DAFTAR PUSTAKA

[1] A. Devaraju and K. Pazhanivel, "a Study on Stress Analysis for Design of Pressure Vessel," *Int. J. Mech. Prod. Eng.*, vol. 1, no. 3, pp. 2320–2092, 2015.

[2] M. Rodiawati, A. Risano, and A. Udi, "Perancangan Bejana Tekan (Pressure Vessel) Untuk Pengolahan Limbah Kelapa Sawit Dengan Variabel Kapasitas Produksi 10.000 Ton/Bulan," *J. Ilm. Tek. Mesin FEMA*, vol. 1, no. 4, pp. 36–41, 2013.

[3] A. B. Setiawan, "Perancangan dan Analisa Tegangan Separator Produksi Menggunakan Software PV Elite dan Solidworks," *J. Tek. Mesin*, vol. 7, no. 2, p. 97, 2018, doi: 10.22441/jtm.v7i2.3432.

[4] S. K. Raparla, "Design and Analysis of Multilayer High Pressure Vessels Abstract :," *Int. J. Eng. Res. Appl.*, vol. 2, no. 1, pp. 355–361, 2012.

[5] E. G. Hoffman, *Jig and Fixture Design (Fifth Edition)*. Cengage Learning Canada Inc., 2004.

[6] B. E. Ball and J. C. Will, *CASTI Guidebook to ASME Section VIII*. 2002.

[7] ASME Section VIII Division 1, "ASME Boilers and Pressure Vessel Code," *ASME Sect. VIII Div. 1*, p. 717, 2019.

[8] E. Magyesy, "The ME Bookshelf: Pressure Vessel Handbook," *Mechanical Engineering*, vol. 112, no. 9. p. 90, 1990.

[9] H. Bhosale, D. S. Bedi, and A. Modasara, "Design of Vertical Pressure Vessel using PV Elite software," pp. 2147–2153, 2017.

[10] Fakhri Hermadigi, "Analisa Perhitunhan Otimum Thickness, MAWP, Tegangan Dan Lifetime pada Gas Dryer Dengan Material SAM GP. 70 Pada Proyek SPBG (Stasiun Pengisian Bahan Bakar Gas)," no. 2656, pp. 27–32, 2019.

LAMPIRAN I

	PENGADAAN 1 (SATU) UNIT LP PRODUCTION SEPARATOR DI GATHERING STATION 1 BUNYU FIELD		
DATA SHEET FOR LP 2 (TWO) PHASE PRODUCTION SEPARATOR S-116		DOC.NO	: TBA
		REV.	:
		PAGE	: OF
		FIELD AREA	: BUNYU
		LOCATION	: BUNYU
		PLANT	: GATHERING STATION 1

1	Item No.	S-116				
2	Service	LP 2 (TWO) PHASE PRODUCTION SEPARATOR				
3	No. Required.	2 (TWO)				
4	Position (Horizontal / Vertical)	HORIZONTAL				
5		**OPERATING CONDITION**				
6	Fluid	**Hydrocarbon**				
7	Capacity (Gas / Liquid)	/ 4500 BPD				
8	Pressure (Operating / Design)	30 psig / 160 psig				
9	Temperature (Operating / Design)	102 °F / 200 °F				
10	Density (Vapour/Light Liquid/Heavy Liquid)	0.151 lb/ft3 / 52.27 lb/ft3 / 62.24 lb/ft3				
11	Total Volume ft3	237.32				
12	Normal Liquid Hold-up ft3	73.64				
13	Control Range Required	LLL : 13 in	NLL : 19 in	HLL : 25 in		
14		LLLL : 7 in		HHLL : 31 in		
15		**DESIGN CONDITION**				
16	Code & Standard	ASME Section VIII Div.1 Lastest Edition				
17	ASME U-Stamp / MIGAS Certification (COI)	☑ No ☐ Yes / ☐ No ☑ Yes				
18	Special Service / Lethal Service	☑ No ☐ Yes / ☑ No ☐ Yes				
19	Shell Thickness	VTA mm				
20	Head Thickness	VTA mm				
21	Inside Diameter (ID)	59 Inch				
22	TL-TL Length	12.5 Feet				
23	Vacuum Condition (Full, Half, No), Temp	No @ 212 °F				
24	Minimum Design Metal Temperature (MDMT)	32 °F @ ATM psiG				
25	Hydrostatic / Pneumatic Test. Pressure	VTA psiG / None psiG				
26	Joint Efficiency / Radiography	1 / Full 100 % Spot : % As per code				
27	Corrosion Allowance (CA) :	Shell / Head : 3.175 Nozzles : 3.175 Welded Internals : 3.175				
28	Post Weld Heat Treatment (PWHT)	☐ Yes ☑ No As per Code				
29	Head Type	☑ 2 : 1 Ellipsoidal ☐ Conical & Flange Hemisperical Torispherical F & D				
30	Insulation	☑ N/A ☐ Hot ☐ Cold ☐ PP Thickness : N/A mm				
31	External Painting / Internal Coating	note 19 / none				
32	Fireproofing	☑ No ☐ Yes Thickness : N/A mm				
33	Droplet size (Liquid in Gas)	150 µm (Note 25, 28)				
34	Inlet Momentum	7165 lb/ft^2.s Schoepentoeter (Note 28)				
35	Wind, Seismic	AISC 7-93, AISC 341-16				
36	Important Factor	1,5				
37		**MATERIAL OF CONSTRUCTION**				
38	Shell	: SA 516 Gr.70				
39	Head	: SA 516 Gr.70				
40	Nozzle/Manhole Flanges	: SA 105				
41	Manhole/Nozzle Neck	: SA 106 Gr.B				
42	Manhole Cover	: SA 105				
43	Saddle Support	: SA 516 Gr.70				
44	Internal (Non-Removable	: SA 516 Gr.70				
45	Internal (Removable)	: SS.316L				
46	External Attachment	: SA 516 Gr.70				
47	Ladder & Platform	: ASTM A36				
48	External Bolt & Nut	: A193-B7 / A194 Gr.2H Fluoro Carbon min. thickness 35 mm				
49	Internal Bolt / Nut	: A193-B8M / A194 Gr.8M				
50	Internal Pipes	: SA 312 TP316L				
51	Internal Fittings	: SA 182 F 316 L				
52	Name Plate	: SA-240 Gr 316L				
53	Lifting Lugs	: SA 516 Gr.70				
54	Platform Floor	: Antisilp Serrated Gratings Hot Dipped Galvanized				
55	Gasket	: ASME 16.20 Spiral Wound, Inner ring SS.304, Outer ring CS graphited filled.				
56	Picking and Passivating	: All stainless steel parts				
57		**ACCESSORIES SUPPLIED BY MANUFACTURER**				
58	☑ Platform & Ladder	☑ Pipe Support Clips	☑ Manhole & Davit	☑ Vortex Breake		
59	☑ Lifting Lug	☐ Corrosion Point	☑ Earth lug			
60	☐ Internal Ladder Rung	☐ Insulation	☑ Tailing lug			
61	☑ Anchor or Setting Bolts	☑ Sliding Plate	☑ Nameplate (Note 34)			
62	☑ Toe Board	☐ Fireproofing Clip	☐ Non-Lubricant Sliding Plate			
63	☑ Inlet Diverter / Inlet Device (Note 31)	☐ Cathodic protection support	☑ On Skid Mounted			
64	☑ Wire Mesh / Mist Extractor (Note 31)	☐ Support Skirt	☑ Support Saddle (Note 29)			

