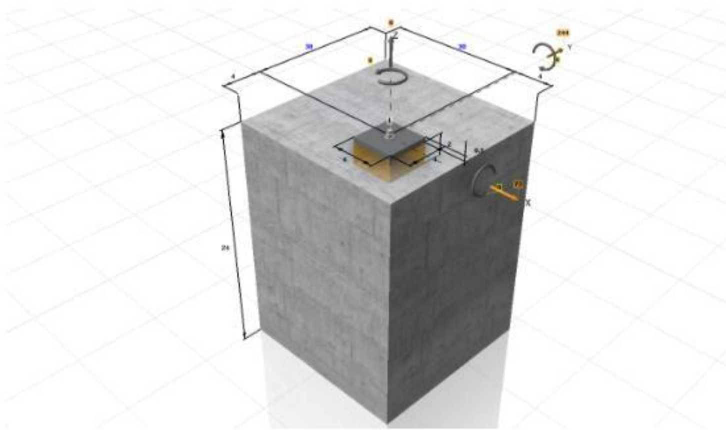
Base Plate:

Sizing	Thickness 0.5 in	Length 4 in	Width 4 in
Standoff	Grout Pad	Height 2 in	
Strength	36000 psi		

Profile:	None	
Hole Condition:	Dry Hole	
Max. Service Temperature:	Long Term: 110 °F	Short Term: 130 °F

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	24	in	h_{min}	4.250	in
Edge Cx-	30	in	c_{min}	1.875	in
Edge Cx+	4	in	c_{ac}	5.038	in
Edge Cy-	4	in	s_{min}	1.875	in
Edge Cy+	30	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	255.00	1786.00	0.143	OK	
Concrete Breakout Strength:	255.00	1364.00	0.187	OK	Controls
Pryout Strength	255.00	3978.00	0.064	OK	

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

- The results of the calculations carried out by means of the DDA Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an design professional/engineer, particularly with regard to compliance with applicable standards, norms and permits, prior to using them for your specific project. The DDA Software serves only as an aid to interpret standards, norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
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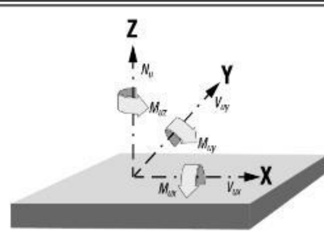
- Calculations including seismic design requirements in accordance with ACI 318 are required for anchors in structures assigned to seismic design categories C, D, E and F.
- Under these seismic conditions, the direction of shear may not be predictable. In accordance with ACI 318 the full shear force should be assumed also in reverse direction for a safe design. Load reversal may influence the direction of the controlling concrete breakout strength.

8.Load Condition

Design Loads / Actions

Nu	0.0	lb	Vux	73.0	lb	Vuy	244.0	lb
Muz	0.0	in-lb	Mux	0.0	in-lb	Muy	0.0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



9.Load Distribution

Max. concrete compressive strain:	0.000	%	Anchor Eccentricity					
Max. concrete compressive stress:	0.000	psi	ex	0	in	ey	0	in
Resulting tension force:	0.000	lb	Profile Eccentricity					
Resulting compression force:	0.000	lb	ex	0	in	ey	0	in

Resulting anchor forces / Load distribution

Anchor	Tension Load (lb)	Shear Load (lb)	Component Shear Load (lb) Shear X	Shear Y	Anchor Coordinates (in) X	Y
1	0.00	254.7	73.0	244.0	0.000	0.000

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

Nikkiso Cryoquip Vaporizer

DEWALT

DEWALT DESIGN ASSIST 1.7.6.0

Page 1

Nikkiso Cryoquip Vaporizer Anchorage 2501-0033

8/12/2025

1.Project Information

Company:	Peterson Structural Engineers
Project Engineer:	CTN
Address:	
Phone:	M: P:
Email:	cabe.nieth@psengineers.com
Project Name:	2501-0033
Project Address:	Scappoose, Oregon
Notes:	

2.Selected Anchor Information

Selected Anchor :	HIT-RE 500 V3
Brand:	Hilti®
Material:	7/8" Ø Threaded Rod ASTM F593 Group 1 - CW2
Embedment:	h_{ef} 7.00 in h_{nom} 7 in
Approval:	ICC-ES ESR-3814
Issued/Revision:	Jan,2025 -
Drill method:	Hammer Drilled

