

Vertical Atmospheric Tank

Project **CEREBRO - EXEMPLOS**

Vessel Identification **Tanque-CER-ATM-05**

1 - Main Characteristics

1.1	Type	Vertical	
1.2	Operation	Atmospheric	
1.3	Useful Volume (V_{PU})	1778	L
1.4	Actual Volume (V_R)	1956	L
1.5	Total Volume (V_{TTV})	2061	L
1.6	Additional of Volume.....	10.00	%
1.7	Top Head	Toriconical ASME 6%	
1.8	Bottom Head.....	Toriconical ASME 6%	
1.9	Product maximum density	1300.00	kg/m ³
1.10	Overthickness (No Overthickness)	0.00	mm
1.11	Shell Weld Efficiency(Not Radiographed)(ϵ_c)	0.70	
1.12	Top Head Weld Efficiency(Not Radiographed)(ϵ_s)	0.70	
1.13	Bottom Head Weld Efficiency(Not Radiographed)(ϵ_i).....	0.70	

2 - Geometry

2.1	Inside Diameter (D).....	1200	mm
2.2	Cylindric Height (H).....	1500	mm
2.3	Liquid Height (H_{LL})	1343	mm
2.4	D/H ratio.....	0.80	
2.5	Shell Height (H_C).....	1480	mm