65	Weight	Shipping		Empty		Operation		Test	
66		-	kg	-	kg	-	kg	-	kg

PENGADAAN 1 (SATU) UNIT LP PRODUCTION SEPARATOR DI GATHERING STATION 1 BUNYU FIELD

DATA SHEET FOR LP 2 (TWO) PHASE PRODUCTION SEPARATOR S-116

DOC.NO	: TBA
REV.	:
PAGE	: O
FIELD AREA	: BUNYU
LOCATION	: BUNYU
PLANT	: GATHERING STATION 1

Item No. : S-116 Service : **HYDROCARBON**

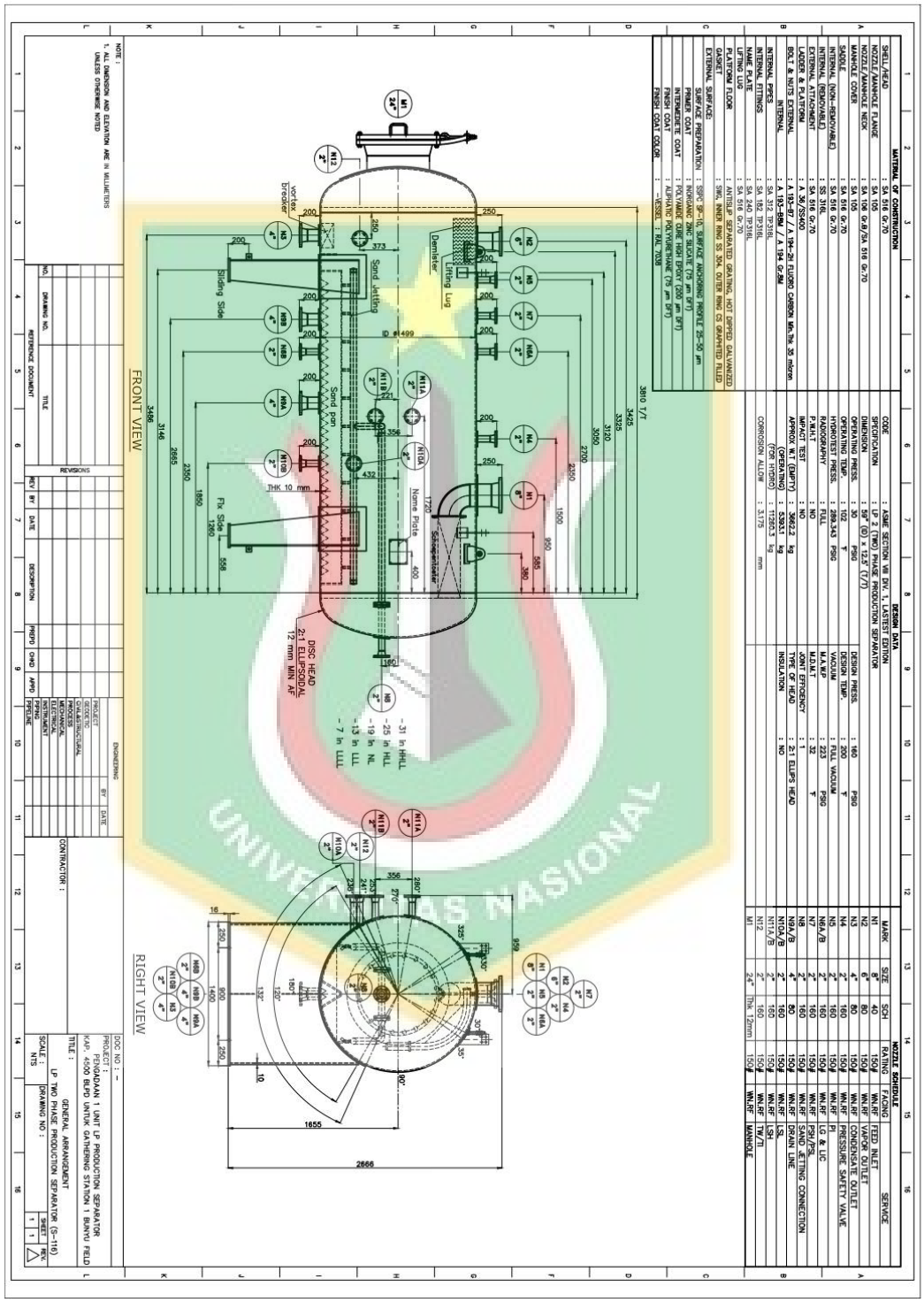
NOZZLE SCHEDULE

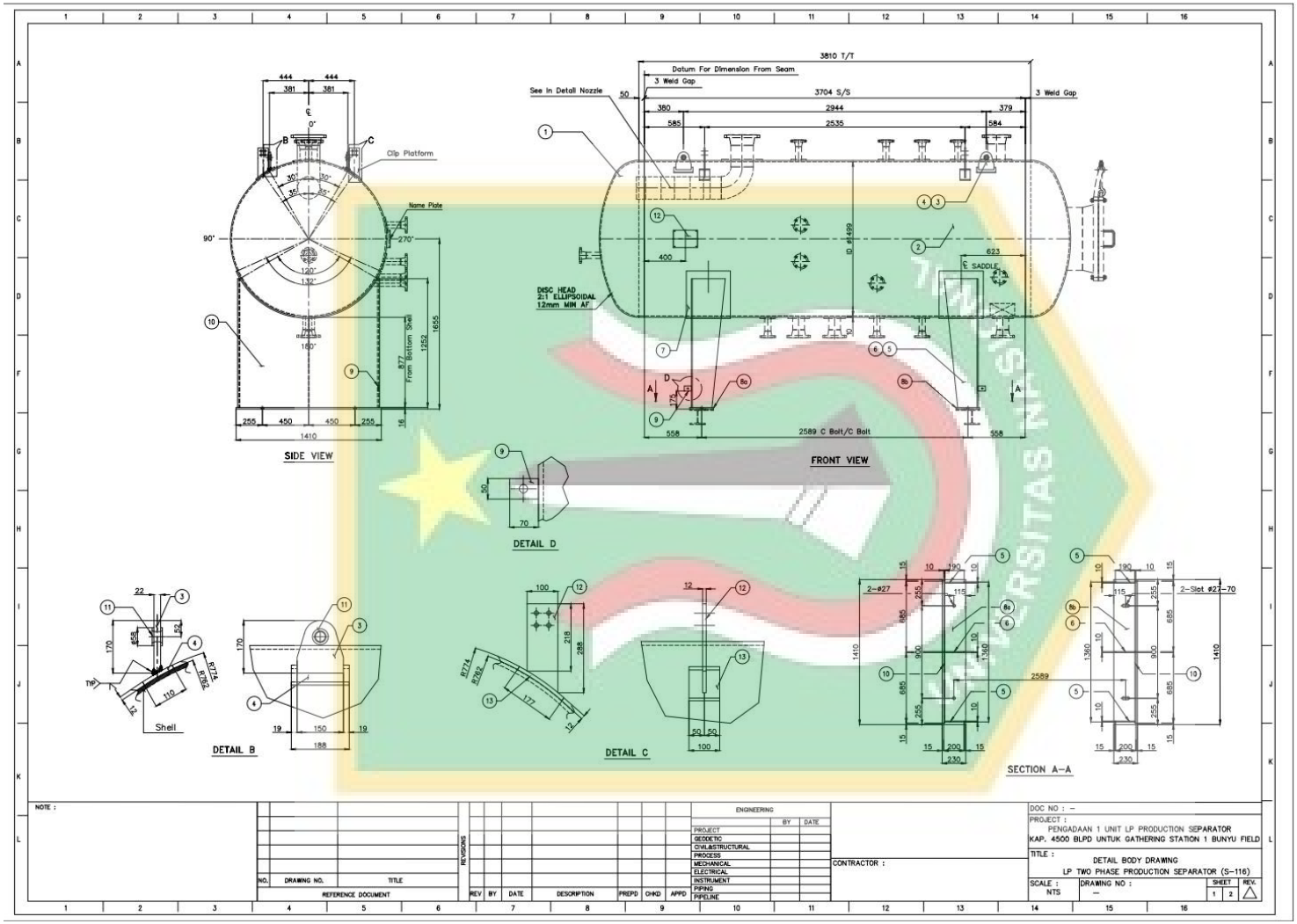
Mark	Size (Inch)	Service	Qty	Rating	Facing	Type	Sch.No	Remarks
N1	8	Feed Inlet	1	150#	RF	WN	40	C/w Inlet Diverter Schoepentoeter (Note 26)
N2	6	Vapor Outlet	1	150#	RF	WN	80	C/w Wire Mesh (Note 28)
N3	4	Condensate Outlet	1	150#	RF	WN	80	C/w Vortex Breaker (Note 28)
N4	2	Pressure Safety Valve	1	150#	RF	WN	160	
N5	2	PI Connection	1	150#	RF	WN	160	
N6 A/B	2	LG, LIC	2	150#	RF	WN	160	(Note 32)
N7	2	PSH, PSL Connection	1	150#	RF	WN	160	
N8	2	Utility Connection	1	150#	RF	WN	160	Jetting line source located at vessel head (Note 26, 27)
N9 A/B	4	Drain Line	2	150#	RF	WN	80	liquid draining and sand jetting
N10 A/B	2	LSL	2	150#	RF	WN	160	(Note 32)
N11 A/B	2	LSH	2	150#	RF	WN	160	(Note 32)
N12	2	TW/TI	1	150#	RF	WN	160	
M1	24	Manhole	1	150#	RF	WN	12mm	C/w Davit