3.Design Principles

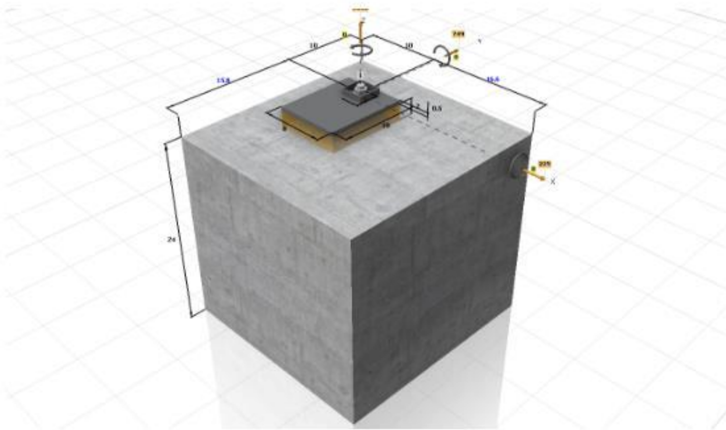
Design Method:	ACI 318-19					
Load Combinations:	Section 5.3		User Defined Loads			
Seismic Loading:	Tension	17.10.5.3(d)	Shear	17.10.6.3(c)	Ω_o=	2

4.Base Material Information

Concrete:								
Type:	Cracked		Normal Weight Concrete					
Strength	2500	psi						
Reinforcement:								
Edge Reinforcement	None or < #4 Rebar							
Spacing	Tension	No (Condition B)	Shear	No (Condition B)				
Controls Breakout	Tension	False	Shear	False				
Base Plate:								
Sizing	Thickness	0.5 in	Length	10 in	Width	8 in		
Standoff	Grout Pad		Height	2 in				
Strength	36000	psi						
Profile:	HSS Rectangular	3 X 3 X 0.125						
Hole Condition:	Dry Hole							
Max. Service Temperature:	Long Term: 110	°F	Short Term: 130	°F				

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	24	in	h_{min}	9.000	in
Edge Cx-	10	in	c_{min}	4.375	in
Edge Cx+	16.6	in	c_{ac}	9.923	in
Edge Cy-	15.8	in	s_{min}	4.375	in
Edge Cy+	10	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	6162.00	25509.00	0.242	OK	
Concrete Breakout Strength:	6162.00	7209.00	0.855	OK	Controls
Bond Strength	6162.00	9362.00	0.658	OK	

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	782.00	9042.00	0.086	OK	
Concrete Breakout Strength:	782.00	7471.00	0.105	OK	Controls
Pryout Strength	782.00	20702.00	0.038	OK	

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

- The results of the calculations carried out by means of the DDA Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an design professional/engineer, particularly with regard to compliance with applicable standards, norms and permits, prior to using them for your specific project. The DDA Software serves only as an aid to interpret standards, norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
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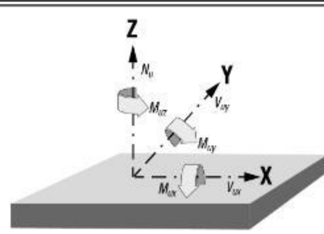
- Calculations including seismic design requirements in accordance with ACI 318 are required for anchors in structures assigned to seismic design categories C, D, E and F.
- Under these seismic conditions, the direction of shear may not be predictable. In accordance with ACI 318 the full shear force should be assumed also in reverse direction for a safe design. Load reversal may influence the direction of the controlling concrete breakout strength.

8.Load Condition

Design Loads / Actions

Nu	6162.0	lb	Vux	225.0	lb	Vuy	749.0	lb
Muz	0.0	in-lb	Mux	0.0	in-lb	Muy	0.0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



9.Load Distribution

Max. concrete compressive strain:	0.000	%	Anchor Eccentricity				
Max. concrete compressive stress:	0.000	psi	ex	0	in	ey 3	in
Resulting tension force:	6162.000	lb	Profile Eccentricity				
Resulting compression force:	0.000	lb	ex	0	in	ey 3	in

Resulting anchor forces / Load distribution

Anchor	Tension Load (lb)	Shear Load (lb)	Component Shear Load (lb) Shear X	Shear Y	Anchor Coordinates (in) X	Y
1	6162.00	782.1	225.0	749.0	0.000	3.000

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

Pressure Control Manifold

PCM Anchorage 2501-0033

8/12/2025

1.Project Information

Company:	Peterson Structural Engineers
Project Engineer:	CTN
Address:	
Phone:	M: - P: -
Email:	cabe.nieth@psengineers.com
Project Name:	2501-0033
Project Address:	Scappoose, Oregon
Notes:	

2.Selected Anchor Information

Selected Anchor :	HIT-RE 500 V3
Brand:	Hilti®
Material:	3/8" Ø Threaded Rod ASTM F593 Group 1 - CW1
Embedment:	h_{ef} 4.00 in h_{nom} 4 in
Approval:	ICC-ES ESR-3814
Issued/Revision:	Jan,2025 -
Drill method:	Hammer Drilled

3.Design Principles

Design Method:	ACI 318-19
Load Combinations:	Section 5.3 User Defined Loads
Seismic Loading:	Tension 17.10.5.3(d) Shear 17.10.6.3(c) Ω_o= 2

4.Base Material Information

Concrete:

Type:	Cracked Normal Weight Concrete
Strength	2500 psi

Reinforcement:

Edge Reinforcement	None or < #4 Rebar
Spacing	Tension No (Condition B) Shear No (Condition B)
Controls Breakout	Tension False Shear False

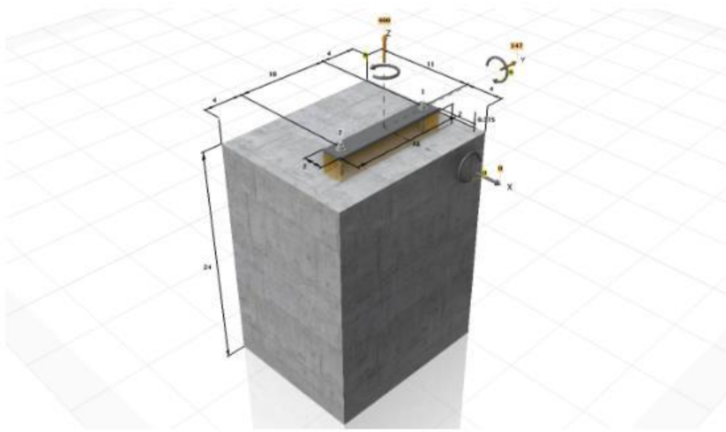
Base Plate:

Sizing	Thickness 0.375 in Length 12 in Width 2 in
Standoff	Grout Pad Height 2 in
Strength	36000 psi

Profile:	None
Hole Condition:	Dry Hole
Max. Service Temperature:	Long Term: 110 °F Short Term: 130 °F

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	24	in	h_{min}	5.250	in
Edge Cx-	11	in	c_{min}	1.875	in
Edge Cx+	4	in	c_{ac}	7.115	in
Edge Cy-	4	in	s_{min}	1.875	in
Edge Cy+	4	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	204.00	5038.00	0.040	OK	
Concrete Breakout Strength:	408.00	3840.00	0.106	OK	
Bond Strength	408.00	3494.00	0.117	OK	Controls

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	74.00	1786.00	0.041	OK	
Concrete Breakout Strength:	74.00	1364.00	0.054	OK	Controls
Pryout Strength	147.00	10033.00	0.015	OK	

7.Warnings and Remarks

ANCHOR DESIGN CRITERIA IS SATISFIED

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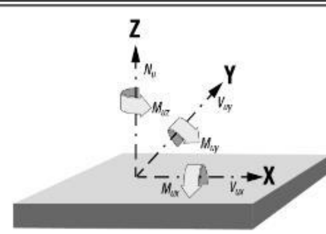
- Under these seismic conditions, the direction of shear may not be predictable. In accordance with ACI 318 the full shear force should be assumed also in reverse direction for a safe design. Load reversal may influence the direction of the controlling concrete breakout strength.

8.Load Condition

Design Loads / Actions

Nu	408.0	lb	Vux	0.0	lb	Vuy	147.0	lb
Muz	0.0	in-lb	Mux	0.0	in-lb	Muy	0.0	in-lb

Consider Load Reversal X Direction 100% Y Direction 100%



Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

9.Load Distribution

Max. concrete compressive strain:	0.000	%	Anchor Eccentricity						
Max. concrete compressive stress:	0.000	psi	ex	0	in	ey	0	in	
Resulting tension force:	408.000	lb	Profile Eccentricity						
Resulting compression force:	0.000	lb	ex	0	in	ey	0	in	

Resulting anchor forces / Load distribution

Anchor	Tension Load (lb)	Shear Load (lb)	Component Shear Load (lb) Shear X	Shear Y	Anchor Coordinates (in) X	Y
1	204.00	73.5	0.0	73.5	0.000	5.000
2	204.00	73.5	0.0	73.5	0.000	-5.000

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

ASME Tube

DEWALT DESIGN ASSIST 1.7.6.0 | Page 1

ASME Tube Anchorage 2501-0033

8/12/2025

1.Project Information

Company:	Peterson Structural Engineers
Project Engineer:	CTN
Address:	
Phone:	M: P:
Email:	cabe.nieth@psengineers.com
Project Name:	2501-0033
Project Address:	Scappoose, Oregon
Notes:	

2.Selected Anchor Information

Selected Anchor :	HIT-RE 500 V3
Brand:	Hilti®
Material:	7/8" Ø Threaded Rod ASTM F593 Group 1 - CW2
Embedment:	h_{ef} 7.00 in h_{nom} 7 in
Approval:	ICC-ES ESR-3814
Issued/Revision:	Jan,2025 -
Drill method:	Hammer Drilled