2.6	Top Head's Height (H_{TS})	179	mm
2.7	Bottom Head's Height (H_{TI}).....	643	mm
2.8	Height from bottom to ground (H_{FP})	400	mm
2.9	Vessel total height (H_{TT})	2702	mm

3 - Material

3.1	Top Head	Stainless steel - SA-240 TP 304
3.2	Shell	Stainless steel - SA-240 TP 304
3.3	Bottom Head.....	Stainless steel - SA-240 TP 304
3.4	Legs	Stainless steel - SA-240 TP 304
3.5	Base Plate	Stainless steel - SA-240 TP 304

4 - Plates Thickness

4.1	Top Head(e_{ts})	3.00	mm
4.2	Shell(e_c)	2.50	mm
4.3	Bottom Head(e_{ti})	3.00	mm
4.4	Legs(e_p)	2.11	mm
4.5	Base Plate(e_{sp}).....	5.00	mm
4.6	Overthickness	0.00	mm

5 - Finish

5.1 Tank Inside Surface..... Polished Grit 220 + Electropolishing

5.2	Tank External Surface	Polished Grit 220
5.3	Legs	Polished Grit 220

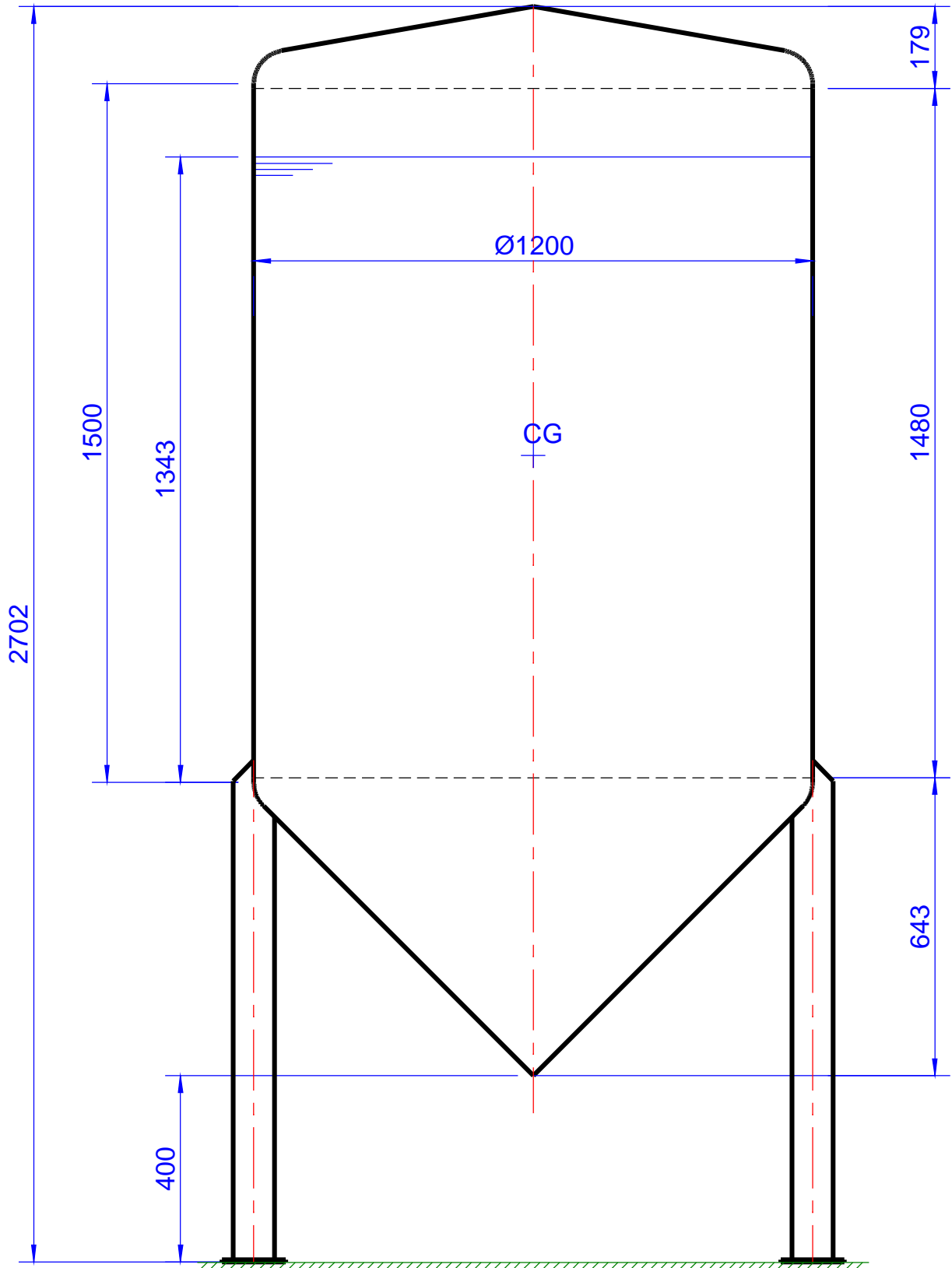
6 - Net Weight (without features)