NOTES

1). Vendor shall determine the required minimum thickness and guarantee them on mechanical strength, considering design pressure and sum of allowances.
2). All dimensions are in millimiters, unless otherwise noted. Dimension shown are minimum requirement, vendor to verify.
3). Nozzle projections are measured from the vessel axis to the flange face.
4). Flange-bolt-holes shall straddle the principal centerlines of the vessel
5). Bolted connections shall not have counter nuts unless otherwise stated.
6). All welds are continuous unless otherwise stated.
7). Nozzle neck thicknesses and reinforcements shall be determined and sized by Vendor.
8). Nozzle reinforcement pads shall be provided with a tell tale hole 1/4" NPT with plug.
9). Vendor shall supply and install all items shown or referenced on this data sheet, unless otherwise noted
10). All internal parts shall be removable thru manhole.
11). For all pressure parts (plates, heads, nozzles, flanges, etc.) as well as for supports (skirts, saddles, legs), Vendor shall provide material test certificates.
Material certificate shall conform to NF EN 10024 (CCPU 3.1B) and EN 10204 2.2 for non-pressure parts.
12). Vessel shall be designed to withstand external loading due to piping for all process nozzle (excluding utilities nozzles). Local stress analysis shall be performed by vendor.
13). Vessel safety devices and local instrumentation shall be refers to instrument datasheet.
14). Mechanical and process performance guarantee are vendor responsible.
15). Vendor to verify/specify data at location marked with VTA/VTS.
16). Vendor to calculate and furnish the exact weight.
17). Vendor to advice the dimension of filter and all nozzles.
18). Nozzle neck and shell thickness indicate only. Vendor shall verify the thickness indicated in this datasheet based on mechanical strength calculation during detail engineering phase. Vendor shall use the thicker thickness.
19). Pressure vessel shall be painted with as per specification below :
a. Vessel external surface :
Surface Preparation : SSPC SP-10, surface anchoring profile 25-50 µm
Primer Coat : Inorganic Zinc Silicate (75 µm DFT)
Intermediete Coat : Polyamide Cure High Epoxy (200 µm DFT)
Finish Coat : Aliphatic Polyurethane (75 µm DFT)
b. Vessel colour coding and identification shall be refers to document no. A-007/A2.4/EP2200/2014-S0 Spesifikasi Kode Warna Idendtifikasi Untuk Tangki dan Vessel (Clolor : Light Grey RAL 7038)

LAMPIRAN II


MATERIAL OF CONSTRUCTION
SHELL/HEAD : SA 516 Gr.70
NOZZLE/MANHOLE FLANGE : SA 105
NOZZLE/MANHOLE NECK : SA 106 Gr.B/SA 516 Gr.70
MANHOLE COVER : SA 516 Gr.70
SADDLE : SA 516 Gr.70
INTERNAL (NON-REMOVABLE) : SA 516 Gr.70
INTERNAL (REMOVABLE) : SS 316L
EXTERNAL ATTACHMENT : SA 516 Gr.70
LADDER & PLATFORM : A 36/SS400
BOLT & NUTS EXTERNAL : A 193-B7M / A 194-2H ELLIPS CARBON Min.Thk 35 micron
INTERNAL : SA 193-B8M / A 194 Gr.8M
INTERNAL PIPES : SA 312 TP316L
INTERNAL FITTINGS : SA 182 TP316L
NAME PLATE : SA 240 TP316L
LIFTING LUG : SA 516 Gr.70
PLATFORM FLOOR : WALKWAY GRATING : HOT DIPPED GALVANISED
GASKET : SWG, INNER RING SS 304, OUTER RING CS GRAPHITED FILLED
EXTERNAL SURFACE:
SURFACE PREPARATION : SSPC SP-10, SURFACE ANCHORING PROFILE 25-50 µm
PRIMER COAT : INORGANIC ZINC SILICATE (75 µm DFT)
INTERMEDIATE COAT : POLYAMIDE EPOXY HIGH BUILD (200 µm DFT)
FINISH COAT : POLYURETHANE (75 µm DFT)
FINISH COAT COLOR : VESSEL : RAL 7038
DESIGN DATA
CODE : ASME SECTION VIII DIV. 1, LASTEST EDITION
SPECIFICATION : LP 2 (TWO) PHASE PRODUCTION SEPARATOR
OPERATING PRESS. : 30 PSIG
OPERATING TEMP. : 102 °F
HYDROTEST PRESS. : 289.343 PSIG
RADIOGRAPHY : FULL
P.W.H.T : NO
IMPACT TEST : NO
APPROX (EMPTY) : 5082.3 kg
APPROX (OPERATING) : 5398.1 kg
(FOR HYDRO) : 11280.3 kg
CORROSION ALLOW : 3.175 mm
DESIGN PRESS. : 140 PSIG
DESIGN TEMP. : 200 °F
VACUUM : FULL VACUUM
M.A.W.P : 223 PSIG
M.D.M.T : 32 °F
JOINT EFFICIENCY : 1
TYPE OF HEAD : 2:1 ELLIPS HEAD
INSULATION : NO
NOZZLE SCHEDULE
MARK | SIZE | SCH | RATING | FACING | SERVICE
N1 | 8" | 40 | 150# | WN.RF | FEED INLET
N2 | 4" | 80 | 150# | WN.RF | WATER OUTLET
N3 | 4" | 80 | 150# | WN.RF | CONDENSATE OUTLET
N4 | 2" | 160 | 150# | WN.RF | PRESSURE SAFETY VALVE
N5 | 2" | 160 | 150# | WN.RF | PI
N6A/B | 2" | 160 | 150# | WN.RF | LG & LIC
N7 | 2" | 160 | 150# | WN.RF | PSH/PSL
N8 | 2" | 160 | 150# | WN.RF | SAND JETTING CONNECTION
N10A/B | 2" | 160 | 150# | WN.RF | DRAIN LINE
N11A/B | 2" | 160 | 150# | WN.RF | LSL
N12 | 2" | 160 | 150# | WN.RF | LSH
M1 | 24" Thk 12mm | | 150# | WN.RF | TW/TI
MANHOLE
3810 T/T
3425
3325
3120
3050
2700
2350
1500
950
585
380
250
200
373
280
ID ø1499
Demister
Lifting Lug
Sand Jetting
Sand Jetting
Sliding Side
Vortex Breaker
Name Plate
Thermowell
THK 10 mm
Fix Side
1720
400
432
356
558
3260
3486
3146
2665
2350
1850
DISC HEAD
2:1 ELLIPSODAL
12 mm MIN AF
- 31 in HHLL
- 25 in HLL
- 19 in NL
- 13 in LL
- 7 in LLL
FRONT VIEW
RIGHT VIEW
356
280°
270°
241°
230°
335°
35°
959
16
350
1400
800
250
10
90°
180°
120°
132°
1655
2666
NOTE :
1. ALL DIMENSION AND ELEVATION ARE IN MILLIMETERS UNLESS OTHERWISE NOTED
REVISIONS
NO. | DRAWING NO. | REFERENCE DOCUMENT | TITLE | REV | BY | DATE | DESCRIPTION | PREPD | CHKD | APPD
ENGINEERING
PROJECT | BY | DATE
PROCESS
CIVIL&STRUCTURAL
MECHANICAL
ELECTRICAL
INSTRUMENT
PIPELINE
CONTRACTOR :
DOC NO : --
PROJECT :
PENGADAAN 1 UNIT LP PRODUCTION SEPARATOR KAP. 4500 BLPD UNTUK GATHERING STATION 1 BUNYU FIELD
TITLE :
GENERAL ARRANGEMENT
LP TWO PHASE PRODUCTION SEPARATOR (S-116)
SCALE : NTS
DRAWING NO :
SHEET | REV.
1 | 1 | 0



NOTE :

NO.	DRAWING NO.	TITLE
REFERENCE DOCUMENT		

REV	BY	DATE	DESCRIPTION	PREPD	CHKD	APPD
REVISIONS						

ENGINEERING	BY	DATE
PROJECT		
GEODETIC		
CIVIL&STRUCTURAL		
PROCESS		
MECHANICAL		
ELECTRICAL		
INSTRUMENT		
PIPING		
PIPELINE		

CONTRACTOR :