3.Design Principles

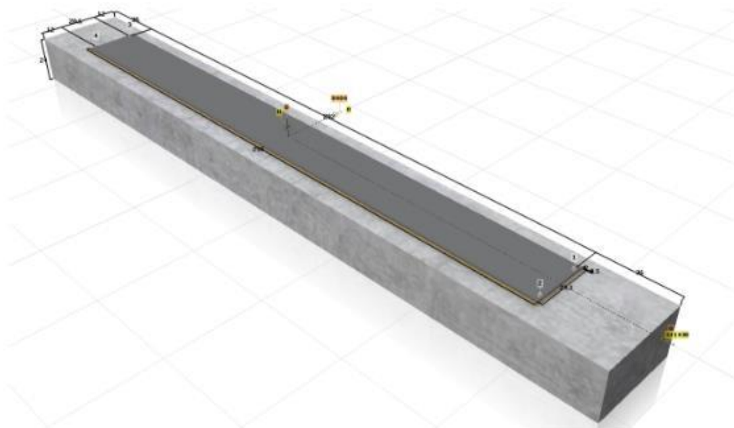
Design Method:	ACI 318-19				
Load Combinations:	Section 5.3		User Defined Loads		
Seismic Loading:	Tension	17.10.5.3(d)	Shear	17.10.6.3(c)	Ω_o= 2

4.Base Material Information

Concrete:								
Type:	Cracked		Normal Weight Concrete					
Strength	2500	psi						
Reinforcement:								
Edge Reinforcement	None or < #4 Rebar							
Spacing	Tension	No (Condition B)	Shear	No (Condition B)				
Controls Breakout	Tension	False	Shear	False				
Base Plate:								
Sizing	Thickness	0.5	in	Length	27.1	in	Width	295 in
Standoff	Grout Pad			Height	2	in		
Strength	36000	psi						
Profile:	None							
Hole Condition:	Dry Hole							
Max. Service Temperature:	Long Term: 110	°F		Short Term: 130	°F			

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	24	in	h_{min}	9.000	in
Edge Cx-	36	in	c_{min}	4.375	in
Edge Cx+	36	in	c_{ac}	9.923	in
Edge Cy-	12	in	s_{min}	4.375	in
Edge Cy+	12	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	6547.78	25509.00	0.257	OK	
Concrete Breakout Strength:	14361.00	16816.00	0.854	OK	Controls
Bond Strength	14361.00	25334.00	0.567	OK	

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	2101.00	9042.00	0.232	OK	Controls
Concrete Breakout Strength:	8404.00	37464.00	0.224	OK	
Pryout Strength	8404.00	87317.00	0.096	OK	

7.Warnings and Remarks

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- Under these seismic conditions, the direction of shear may not be predictable. In accordance with ACI 318 the full shear force should be assumed also in reverse direction for a safe design. Load reversal may influence the direction of the controlling concrete breakout strength.

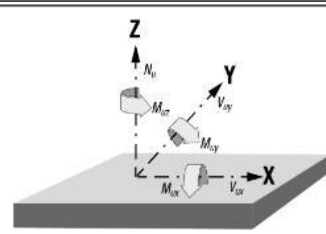
8.Load Condition

Design Loads / Actions

Nu	0.0	lb	Vux	0.0	lb	Vuy	8404.0	lb
Muz	0.0	in-lb	Mux	311430.0	in-lb	Muy	0.0	in-lb

Consider Load Reversal

X Direction 100% Y Direction 100%



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9.Load Distribution

Max. concrete compressive strain:	0.021	%	Anchor Eccentricity					
Max. concrete compressive stress:	93.007	psi	ex	0	in	ey	0	in
Resulting tension force:	14360.810	lb	Profile Eccentricity					
Resulting compression force:	14360.810	lb	ex	0	in	ey	0	in

Resulting anchor forces / Load distribution

Anchor	Tension Load (lb)	Shear Load (lb)	Component Shear Load (lb) Shear X	Shear Y	Anchor Coordinates (in) X	Y
1	6547.78	2101.0	0.0	2101.0	146.000	10.300
2	632.63	2101.0	0.0	2101.0	146.000	-10.300
3	6547.78	2101.0	0.0	2101.0	-146.000	10.300
4	632.63	2101.0	0.0	2101.0	-146.000	-10.300

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

Thermax Vaporizer

DEWALT

Thermax Vaporizer Anchorage 2501-0033

8/12/2025

1.Project Information

Company:	Peterson Structural Engineers
Project Engineer:	CTN
Address:	
Phone:	M: P:
Email:	cabe.nieth@psengineers.com
Project Name:	2501-0033
Project Address:	Scappoose, Oregon
Notes:	

2.Selected Anchor Information

Selected Anchor :	HIT-RE 500 V3
Brand:	Hilti®
Material:	5/8" Ø Threaded Rod ASTM F593 Group 1 - CW1
Embedment:	h_{ef} 5.00 in h_{nom} 5 in
Approval:	ICC-ES ESR-3814
Issued/Revision:	Jan,2025 -
Drill method:	Hammer Drilled

3.Design Principles

Design Method:	ACI 318-19					
Load Combinations:	Section 5.3		User Defined Loads			
Seismic Loading:	Tension	17.10.5.3(d)	Shear	17.10.6.3(c)	Ω_o=	2