6.1	Top Head(G_{ts})	32	kgf
6.2	Shell(G_c).....	111	kgf
6.3	Bottom Head(G_c)	42	kgf
6.4	Legs(G_p).....	20	kgf
6.5	Base Plate(G_{sp}).....	2	kgf
6.6	Empty Tank(G_v)	207	kgf
6.7	Tank with the Product(G_{tot})	2750	kgf

7 - Supporting System - Main Characteristics

7.1	Supporting	Legs	
7.2	Number of Legs	4	
7.3	Leg Type	Schedule	
7.4	Nominal dimensions	Ø3" Schedule 5s	
7.5	Leg Dimension	88.90	mm
7.6	Thickness.....	2.11	mm
7.7	Leg total height	1077.4	mm
7.8	Base Plate Type	Circular	
7.9	Base Plate Dimensions.....	Ø137.00	mm

8 - Vessel (Dimensions)



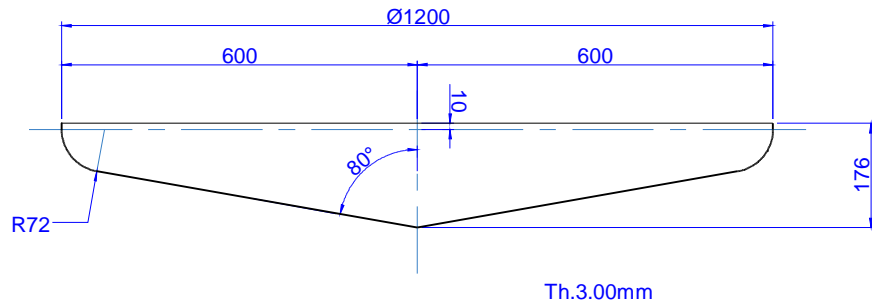
Head Report - Top

9 - Main Data

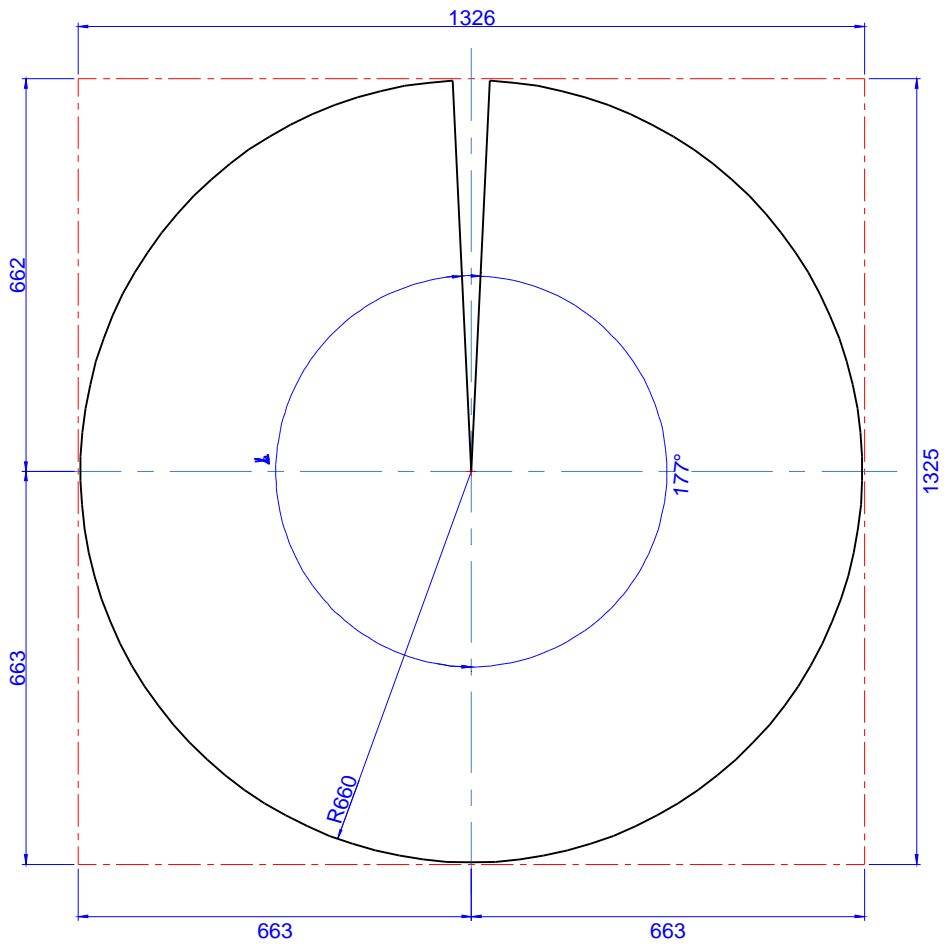
9.1	Head Type	Toriconical ASME 6%	
9.2	Inside Diameter.....	1,200	mm
9.3	Thickness.....	3.00	mm
9.4	Thin Out	0.00	mm
9.5	Material	Stainless steel - SA-240 TP 304	
9.6	Density	7,963	kg/m ³
9.7	r/D ratio	0.06	
9.8	Vertex semi-angle(α)	80	°

10 - Results

10.1	Joining radius (r)	72	mm
10.2	Knuckle height (h_1)	71	mm
10.3	Flange's Height (h_s)	10	mm
10.4	Head inside height (H_i)	176	mm
10.5	Distance from the head center to the inside-corner center (r_1)	528	mm
10.6	Cone external radius (r_2)	541	mm
10.7	Developed cone external radius (R_c).....	660	mm
10.8	Developed plate semi-angle(β)	177	°
10.9	Head total volume(v_{total})	0.117	m ³
10.10	Head Net weight (P_L)	32.13	kgf
10.11	Head gross weight (P_B)	41.97	kgf



Head: Toriconical ASME 6% (No scale)



Developed Plate (No scale)