DOC NO : --

PROJECT :
PENGADAAN 1 UNIT LP PRODUCTION SEPARATOR
KAP. 4500 BLPD UNTUK GATHERING STATION 1 BUNYU FIELD

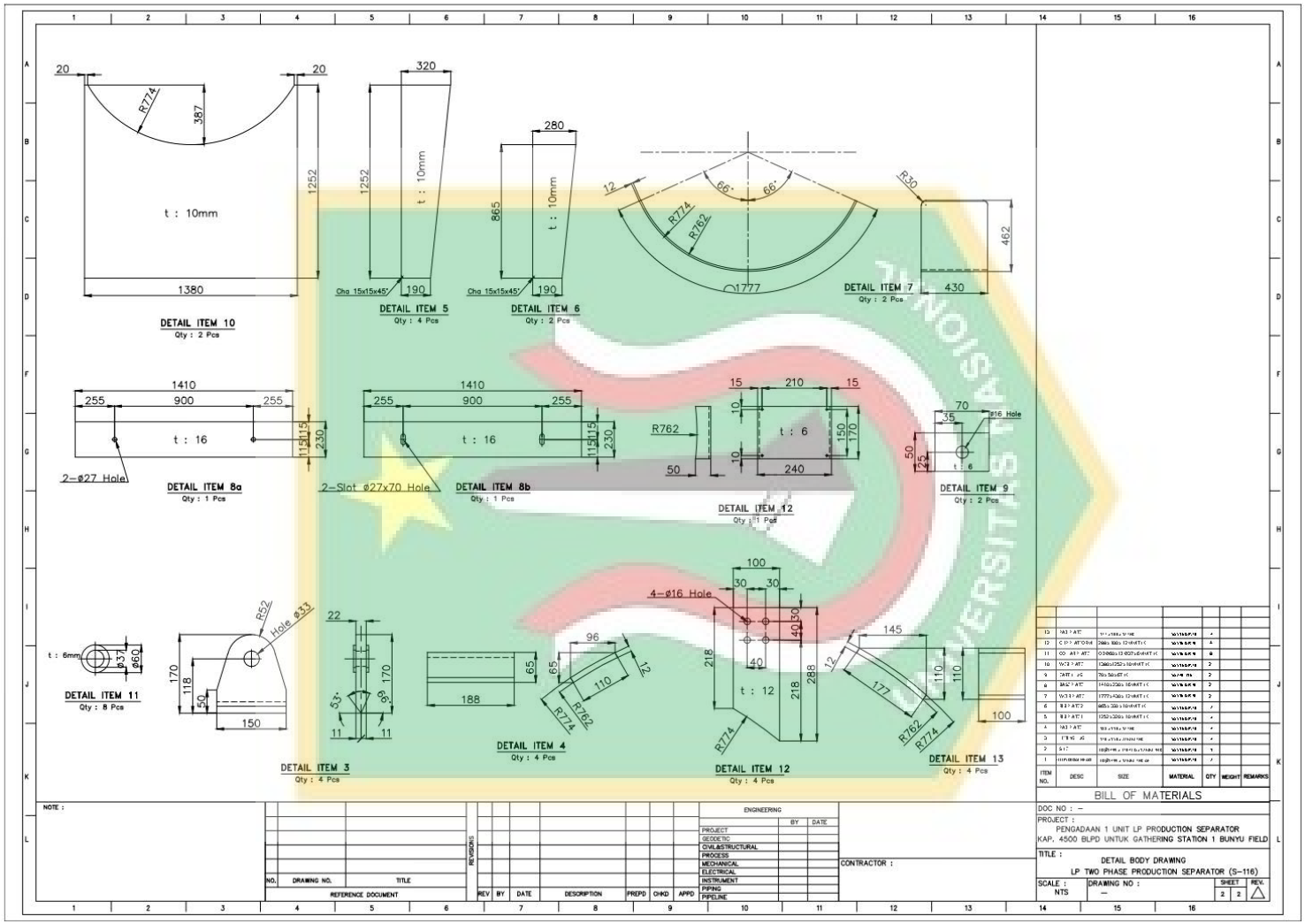
TITLE :
DETAIL BODY DRAWING
LP TWO PHASE PRODUCTION SEPARATOR (S-116)

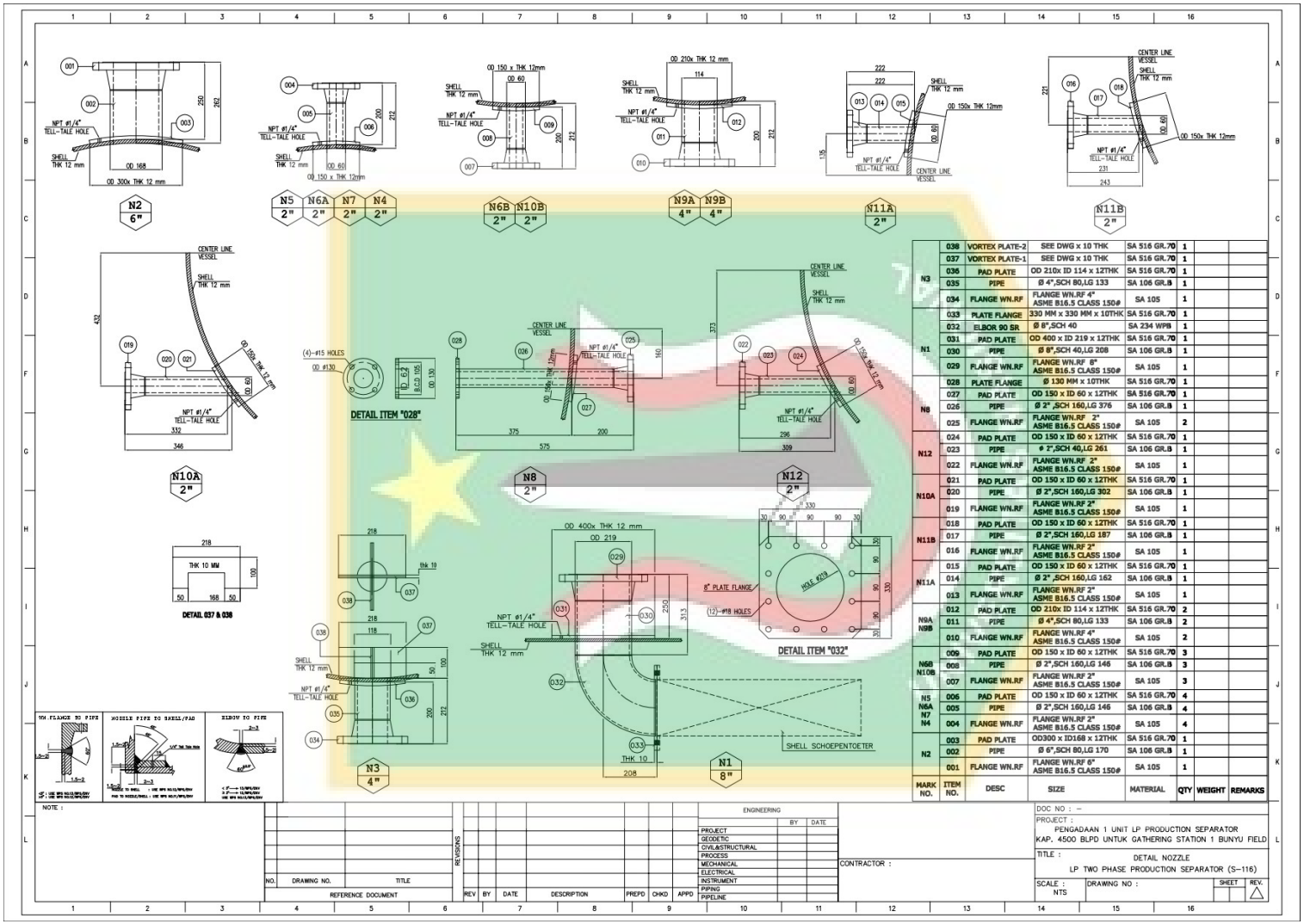
SCALE : NTS

DRAWING NO : --

SHEET 1 2

REV.


DETAIL ITEM 10
Qty : 2 Pcs
DETAIL ITEM 5
Qty : 4 Pcs
DETAIL ITEM 6
Qty : 2 Pcs
DETAIL ITEM 7
Qty : 2 Pcs
DETAIL ITEM 8a
Qty : 1 Pcs
DETAIL ITEM 8b
Qty : 1 Pcs
DETAIL ITEM 12
Qty : 1 Pcs
DETAIL ITEM 9
Qty : 2 Pcs
DETAIL ITEM 11
Qty : 8 Pcs
DETAIL ITEM 3
Qty : 4 Pcs
DETAIL ITEM 4
Qty : 4 Pcs
DETAIL ITEM 12
Qty : 4 Pcs
DETAIL ITEM 13
Qty : 4 Pcs
BILL OF MATERIALS
NOTE :
REFERENCE DOCUMENT
REVISIONS
ENGINEERING
PROJECT
GEODETIC
CIVIL&STRUCTURAL
PROCESS
MECHANICAL
ELECTRICAL
INSTRUMENT
PIPING
PIPELINE
CONTRACTOR :
DOC NO : –
PROJECT :
PENGADAAN 1 UNIT LP PRODUCTION SEPARATOR
KAP. 4500 BLPD UNTUK GATHERING STATION 1 BUNYU FIELD
TITLE :
DETAIL BODY DRAWING
LP TWO PHASE PRODUCTION SEPARATOR (S–116)
SCALE : NTS
DRAWING NO : –
SHEET 2 2
REV.