4.Base Material Information

Concrete:

Type:	Cracked		Normal Weight Concrete					
Strength	2500	psi						

Reinforcement:

Edge Reinforcement	None or < #4 Rebar			
Spacing	Tension	No (Condition B)	Shear	No (Condition B)
Controls Breakout	Tension	False	Shear	False

Base Plate:

Sizing	Thickness	0.5	in	Length	21.3	in	Width	21.5	in
Standoff	Grout Pad			Height	2	in			
Strength	36000	psi							

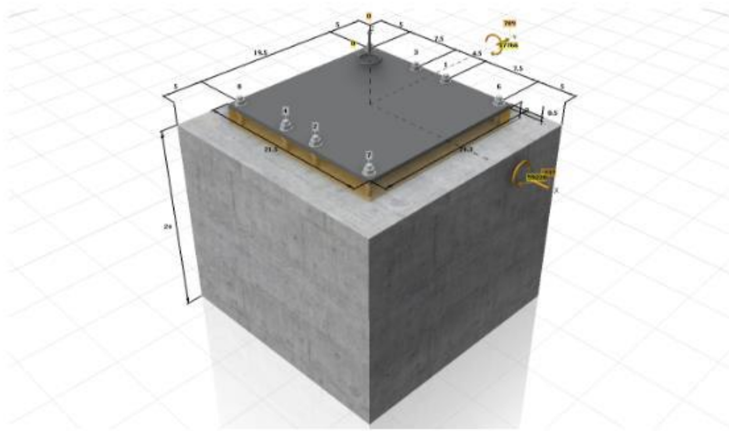
Profile: None

Hole Condition: Dry Hole

Max. Service Temperature: Long Term: 110 °F Short Term: 130 °F

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

5.Geometric Conditions



h_{slab}	24	in	h_{min}	6.500	in
Edge Cx-	5	in	c_{min}	3.125	in
Edge Cx+	5	in	c_{ac}	7.581	in
Edge Cy-	5	in	s_{min}	3.125	in
Edge Cy+	5	in			

6.Summary Results

Tension Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength:	877.92	14690.00	0.060	OK	
Concrete Breakout Strength:	3122.00	4523.00	0.690	OK	Controls
Bond Strength	3122.00	5841.00	0.534	OK	

Shear Loading

Design Proof	Demand(lb)	Capacity(lb)	Utilization	Status	Critical
Steel Strength	103.00	5207.00	0.020	OK	
Concrete Breakout Strength:	824.00	8805.00	0.094	OK	Controls
Pryout Strength	824.00	37253.00	0.022	OK	

Input data and results must be checked for agreement with the existing conditions, the standards and guidelines and must be checked for plausibility

7.Warnings and Remarks

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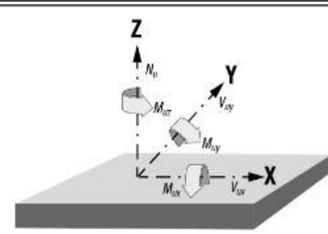
- Under these seismic conditions, the direction of shear may not be predictable. In accordance with ACI 318 the full shear force should be assumed also in reverse direction for a safe design. Load reversal may influence the direction of the controlling concrete breakout strength.

8.Load Condition

Design Loads / Actions

Nu	0.0	lb	Vux	-237.0	lb	Vuy	789.0	lb
Muz	0.0	in-lb	Mux	59220.0	in-lb	Muy	17766.0	in-lb
Consider Load Reversal			X Direction	100%		Y Direction	100%	



9.Load Distribution

Max. concrete compressive strain:	0.035	%	Anchor Eccentricity						
Max. concrete compressive stress:	150.855	psi	ex	0	in	ey	0	in
Resulting tension force:	3121.589	lb	Profile Eccentricity						
Resulting compression force:	3121.589	lb	ex	0	in	ey	0	in

Resulting anchor forces / Load distribution

Anchor	Tension Load (lb)	Shear Load (lb)	Component Shear Load (lb) Shear X	Shear Y	Anchor Coordinates (in) X	Y
1	753.81	103.0	-29.6	98.6	2.250	9.750
2	0.00	103.0	-29.6	98.6	2.250	-9.750
3	800.35	103.0	-29.6	98.6	-2.250	9.750
4	0.00	103.0	-29.6	98.6	-2.250	-9.750
5	877.92	103.0	-29.6	98.6	-9.750	9.750
6	676.24	103.0	-29.6	98.6	9.750	9.750
7	0.00	103.0	-29.6	98.6	9.750	-9.750
8	13.28	103.0	-29.6	98.6	-9.750	-9.750

Project Title:
Engineer:
Project ID:
Project Descr:

General Footing

Project File: 2025_08_19 Mat Slab Enercalc Design 2501-0033.ec6

LIC# : KW-06014167, Build:20.25.05.07 PETERSON STRUCTURAL ENGINEERS (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Equipment Mat Slab Design