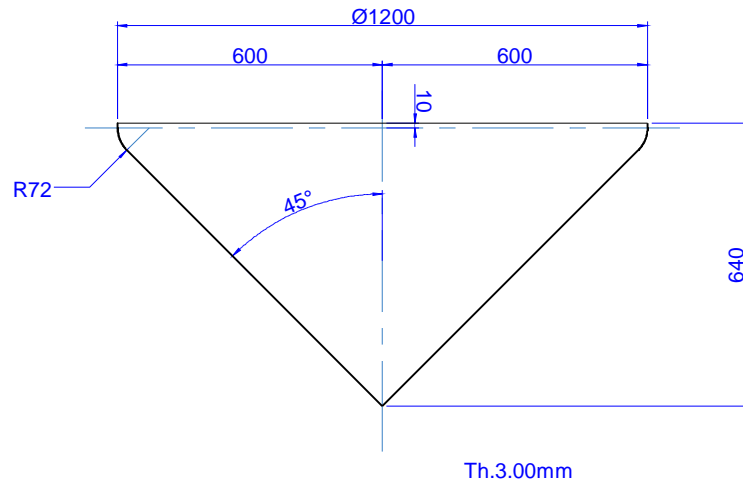
Head Report - Bottom

11 - Main Data

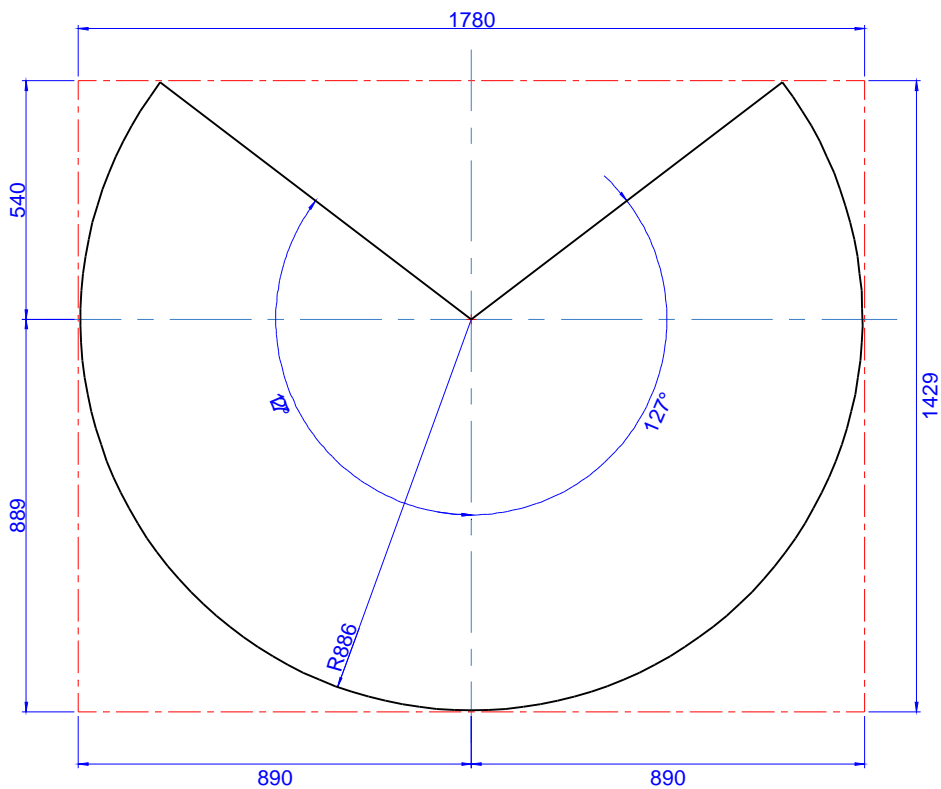
11.1	Head Type	Toriconical ASME 6%	
11.2	Inside Diameter.....	1,200	mm
11.3	Thickness.....	3.00	mm
11.4	Thin Out	0.00	mm
11.5	Material	Stainless steel - SA-240 TP 304	
11.6	Density	7,963	kg/m ³
11.7	r/D ratio	0.06	
11.8	Vertex semi-angle(α)	45	°

12 - Results

12.1	Joining radius (r)	72	mm
12.2	Knuckle height (h_1)	51	mm
12.3	Flange's Height (h_s)	10	mm
12.4	Head inside height (H_i)	640	mm
12.5	Distance from the head center to the inside-corner center (r_1)	528	mm
12.6	Cone external radius (r_2)	579	mm
12.7	Developed cone external radius (R_c).....	886	mm
12.8	Developed plate semi-angle(β)	127	°
12.9	Head total volume(v_{total})	0.271	m ³
12.10	Head Net weight (P_L)	41.59	kgf
12.11	Head gross weight (P_B)	60.76	kgf



Head: Toriconical ASME 6% (No scale)



Developed Plate (No scale)

Supporting Report

13 - Requirements in Supporting System

13.1	Wind Velocity (V_v)	0	km/h
13.2	Wind Deriving Strength (F_v)	0	kgf
13.3	Seismic Zone	0	
13.4	Seismic Empiric Coefficient (k_{ms})	0.00	
13.5	Horizontal Inertia Strength (F_{JH})	0	kgf
13.6	Horizontal Force (F_H)	0	kgf
13.7	Tumbling Momentum in LTI (M_{LTI})	0	kgf.m
13.8	Tumbling Momentum in Anchorage Point (M_b)	0	kgf.m
13.9	Legs Reaction Opposed to the Wind (F_c)	682	kgf
13.10	Legs Reaction Towards the Wind (F_T)	-682	kgf
13.11	Eccentric Strength 1 (F_{ex1})	682	kgf
13.12	Eccentric Strength 2 (F_{ex2})	-682	kgf
13.13	Lateral Strength on Legs (F_L)	0	kgf
13.14	Shaft Eccentricity (e_x)	1.50	mm