MARK NO.	ITEM NO.	DESC	SIZE	MATERIAL	QTY	WEIGHT	REMARKS
N3	038	VORTEX PLATE-2	SEE DWG x 10 THK	SA 516 GR.70	1		
	037	VORTEX PLATE-1	SEE DWG x 10 THK	SA 516 GR.70	1		
	036	PAD PLATE	OD 210x ID 114 x 12THK	SA 516 GR.70	1		
	035	PIPE	Ø 4",SCH 80,LG 133	SA 106 GR.B	1		
	034	FLANGE WN.RF	FLANGE WN.RF 4" ASME B16.5 CLASS 150ø	SA 105	1		
N1	033	PLATE FLANGE	330 MM x 330 MM x 10THK	SA 516 GR.70	1		
	032	ELBOR 90 SR	Ø 8",SCH 40	SA 234 WPB	1		
	031	PAD PLATE	OD 400 x ID 219 x 12THK	SA 516 GR.70	1		
	030	PIPE	Ø 8",SCH 40,LG 208	SA 106 GR.B	1		
	029	FLANGE WN.RF	FLANGE WN.RF 8" ASME B16.5 CLASS 150ø	SA 105	1		
N8	028	PLATE FLANGE	Ø 130 MM x 10THK	SA 516 GR.70	1		
	027	PAD PLATE	OD 150 x ID 60 x 12THK	SA 516 GR.70	1		
	026	PIPE	Ø 2",SCH 160,LG 376	SA 106 GR.B	1		
	025	FLANGE WN.RF	FLANGE WN.RF 2" ASME B16.5 CLASS 150ø	SA 105	2		
N12	024	PAD PLATE	OD 150 x ID 60 x 12THK	SA 516 GR.70	1		
	023	PIPE	ø 2",SCH 40,LG 261	SA 106 GR.B	1		
	022	FLANGE WN.RF	FLANGE WN.RF 2" ASME B16.5 CLASS 150ø	SA 105	1		
N10A	021	PAD PLATE	OD 150 x ID 60 x 12THK	SA 516 GR.70	1		
	020	PIPE	Ø 2",SCH 160,LG 302	SA 106 GR.B	1		
	019	FLANGE WN.RF	FLANGE WN.RF 2" ASME B16.5 CLASS 150ø	SA 105	1		
N11B	018	PAD PLATE	OD 150 x ID 60 x 12THK	SA 516 GR.70	1		
	017	PIPE	Ø 2",SCH 160,LG 187	SA 106 GR.B	1		
	016	FLANGE WN.RF	FLANGE WN.RF 2" ASME B16.5 CLASS 150ø	SA 105	1		
N11A	015	PAD PLATE	OD 150 x ID 60 x 12THK	SA 516 GR.70	1		
	014	PIPE	Ø 2" ,SCH 160,LG 162	SA 106 GR.B	1		
	013	FLANGE WN.RF	FLANGE WN.RF 2" ASME B16.5 CLASS 150ø	SA 105	1		
N9A N9B	012	PAD PLATE	OD 210x ID 114 x 12THK	SA 516 GR.70	2		
	011	PIPE	Ø 4",SCH 80,LG 133	SA 106 GR.B	2		
	010	FLANGE WN.RF	FLANGE WN.RF 4" ASME B16.5 CLASS 150ø	SA 105	2		
N6B N10B	009	PAD PLATE	OD 150 x ID 60 x 12THK	SA 516 GR.70	3		
	008	PIPE	Ø 2",SCH 160,LG 146	SA 106 GR.B	3		
	007	FLANGE WN.RF	FLANGE WN.RF 2" ASME B16.5 CLASS 150ø	SA 105	3		
N5 N6A N7 N4	006	PAD PLATE	OD 150 x ID 60 x 12THK	SA 516 GR.70	4		
	005	PIPE	Ø 2",SCH 160,LG 146	SA 106 GR.B	4		
	004	FLANGE WN.RF	FLANGE WN.RF 2" ASME B16.5 CLASS 150ø	SA 105	4		
N2	003	PAD PLATE	OD300 x ID168 x 12THK	SA 516 GR.70	1		
	002	PIPE	Ø 6",SCH 80,LG 170	SA 106 GR.B	1		
	001	FLANGE WN.RF	FLANGE WN.RF 6" ASME B16.5 CLASS 150ø	SA 105	1		

NOTE :

NO.	DRAWING NO.	TITLE
REFERENCE DOCUMENT		

REV	BY	DATE	DESCRIPTION	PREPD	CHKD	APPD
REVISIONS						

ENGINEERING	BY	DATE
PROJECT		
GEODETIC		
CIVIL&STRUCTURAL		
PROCESS		
MECHANICAL		
ELECTRICAL		
INSTRUMENT		
PIPING		
PIPELINE		

CONTRACTOR :

DOC NO : –

PROJECT :
PENGADAAN 1 UNIT LP PRODUCTION SEPARATOR
KAP. 4500 BLPD UNTUK GATHERING STATION 1 BUNYU FIELD

TITLE :
DETAIL NOZZLE
LP TWO PHASE PRODUCTION SEPARATOR (S–116)

SCALE : NTS | DRAWING NO : | SHEET | REV.

LAMPIRAN III

18

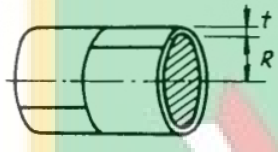
INTERNAL PRESSURE

FORMULAS IN TERMS OF INSIDE DIMENSIONS

NOTATION

P = Design pressure or max. allowable working pressure psi
S = Stress value of material psi, page 189
E = Joint efficiency, page 172
R = Inside radius, inches
D = Inside diameter, inches
t = Wall thickness, inches
$C.A.$ = Corrosion allowance, inches

A

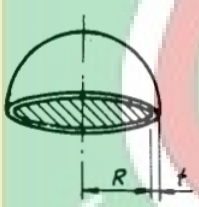


CYLINDRICAL SHELL (LONG SEAM)[1]

$$t = \frac{PR}{SE - 0.6P} \qquad P = \frac{SE\,t}{R + 0.6t}$$

1. Usually the stress in the long seam is governing. See preceding page.
2. When the wall thickness exceeds one half of the inside radius or P exceeds 0.385 SE, the formulas given in the Code Appendix 1-2 shall be applied.

B

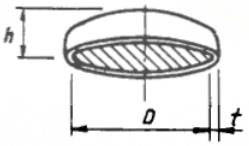


SPHERE and HEMISPHERICAL HEAD

$$t = \frac{PR}{2SE - 0.2P} \qquad P = \frac{2SE\,t}{R + 0.2t}$$

1. For heads without a straight flange, use the efficiency of the head to shell joint if it less than the efficiency of the seams in the head.
2. When the wall thickness exceeds 0.356 R or P exceeds 0.665 SE, the formulas given in the Code Appendix 1-3, shall be applied.

C



h = D/4

2:1 ELLIPSOIDAL HEAD

$$t = \frac{PD}{2SE - 0.2P} \qquad P = \frac{2SEt}{D + 0.2t}$$

1. For ellipsoidal heads, where the ratio of the major and minor axis is other than 2:1, see Code Appendix 1-4(c).

TABLES

For quick comparison of required plate thickness and weight for various materials and at a different degree of radiographic examination.

A Stress values at temperature –20° to 500 °F.

	SA 285 C	SA 53 B SA 515-60 SA 516-60	SA 515-70 SA 516-70
85% J. E.	13,345	14,535	17,000
100% J. E.	15,700	17,100	20,000

B Ratios of Stress Values

	13,345	14,535	15,700	17,000	17,100	20,000
13,345	–	1.09	1.18	1.27	1.28	1.49
14,535	0.92	–	1.08	1.17	1.18	1.37
15,700	0.85	0.92	–	1.08	1.09	1.27
17,000	0.79	0.86	0.93	–	1.01	1.18
17,100	0.78	0.85	0.92	0.99	–	1.17
20,000	0.67	0.73	0.79	0.85	0.86	–

Table **A** shows the stress value of the most frequently used shell and head materials.

Table **B** shows the ratios of these stress values.

EXAMPLE:

1. For a wessel using SA 515-70 plate, when spot radiographed, the required thickness 0.4426 inches and the weight of the vessel 12600 lbs.

2. What plate thickenss will be required, and what will the weight of the vessel be using SA 285-C plate and full radiographic examination:

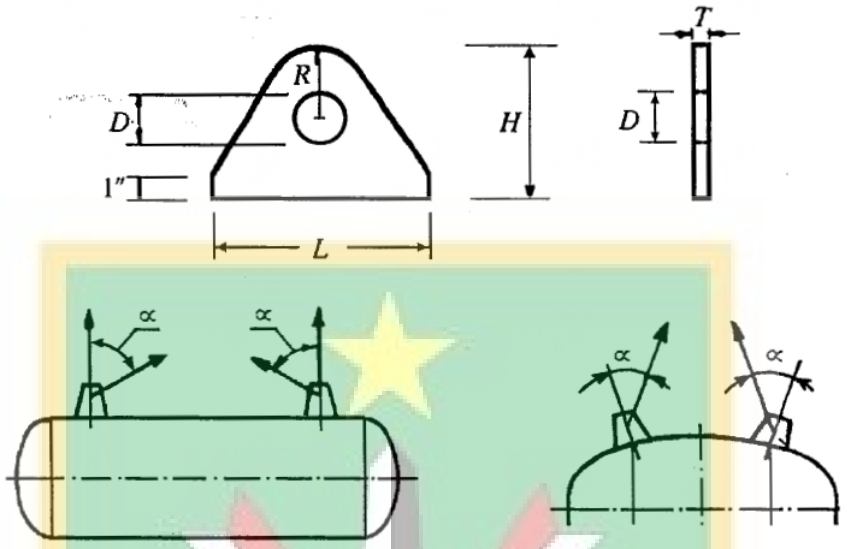
   In case 1. The stress value of the material 17,000
   In case 2. The stress value of the material 15,700

The ratio of the two stress values from Table B=1.08 In this proportion the required plate thickness and the weight of the vessel will be increased.