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019
Load Combinations Used : ASCE 7-16

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50 ksi
fy : Rebar Yield	=	60.0 ksi
Ec : Concrete Elastic Modulus	=	2,850.0 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Soil Design Values

Allowable Soil Bearing	=	1.0 ksf
Soil Density	=	110.0 pcf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

Increases based on footing Depth

Footing base depth below soil surface	=	ft
Allow press. increase per foot of depth	=	ksf
when footing base is below	=	ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=	ksf
when max. length or width is greater than	=	ft

Dimensions

Width parallel to X-X Axis	=	30.0 ft
Length parallel to Z-Z Axis	=	16.0 ft
Footing Thickness	=	24.0 in

Load location offset from footing center...

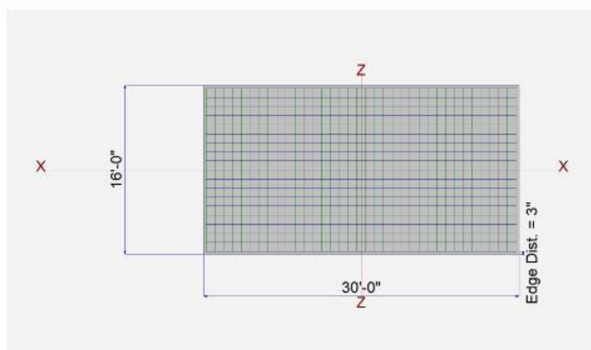
ex : Prll to X-X Axis	=	18 in
	=	in

Pedestal dimensions...

px : parallel to X-X Axis	=	in
pz : parallel to Z-Z Axis	=	in
Height	=	in

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation	Bars along Z-Z Axis
# Bars required within zone	69.6 %
# Bars required on each side of zone	30.4 %



Bottom Reinforcing

Bars parallel to X-X Axis

Number of Bars	=	19.0
Reinforcing Bar Size	=	# 6

Bars parallel to Z-Z Axis

Number of Bars	=	36.0
Reinforcing Bar Size	=	# 6

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0 in

Top Reinforcing

Bars parallel to X-X Axis

Number of Bars	=	19
Reinforcing Bar Size	=	6

Bars parallel to Z-Z Axis

Number of Bars	=	36
Reinforcing Bar Size	=	6

Rebar Centerline to Edge of Concrete...

at Top of footing	=	3.0 in

Project Title:
Engineer:
Project ID:
Project Descr:

General Footing

Project File: 2025_08_19 Mat Slab Enercalc Design 2501-0033.ec6

LIC# : KW-06014167, Build:20.25.05.07 PETERSON STRUCTURAL ENGINEERS (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Equipment Mat Slab Design

Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	62.450							k
OB : Overburden	=								ksf
M-xx	=	31.225				55.318	181.845		k-ft
M-zz	=								k-ft
V-x	=					0.0	0.0		k
V-z	=					8.846	17.611		k

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.5618	Soil Bearing	0.5618 ksf	1.0 ksf	+D+0.70E about X-X axis
PASS	5.671	Overturning - X-X	170.682 k-ft	967.92 k-ft	+0.60D+0.70E
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	2.944	Sliding - Z-Z	12.328 k	36.297 k	+0.60D+0.70E
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.4190	Z Flexure (+X) Bot Tens	20.083 k-ft/ft	47.931 k-ft/ft	+1.40D
PASS	0.4190	Z Flexure (-X) Bot Tens	20.084 k-ft/ft	47.931 k-ft/ft	+1.40D
PASS	0.1908	X Flexure (+Z) Bot Tens	9.238 k-ft/ft	48.420 k-ft/ft	+1.20D+E
PASS	0.1053	X Flexure (-Z) Bot Tens	5.10 k-ft/ft	48.420 k-ft/ft	+1.40D
PASS	0.0	Z Flexure (+X) Top Tens	0 k-ft/ft	0.0 k-ft/ft	
PASS	0.0	Z Flexure (-X) Top Tens	0 k-ft/ft	0.0 k-ft/ft	
PASS	0.0	X Flexure (+Z) Top Tens	0 k-ft/ft	0.0 k-ft/ft	
PASS	0.006996	X Flexure (-Z) Top Tens	0.3388 k-ft/ft	48.420 k-ft/ft	+0.90D+E
PASS	0.1334	1-way Shear (+X)	10.004 psi	75.0 psi	+1.40D
PASS	0.120	1-way Shear (-X)	9.0 psi	75.0 psi	+1.40D
PASS	0.09160	1-way Shear (+Z)	6.870 psi	75.0 psi	+1.20D+E
PASS	0.05326	1-way Shear (-Z)	3.994 psi	75.0 psi	+1.40D
PASS	0.3284	2-way Punching	49.266 psi	150.0 psi	+1.40D