14 - Base Plate Characteristics

14.1	Base Plate Dimension(l_s)	137.00	mm
14.2	Base Plate Thickness(e_s)	5.00	mm
14.3	Admissible contact pressure between the Base Concret/Pad(δ_b)	73	kgf/cm ²
14.4	Actuating Contact Pressure between Base/Pd(p_c)	5	kgf/cm ²

15 - Welded Joint Dimensioning

15.1	Welding Fillet Unilateral Length (L_1)	136	mm
15.2	Weld Shearing Strength (F_{cs})	15.2	kgf/cm
15.3	Weld Section Linear Module (S_w)	18256	mm ²
15.4	Weld Bending Strength (F_{fs})	0.6	kgf/cm
15.5	Total Combined Strength (F_{tc})	15.2	kgf/cm
15.6	Bending Stress (σ_f)	501	kgf/cm ²
15.7	Weld Fillet width (b_w)	2.50	mm
15.8	Longitudinal Traction Stress on the Shell (σ_{LT})	-14.2	kgf/cm ²
15.9	Longitudinal Compressure Stress on the Shell (σ_{LC})	28.8	kgf/cm ²
15.10	Tension Extension Localized (L_2)	166.5	mm
15.11	Stress Located Above the Leg (σ_L)	163.8	kgf/cm ²

16 - Anchors Characteristics

16.1	Minimum area for anchor screw(A_{CH})	0.0	mm ²
16.2	Anchor screw minimum diameter(d_{CH})	8.0	mm
16.3	Anchor screws fixation diameter(D_{CH})	1208.0	mm

17 - Cylindric Pipe Data

17.1	Pipe External Diameter (d_{ep})	8.74	cm
17.2	Pipe Thickness (e_p)	0.21	cm
17.3	Pipe Material	Stainless steel - SA-240 TP 304	
17.4	Material Drainage Stress (F_y)	2109	kgf/cm ²
17.5	Material Elasticity Module (E)	1989687	kgf/cm ²

18 - Section Characteristics

18.1	Section Area (A)	5.654	cm ²
18.2	Inertia momentum (I _x)	51	cm ⁴
18.3	Resistance elastic Momentum (W _x).....	11.77	cm ³
18.4	Gyration Radius (r _x)	3.016	cm

19 - Data for Axial Compressure

19.1	Maximum length without bracing (L).....	103.282	cm
19.2	Effective Length Factor (K)	1.20	

20 - Actuating Requiring Stresses

20.1	Axial Stress Due To Loading (P _d)	681.89	kgf
20.2	Bending Momentum Due to Loading (M _d)	102.28	kgf.cm

21 - Loadings for Dimensioning

21.1	Required Axial Stress : Loading =1.4 D (P _u)	954.64	kgf
21.2	Bending Momentum Required : Loading =1.4 D (M _u)	143.20	kgf.cm