$0.4426 \times 1.08 = 0.4780$ in.

$12600 \times 1.08 = 13608$ lb.

LIFTING LUG

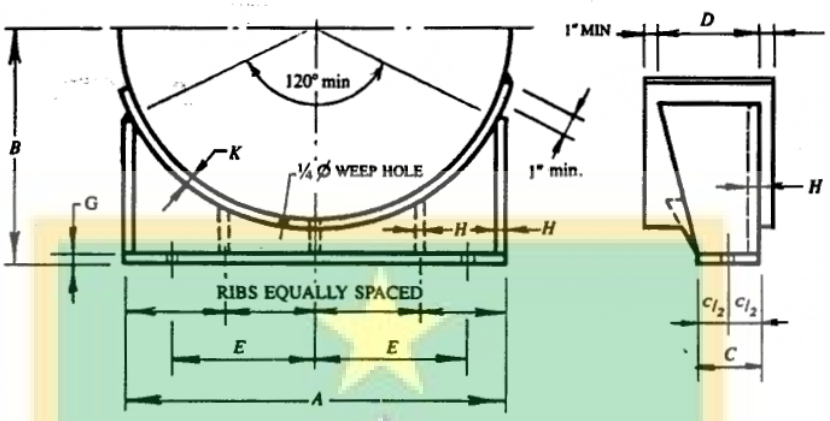


VESSEL WEIGHT (Lbs)	D (In)	T (In)	R (In)	H (In)	L (In)	WELD (Min)
12,000	1	½	1½	5	10	Double-bevel groove weld with T/4 (max. 3/8 in.) fillet weld all around.
20,000	1 1/8	¾	2	6	10	
30,000	1 3/8	1	2 1/8	6	10	
50,000	1 5/8	1¼	2½	7	12	
70,000	2 1/8	1¼	3½	8	12	
100,000	2½	1½	4½	9	16	
150,000	3	1¾	5	10	16	
200,000	4	2	6	12	18	
250,000	4¼	2	6½	13	18	
300,000	4½	2½	7	14	20	

Notes:

1. All dimensions are in inches.
2. The design is based on conditions:
   a. $\alpha = 45^{\circ}$ maximum
   b. Minimum tensile strength of lug material 70,000 psi.
   c. Direction of force is in the plane of lugs.

SADDLE
FOR SUPPORT OF HORIZONTAL VESSELS



The design based on:

1. the vessel supported by two saddles
2. to resist horizontal force *(F)* due to the maximum operating weight of vessel as tabulated.
3. the maximum allowable stress is ⅔ of the compression yield point: ⅔ of 30,000 = 20,000 psi.
4. the maximum allowable load on concrete foundation 500 psi.
5. the minimum contact angle of shell and saddle 120°.

Weld: ¼" continuous fillet weld all contacting plate edges.

Drill and tap ¼" weep holes in wear plate.

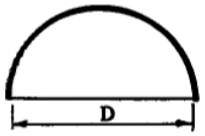
At the sliding saddle the nuts of the anchor bolts shall be hand-tight and secured by tack welding.

SEE FACING PAGE FOR DIMENSIONS

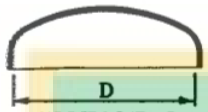
SADDLE

NOMINAL DIAM. OF VESSEL FT. - IN.	DIMENSIONS						NO. OF RIBS	PLATE THICKNESS INCHES			MAXIMUM WEIGHT ON VESSEL
	A FT. - IN.	B FT. - IN.	C IN.	D IN.	E FT. - IN.	BOLT DIAM. INCH		BASE G	WEB, FLANGE, RIBS H	WEAR K	
1-0	0-10½	1-0	4	4	0-3½	½	0	¼	¼	—	42000
1-2	1-½	1-1	4	4	0-4	½	0	¼	¼	—	50000
1-4	1-2	1-2	4	4	0-5	½	0	¼	¼	—	56000
1-6	1-3½	1-3	4	4	0-6	½	0	¼	¼	—	62000
1-8	1-5½	1-4	4	4	0-6½	½	0	¼	¼	—	70000
1-10	1-7	1-5	4	6	0-7	½	0	¼	¼	—	76000
2-0	1-9	1-6	4	6	0-7½	½	0	¼	¼	—	84000
2-2	1-10½	1-7	4	6	0-8	½	0	¼	¼	¼	90000
2-4	2-½	1-8	4	6	0-8½	½	0	½	¼	¼	98000
2-6	2-2	1-9	4	6	0-9	½	0	½	¼	¼	104000
2-8	2-4	1-10	4	6	0-9½	½	0	½	¼	¼	112000
2-10	2-5	1-11	6	11	0-10	½	0	½	¼	¼	128000
3-0	2-6½	2-0	6	11	0-11	½	0	½	¼	¼	134000
3-2	2-9	2-1	6	11	1-0	¾	0	½	¼	¼	144000
3-4	2-11	2-2	6	11	1-1	¾	0	½	5/16	5/16	210000
3-6	3-½	2-3	6	11	1-2	¾	0	½	5/16	5/16	220000
4-0	3-6	2-6	6	11	1-4	¾	0	¾	5/16	5/16	252000
4-6	3-11	3-0	6	11	1-6	¾	0	¾	5/16	5/16	282000
5-0	4-4	3-3	6	11	1-8	¾	1	¾	5/16	5/16	312000
5-6	4-9½	3-6	6	11	1-10	¾	1	¾	5/16	5/16	344000
6-0	5-2½	3-9	9	18	2-0	¾	1	¾	5/16	5/16	402000
6-6	5-8	4-0	9	18	2-2	¾	1	¾	½	5/16	436000
7-0	6-1	4-3	9	18	2-4	1	1	¾	½	5/16	470000
7-6	6-6	4-6	9	18	2-6	1	1	¾	½	5/16	502000
8-0	6-11½	4-9	9	18	2-8	1	1	1	½	5/16	536000
8-6	7-4½	5-0	9	18	2-10	1	2	1	½	½	760000
9-0	7-9½	5-3	9	18	3-0	1	2	1	½	½	806000
9-6	8-3½	5-6	9	24	3-2	1¼	2	1	¾	½	852000
10-0	8-8	5-9	9	24	3-4	1¼	2	1	¾	½	896000
10-6	9-1½	6-0	9	24	3-6	1¼	2	1	¾	½	940000
11-0	9-6½	6-3	9	24	3-8	1¼	2	1	¾	½	986000
11-6	10-0	6-6	9	24	3-10	1¼	3	1	¾	½	1030000
12-0	10-5	6-9	9	24	4-0	1¼	3	1	¾	½	1076000

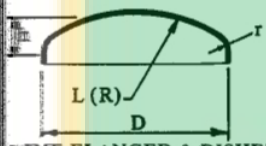
DIMENSIONS OF HEADS



HEMISPHERICAL



ELLIPSOIDAL



ASME FLANGED & DISHED

SYMBOLS USED IN THE TABLES

D = inside diameter of hemispherical and ellipsoidal heads, outside diameter of ASME flanged & dished heads.

h = inside depth of dish of F & D heads

L(R) = inside radius of dish of ASME flanged & dished heads as used in formulas for internal or external pressure.

M = factor used in formulas for internal pressure.

r = inside knuckle radius of ASME flanged & dished heads.

t = wall thickness, nominal or minimum.