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	1.0	n/a	1.858	0.3960	0.4443	n/a	n/a	0.444
X-X, +D+0.60W	1.0	n/a	4.465	0.3621	0.4781	n/a	n/a	0.478
X-X, +D+0.450W	1.0	n/a	3.813	0.3705	0.4697	n/a	n/a	0.470
X-X, +0.60D+0.60W	1.0	n/a	6.203	0.2037	0.3004	n/a	n/a	0.300
X-X, +D+0.70E	1.0	n/a	10.90	0.2784	0.5618	n/a	n/a	0.562
X-X, +D+0.5250E	1.0	n/a	8.640	0.3078	0.5324	n/a	n/a	0.532
X-X, +0.60D+0.70E	1.0	n/a	16.929	0.1201	0.3841	n/a	n/a	0.384
Z-Z, D Only	1.0	5.575	n/a	n/a	n/a	0.3815	0.4587	0.459
Z-Z, +D+0.60W	1.0	5.575	n/a	n/a	n/a	0.3815	0.4587	0.459
Z-Z, +D+0.450W	1.0	5.575	n/a	n/a	n/a	0.3815	0.4587	0.459
Z-Z, +0.60D+0.60W	1.0	5.575	n/a	n/a	n/a	0.2289	0.2752	0.275
Z-Z, +D+0.70E	1.0	5.575	n/a	n/a	n/a	0.3815	0.4587	0.459
Z-Z, +D+0.5250E	1.0	5.575	n/a	n/a	n/a	0.3815	0.4587	0.459
Z-Z, +0.60D+0.70E	1.0	5.575	n/a	n/a	n/a	0.2289	0.2752	0.275

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
X-X, D Only	31.225 k-ft	1,613.20 k-ft	51.664	OK
X-X, +D+0.60W	75.031 k-ft	1,613.20 k-ft	21.50	OK
X-X, +D+0.450W	64.080 k-ft	1,613.20 k-ft	25.175	OK
X-X, +0.60D+0.60W	62.541 k-ft	967.92 k-ft	15.477	OK
X-X, +D+0.70E	183.172 k-ft	1,613.20 k-ft	8.807	OK
X-X, +D+0.5250E	145.185 k-ft	1,613.20 k-ft	11.111	OK

General Footing

Project File: 2025_08_19 Mat Slab Enercalc Design 2501-0033.ec6

LIC# : KW-06014167, Build:20.25.05.07 PETERSON STRUCTURAL ENGINEERS (c) ENERCALC, LLC 1982-2025

DESCRIPTION: Equipment Mat Slab Design

Overturning Stability

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
X-X, +0.60D+0.70E	170.682 k-ft	967.92 k-ft	5.671	OK
Z-Z, D Only	None	3,118.43 k-ft	Infinity	OK
Z-Z, +D+0.60W	None	3,118.43 k-ft	Infinity	OK
Z-Z, +D+0.450W	None	3,118.43 k-ft	Infinity	OK
Z-Z, +0.60D+0.60W	None	1,871.06 k-ft	Infinity	OK
Z-Z, +D+0.70E	None	3,118.43 k-ft	Infinity	OK
Z-Z, +D+0.5250E	None	3,118.43 k-ft	Infinity	OK
Z-Z, +0.60D+0.70E	None	1,871.06 k-ft	Infinity	OK

Sliding Stability

All units k

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
X-X, D Only	0.0 k	60.495 k	No Sliding	OK
X-X, +D+0.60W	0.0 k	60.495 k	No Sliding	OK
X-X, +D+0.450W	0.0 k	60.495 k	No Sliding	OK
X-X, +0.60D+0.60W	0.0 k	36.297 k	No Sliding	OK
X-X, +D+0.70E	0.0 k	60.495 k	No Sliding	OK
X-X, +D+0.5250E	0.0 k	60.495 k	No Sliding	OK
X-X, +0.60D+0.70E	0.0 k	36.297 k	No Sliding	OK
Z-Z, D Only	0.0 k	60.495 k	No Sliding	OK
Z-Z, +D+0.60W	5.308 k	60.495 k	11.398	OK
Z-Z, +D+0.450W	3.981 k	60.495 k	15.197	OK
Z-Z, +0.60D+0.60W	5.308 k	36.297 k	6.839	OK
Z-Z, +D+0.70E	12.328 k	60.495 k	4.907	OK
Z-Z, +D+0.5250E	9.246 k	60.495 k	6.543	OK
Z-Z, +0.60D+0.70E	12.328 k	36.297 k	2.944	OK