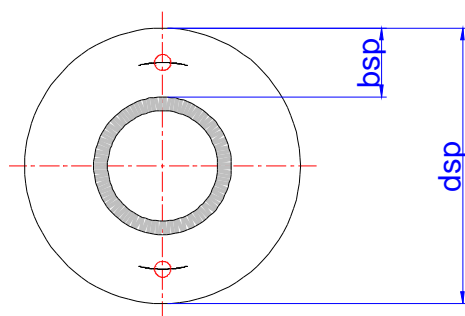
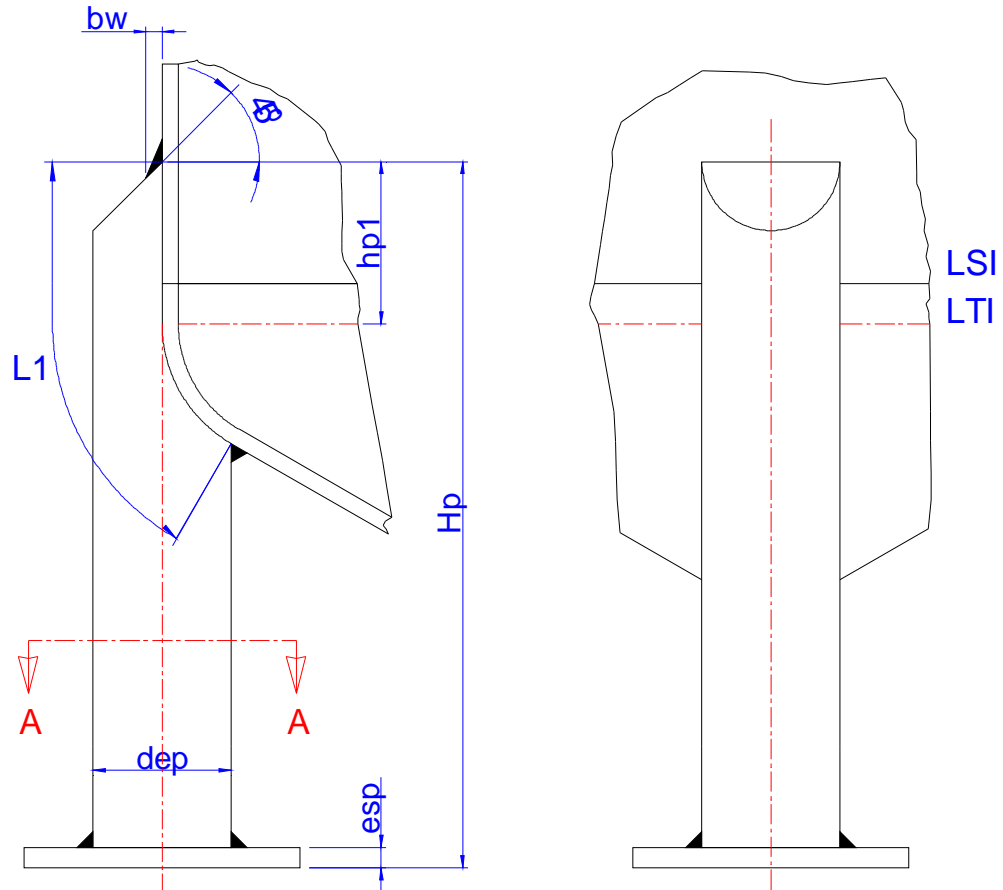
22 - Nominal Stresses For The Profile

22.1	Section C.6: $d_{ep}/e_p \leq 0,441E/F_y$ ($41.42 \leq 416.01$)	OK	
22.2	Section C.6.1	$d_{ep}/e_p \leq 0,070E/F_y$	
22.3	Φ_b	0.95	
22.4	Nominal Bending Momentum (M _n).....	31034.91	kgf.cm
22.5	Checking: $M_u/\Phi_b M_n \leq 1.0$ ($0.00 \leq 1.0$).....	OK	
22.6	Section C.4.1	Sections not subject to buckling by twisting	
22.7	λ	41.09	
22.8	Buckling Elastic Tension (F _e).....	11631.66	kgf/cm ²
22.9	Section C.6.2: Compressure of Cylindric Pipes.....	$F_e > F_y/2$	
22.10	Φ_c	0.85	
22.11	R Coefficient	0.301	
22.12	A _o	5.654	cm ²
22.13	Effective Section Area (A _e)	5.654	cm ²
22.14	Buckling Stress (F _n)	2013.59	kgf/cm ²
22.15	Nominal Axial Stress: $P_n = F_n \cdot A_e$	11384.18	kgf
22.16	Checking: $P_u/\Phi_c P_n \leq 1.0$ ($0.10 \leq 1.0$)	OK	

23 - Combination of Bending and Compressure:1.4 D

23.1	Section C.5: Combination of Axial and Bending Stress	OK	
23.2	C _{mx}	1.0	
23.3	C _{my}	1.0	
23.4	P _E	65761.59	kgf
23.5	α_{nx}	0.98	
23.6	$P_u/\Phi_c P_n + C_{mx} M_{ux}/\Phi_b M_{nx} \alpha_{nx} + C_{my} M_{uy}/\Phi_b M_{ny} \alpha_{ny} \leq 1.0$ ($0.10 \leq 1.0$)	OK	
23.7	$P_u/\Phi_c P_{no} + M_{ux}/\Phi_b M_{nx} + M_{uy}/\Phi_b M_{ny} \leq 1.0$ ($0.10 \leq 1.0$)	OK	

24 - Welded Joint Details (no scale)



Cut A-A

Dimension	Value (mm)
bsp	24.05
bw	2.50
dep	88.90
dsp	137.00
esp	5.00
Hp	1077.42
hp1	44.59
L1	136.00