ALL DIMENSIONS IN INCHES

TEAM ETER D		WALL THICKNESS							
		3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4
14	L (R)	12	12	12					
	r	1.125	1.500	1.875					
	h	2.625	2.750	2.938					
	M	1.56	1.46	1.39					
16	L (R)	15	15	14	14				
	r	1.125	1.500	1.875	2.250				
	h	2.750	2.875	3.188	3.375				
	M	1.65	1.54	1.44	1.36				
18	L (R)	18	16	15	15	18			
	r	1.125	1.500	1.875	2.250	2.625			
	h	2.875	3.313	3.563	3.750	3.625			
	M	1.75	1.56	1.46	1.39	1.41			
20	L (R)	18	18	18	18	18	18		
	r	1.250	1.500	1.875	2.250	2.625	3.000		
	h	3.500	3.563	3.750	3.875	4.063	4.250		
	M	1.69	1.62	1.52	1.46	1.41	1.36		
22	L (R)	21	20	20	20	20	20	20	
	r	1.375	1.500	1.875	2.250	2.625	3.000	3.375	
	h	3.688	3.813	4.000	4.188	4.313	4.500	4.688	
	M	1.72	1.65	1.56	1.50	1.44	1.39	1.36	
24	L (R)	24	24	24	24	24	24	24	24
	r	1.500	1.500	1.875	2.250	2.625	3.000	3.375	3.750
	h	3.875	3.813	4.000	4.188	4.375	4.563	4.813	5.000
	M	1.75	1.75	1.65	1.58	1.50	1.46	1.41	1.39

DIMENSIONS OF HEADS

ALL DIMENSIONS IN INCHES

DIAMETER D		WALL THICKNESS								
		3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8
26	L (R)	24	24	24	24	24	24	24	24	24
	r	1.625	1.625	1.875	2.250	2.625	3.000	3.375	3.750	4.125
	h	4.500	4.438	4.500	4.688	4.875	5.000	5.188	5.375	5.625
	M	1.72	1.72	1.65	1.56	1.50	1.46	1.41	1.39	1.36
28	L (R)	26	26	26	26	24	24	24	24	24
	r	1.750	1.750	1.875	2.250	2.625	3.000	3.375	3.750	4.125
	h	4.813	4.750	4.750	4.938	5.375	5.563	5.688	5.875	6.063
	M	1.72	1.72	1.69	1.60	1.50	1.46	1.41	1.39	1.36
30	L (R)	30	30	30	30	30	30	30	30	30
	r	1.875	1.875	1.875	2.250	2.625	3.000	3.375	3.750	4.125
	h	4.875	4.813	4.813	5.000	5.125	5.375	5.500	5.750	5.938
	M	1.75	1.75	1.75	1.65	1.60	1.54	1.50	1.46	1.44
32	L (R)	30	30	30	30	30	30	30	30	30
	r	2.000	2.000	2.000	2.250	2.625	3.000	3.375	3.750	4.125
	h	5.563	5.500	5.375	5.500	5.625	5.813	6.000	6.188	6.375
	M	1.72	1.72	1.72	1.65	1.60	1.54	1.50	1.50	1.44
34	L (R)	34	34	30	30	30	30	30	30	30
	r	2.125	2.125	2.125	2.250	2.625	3.000	3.375	3.750	4.125
	h	5.563	5.500	6.000	6.063	6.188	6.313	6.438	6.625	6.813
	M	1.75	1.75	1.69	1.65	1.60	1.54	1.54	1.46	1.44
36	L (R)	36	36	36	36	36	36	36	36	36
	r	2.250	2.250	2.250	2.250	2.625	3.000	3.375	3.750	4.125
	h	5.938	5.875	5.813	5.750	5.938	6.125	6.313	6.500	6.688
	M	1.75	1.75	1.75	1.75	1.69	1.62	1.58	1.52	1.52
38	L (R)	36	36	36	36	36	36	36	36	36
	r	2.375	2.375	2.375	2.375	2.625	3.000	3.375	3.750	4.125
	h	6.500	6.438	6.375	6.375	6.438	6.563	6.750	6.938	7.125
	M	1.72	1.72	1.72	1.72	1.69	1.62	1.60	1.52	1.48
40	L (R)	40	40	36	36	36	36	36	36	36
	r	2.500	2.500	2.500	2.500	2.625	3.000	3.375	3.750	4.125
	h	6.625	6.563	6.938	7.000	7.000	7.125	7.313	7.438	7.625
	M	1.69	1.69	1.69	1.69	1.69	1.62	1.58	1.52	1.48
42	L (R)	40	40	40	40	40	40	36	36	36
	r	2.625	2.625	2.625	2.625	2.625	3.000	3.375	3.750	4.125
	h	7.188	7.125	7.063	7.000	7.000	7.125	7.125	8.000	8.125
	M	1.72	1.72	1.72	1.72	1.72	1.65	1.56	1.52	1.48
48	L (R)	42	42	42	42	42	42	42	42	42
	r	3.000	3.000	3.000	3.000	3.000	3.000	3.375	3.750	4.125
	h	8.000	8.750	8.688	8.625	8.563	8.500	8.625	8.813	9.000
	M	1.69	1.69	1.69	1.69	1.69	1.69	1.62	1.58	1.54
54	L (R)	54	48	48	48	48	48	48	48	48
	r	3.250	3.250	3.250	3.250	3.250	3.250	3.375	3.750	4.125
	h	8.938	9.750	9.750	9.625	9.500	9.375	9.438	9.625	9.750
	M	1.77	1.72	1.72	1.72	1.72	1.72	1.69	1.65	1.60
60	L (R)	60	60	54	54	54	54	54	54	54
	r	3.625	3.625	3.625	3.625	3.625	3.625	3.625	3.750	4.125
	h	10.000	9.875	10.688	10.625	10.563	10.500	10.438	10.438	10.563
	M	1.77	1.77	1.72	1.72	1.72	1.72	1.72	1.69	1.65

WEIGHT OF FLANGES

NOM. PIPE SIZE	150 lbs.					300 lbs.				
	SLIP ON	WELD NECK	LONG. WELD NECK	BLIND	STUDS	SLIP ON	WELD NECK	LONG. WELD NECK	BLIND	STUDS
½	1.0	2.0		2.0	1.0	1.5	2.0		2.0	1.0
¾	1.5	2.0		2.0	1.0	2.5	3.0		3.0	2.0
1	2.0	2.5	8.0	2.0	1.0	3.0	4.0	10.0	4.0	2.0
1¼	2.5	2.5	10.0	3.0	1.0	4.5	5.0	14.0	6.0	2.0
1½	3.0	4.0	12.0	3.0	1.0	6.5	7.0	17.0	7.0	3.5
2	5.0	6.0	16.0	4.0	1.5	7.0	8.0	19.0	8.0	4.0
2½	8.0	10.0	21.0	7.0	1.5	10.0	12.0	28.0	12.0	7.0
3	9.0	11.5	24.0	9.0	1.5	13.0	16.0	36.0	16.0	7.5
3½	11.0	12.0	31.0	13.0	3.5	16.0	20.0	45.0	21.0	7.5
4	12.0	16.0	47.0	17.0	4.0	21.0	25.0	54.0	27.0	7.5
5	13.0	20.0	57.0	20.0	6.0	26.0	34.0	86.0	35.0	8.0
6	18.0	24.0	77.0	26.0	6.0	35.0	45.0	108.0	50.0	11.5
8	28.0	42.0	103	45.0	6.5	54.0	70.0	150	81.0	18.0
10	37.0	55.0	150	70.0	15.0	77.0	99.0	218	127	38.0
12	60.0	85.0	215	110	15.0	110	142	289	184	49.0
14	77.0	114	221	131	22.0	164	186	342	236	62.0
16	93.0	142	254	170	31.0	220	246	426	307	83.0
18	120	155	278	209	41.0	280	305	493	390	101
20	155	170	324	272	52.0	325	378	575	492	105
22	159	224		333	69.0	433	429		594	157
24	210	260	439	411	71.0	490	545	823	754	174
26	248	270	470	498	93.6	552	615	870	950	239
30	319	375	600	681	112.0	779	858	1130	1403	307

Table 2-1.1 Pressure–Temperature Ratings for Group 1.1 Materials

Nominal Designation	Forgings	Castings	Plates
C–Si	A 105 (1)	A 216 Gr. WCB (1)	A 515 Gr. 70 (1)
C–Mn–Si	A 350 Gr. LF2 (1)	. . .	A 516 Gr. 70 (1), (2)
C–Mn–Si–V	A 350 Gr. LF6 Cl 1 (3)	. . .	A 537 Cl. 1 (4)
$3\frac{1}{2}$Ni	A 350 Gr. LF3	. . .	. . .

Working Pressure by Classes, bar

	Class						
Temp., °C	150	300	400	600	900	1500	2500
–29 to 38	19.6	51.1	68.1	102.1	153.2	255.3	425.5
50	19.2	50.1	66.8	100.2	150.4	250.6	417.7
100	17.7	46.6	62.1	93.2	139.8	233.0	388.3
150	15.8	45.1	60.1	90.2	135.2	225.4	375.6
200	13.8	43.8	58.4	87.6	131.4	219.0	365.0
250	12.1	41.9	55.9	83.9	125.8	209.7	349.5
300	10.2	39.8	53.1	79.6	119.5	199.1	331.8
325	9.3	38.7	51.6	77.4	116.1	193.6	322.6
350	8.4	37.6	50.1	75.1	112.7	187.8	313.0
375	7.4	36.4	48.5	72.7	109.1	181.8	303.1
400	6.5	34.7	46.3	69.4	104.2	173.6	289.3
425	5.5	28.8	38.4	57.5	86.3	143.8	239.7
450	4.6	23.0	30.7	46.0	69.0	115.0	191.7
475	3.7	17.4	23.2	34.9	52.3	87.2	145.3
500	2.8	11.8	15.7	23.5	35.3	58.8	97.9
538	1.4	5.9	7.9	11.8	17.7	29.5	49.2

NOTES:

(1) Upon prolonged exposure to temperatures above 425°C, the carbide phase of steel may be converted to graphite. Permissible but not recommended for prolonged use above 425°C.