Footing Tension on Bottom

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	6.557	+Z	Bottom	0.5184	ACI 7.6.1.1	0.5280	48.420	OK
X-X, +1.40D	5.10	-Z	Bottom	0.5184	ACI 7.6.1.1	0.5280	48.420	OK
X-X, +1.20D	5.620	+Z	Bottom	0.5184	ACI 7.6.1.1	0.5280	48.420	OK
X-X, +1.20D	4.372	-Z	Bottom	0.5184	ACI 7.6.1.1	0.5280	48.420	OK
X-X, +1.20D+0.50W	6.229	+Z	Bottom	0.5184	ACI 7.6.1.1	0.5280	48.420	OK
X-X, +1.20D+0.50W	3.763	-Z	Bottom	0.5184	ACI 7.6.1.1	0.5280	48.420	OK
X-X, +1.20D+W	6.837	+Z	Bottom	0.5184	ACI 7.6.1.1	0.5280	48.420	OK
X-X, +1.20D+W	3.155	-Z	Bottom	0.5184	ACI 7.6.1.1	0.5280	48.420	OK
X-X, +0.90D+W	5.432	+Z	Bottom	0.5184	ACI 7.6.1.1	0.5280	48.420	OK
X-X, +0.90D+W	2.062	-Z	Bottom	0.5184	ACI 7.6.1.1	0.5280	48.420	OK
X-X, +1.20D+E	9.238	+Z	Bottom	0.5184	ACI 7.6.1.1	0.5280	48.420	OK
X-X, +1.20D+E	0.7541	-Z	Bottom	0.5184	ACI 7.6.1.1	0.5280	48.420	OK
X-X, +0.90D+E	7.833	+Z	Bottom	0.5184	ACI 7.6.1.1	0.5280	48.420	OK
Z-Z, +1.40D	20.084	-X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK
Z-Z, +1.40D	20.083	+X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK
Z-Z, +1.20D	17.215	-X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK
Z-Z, +1.20D	17.214	+X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK
Z-Z, +1.20D+0.50W	17.215	-X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK
Z-Z, +1.20D+0.50W	17.214	+X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK
Z-Z, +1.20D+W	17.215	-X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK
Z-Z, +1.20D+W	17.214	+X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK
Z-Z, +0.90D+W	12.911	-X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK
Z-Z, +0.90D+W	12.911	+X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK
Z-Z, +1.20D+E	17.215	-X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK
Z-Z, +1.20D+E	17.214	+X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK
Z-Z, +0.90D+E	12.911	-X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK
Z-Z, +0.90D+E	12.911	+X	Bottom	0.5184	ACI 7.6.1.1	0.5225	47.931	OK

Footing Tension on Top

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +0.90D+E	0.3388	-Z	Top	0.5184	ACI 7.6.1.1	0.5280	48.420	OK

Project Title:
Engineer:
Project ID:
Project Descr:

General Footing

Project File: 2025_08_19 Mat Slab Enercalc Design 2501-0033.ec6

LIC# : KW-06014167, Build:20.25.05.07 PETERSON STRUCTURAL ENGINEERS

DESCRIPTION: Equipment Mat Slab Design

One Way Shear X

Load Combination...	Vu @ -X	Vu @ +X	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	9.00 psi	10.00 psi	10.00 psi	75.00 psi	0.13	OK
+1.20D	7.71 psi	8.58 psi	8.58 psi	75.00 psi	0.11	OK
+1.20D+0.50W	7.71 psi	8.58 psi	8.58 psi	75.00 psi	0.11	OK
+1.20D+W	7.71 psi	8.58 psi	8.58 psi	75.00 psi	0.11	OK
+0.90D+W	5.79 psi	6.43 psi	6.43 psi	75.00 psi	0.09	OK
+1.20D+E	7.71 psi	8.58 psi	8.58 psi	75.00 psi	0.11	OK
+0.90D+E	5.79 psi	6.43 psi	6.43 psi	75.00 psi	0.09	OK

One Way Shear Z

Load Combination...	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	3.99 psi	5.03 psi	10.00 psi	75.00 psi	0.13	OK
+1.20D	3.42 psi	4.31 psi	8.58 psi	75.00 psi	0.11	OK
+1.20D+0.50W	2.99 psi	4.74 psi	8.58 psi	75.00 psi	0.11	OK
+1.20D+W	2.56 psi	5.17 psi	8.58 psi	75.00 psi	0.11	OK
+0.90D+W	1.71 psi	4.09 psi	6.43 psi	75.00 psi	0.09	OK
+1.20D+E	0.86 psi	6.87 psi	8.58 psi	75.00 psi	0.11	OK
+0.90D+E	0.01 psi	5.79 psi	6.43 psi	75.00 psi	0.09	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	49.27 psi	150.00 psi	0.33	OK
+1.20D	42.23 psi	150.00 psi	0.28	OK
+1.20D+0.50W	42.23 psi	150.00 psi	0.28	OK
+1.20D+W	42.23 psi	150.00 psi	0.28	OK
+0.90D+W	31.67 psi	150.00 psi	0.21	OK
+1.20D+E	42.23 psi	150.00 psi	0.28	OK
+0.90D+E	31.67 psi	150.00 psi	0.21	OK