(2) Not to be used over 455°C.

(3) Not to be used over 260°C.

(4) Not to be used over 370°C.

LAMPIRAN IV

PV Elite® 23 HEXAGON PPM

Vessel Design Summary:

ASME Code, Section VIII Division 1, 2019

Diameter Spec : 1498.600 mm ID		
Vessel Design Length, Tangent to Tangent	3810.00	mm
Specified Datum Line Distance	50.00	mm
Internal Design Temperature	200	°F
Internal Design Pressure	160.000	psig
External Design Temperature	212	°F
Maximum Allowable Working Pressure	180	psig
Shop Test Pressure	233.780	psig
Required Minimum Design Metal Temperature	32.0	°F
Warmest Computed Minimum Design Metal Temperature	-20.0	°F
Wind Design Code	ASCE-93	
Earthquake Design Code	ASCE/SEI 7-16	

Materials of Construction:

Component Type	Material	Class	Thickness	UNS #	Normalized	Impact Tested
Shell	SA-516 70	...	...	K02700	No	No
Head	SA-516 70	...	...	K02700	No	No
Nozzle	SA-106 B	...	...	K03006	No	No
Nozzle	SA-516 70	...	...	K02700	No	No
Re-Pad	SA-516 70	...	...	K02700	No	No
Nozzle Flg	SA-105	...	...	K03504	No	No
Hrz Bolting		...	...		No	No

- Normalized is determined based on the UCS-66 material curve selection and Figure UCS-66.
- Impact Tested is based on material selection and material data properties.

Element Pressures and MAWP (psig & mm):

Element Description or Type	Design Pressure + Stat. head	Ext. Press.	Element M.A.W.P	Total Corrosion Allowance	Str. Flg. Gov.	In Creep Range
HEAD	160.589	0.00	232.000	3.1750	Yes	No
SHELL	160.589	0.00	180.000	3.1750	N/A	No
HEAD	160.589	0.00	232.000	3.1750	Yes	No

Liquid Level: 457.00 mm Dens.: 56.160 lb/ft³ Sp. Gr.: 0.900

Element Types and Properties:

Element Type	"To" Elev mm	Element Length mm	Nominal Thickness mm	Finished Thickness mm	Reqd Thk Internal mm	Reqd Thk External mm	Long Eff	Circ Eff
Ellipse	0.0	50.0	10.0	12.0	9.2	4.7	1.00	1.00

Cylinder	3710.0	3710.0	10.0	10.0	9.2	...	1.00	1.00
Ellipse	3760.0	50.0	10.0	12.0	9.2	4.7	1.00	1.00

Saddle Parameters:

Saddle Width	200.000	mm
Saddle Bearing Angle	120.000	deg.
Centerline Dimension	1655.000	mm
Wear Pad Width	430.000	mm
Wear Pad Thickness	10.000	mm
Wear Pad Bearing Angle	132.000	deg.
Distance from Saddle to Tangent	408.000	mm
Baseplate Length	1400.000	mm
Baseplate Thickness	16.000	mm
Baseplate Width	230.000	mm
Number of Ribs (including outside ribs)	3	
Rib Thickness	10.000	mm
Web Thickness	10.000	mm
Height of Center Web	306.000	mm

Baseplate Sketch

Baseplate Plan View

Baseplate Side View

Summary of Maximum Saddle Loads, Operating Case:

Maximum Vertical Saddle Load	9113.25	lbf
Maximum Transverse Saddle Shear Load	972.55	lbf
Maximum Longitudinal Saddle Shear Load	1945.11	lbf

Summary of Maximum Saddle Loads, Operating Case, Un-Factored:

Maximum Vertical Saddle Load	10666.35	lbf
Maximum Transverse Saddle Shear Load	3623.90	lbf
Maximum Longitudinal Saddle Shear Load	2778.72	lbf

Summary of Maximum Saddle Loads, Hydrotest Case :

Maximum Vertical Saddle Load	13421.38	lbf
Maximum Transverse Saddle Shear Load	222.44	lbf
Maximum Longitudinal Saddle Shear Load	209.42	lbf

Weights:

Fabricated - Bare W/O Removable Internals	3047.3	kgm
Shop Test - Fabricated + Water (Full)	10645.4	kgm
Shipping - Fab. + Rem. Intls.+ Shipping App.	3047.3	kgm
Erected - Fab. + Rem. Intls.+ Insul. (etc)	3047.3	kgm
Empty - Fab. + Intls. + Details + Wghts.	3047.3	kgm
Operating - Empty + Operating Liquid (No CA)	4778.2	kgm

Internal Pressure Results Summary:

Element Thickness, Pressure, Diameter and Allowable Stress :

From	To	Int. Press + Liq. Hd psig	Nominal Thickness mm	Total Corr Allowance mm	Element Diameter mm	Allowable Stress(SE) psi
	HEAD	160.59	10	3.175	1498.6	20000
	SHELL	160.59	10	3.175	1498.6	20000
	HEAD	160.59	10	3.175	1498.6	20000

Element Required Thickness and MAWP :

From	To	Design Pressure psig	M.A.W.P. Corroded psig	M.A.P. New & Cold psig	Minimum Thickness mm	Required Thickness mm
	HEAD	160	232.331	319.787	12	9.188
	SHELL	160	179.831	264.795	10	9.2462
	HEAD	160	232.331	319.787	12	9.188
Minimum			180	265		

MAWP: 180 psig, limited by: SHELL.

Elements Suitable for Design Internal Pressure.

Internal Pressure Calculation Results:

ASME Code, Section VIII Division 1, 2019

Elliptical Head From 10 To 20 SA-516 70 , UCS-66 Crv.B at 200 °F

HEAD
Material UNS Number: K02700

Required Thickness due to Internal Pressure [tr]:
= (P*D*Kcor)/(2*S*E-0.2*P) Appendix 1-4(c)
= (160.589*1504.95*0.994)/(2*20000.0*1.0-0.2*160.589)
= 6.0130 + 3.1750 = 9.1880 mm

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:
Less Operating Hydrostatic Head Pressure of 0.589 psig
= (2*S*E*t)/(Kcor*D+0.2*t) per Appendix 1-4 (c)
= (2*20000.0*1.0*8.825)/(0.994*1504.95+0.2*8.825)
= 236 - 1 = 235 psig

Maximum Allowable Pressure, New and Cold [MAPNC]:
= (2*S*E*t)/(K*D+0.2*t) per Appendix 1-4 (c)
= (2*20000.0*1.0*12.0)/(1.0*1498.6+0.2*12.0)
= 320 psig

Actual stress at given pressure and thickness, corroded [Sact]:
= (P*(Kcor*D+0.2*t))/(2*E*t)
= (160.589*(0.994*1504.95+0.2*8.825))/(2*1.0*8.825)
= 13632.320 psi

Straight Flange Required Thickness:
= (P*R)/(S*E-0.6*P) + c per UG-27 (c)(1)
= (160.589*752.475)/(20000.0*1.0-0.6*160.589)+3.175
= 9.246 mm

Straight Flange Maximum Allowable Working Pressure:
Less Operating Hydrostatic Head Pressure of 0.589 psig
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (20000.0 * 1.0 * 8.825)/(752.475 + 0.6 * 8.825)
= 233 - 1 = 232 psig

Factor K, corroded condition [Kcor]:
= (2 + (Inside Diameter/(2 * Inside Head Depth))^(2))/6
= (2 +(1504.95/(2 * 377.825))^(2))/6
= 0.994410

Percent Elong. per UCS-79, VIII-1-01-57 (75*tnom/Rf)*(1-Rf/Ro) 3.451 %

MDMT Calculations in the Knuckle Portion:

Govrn. thk, tg = 12.0, tr = 6.756, c = 3.175 mm, E* = 1.0
Thickness Ratio = tr *(E*)/(tg - c) = 0.766, Temp. Reduction = 23 °F

Min Metal Temp. w/o impact per UCS-66, Curve B	-10 °F
Min Metal Temp. at Required thickness (UCS 66.1)	-33 °F
Min Metal Temp. w/o impact per UG-20(f)	-20 °F

MDMT Calculations in the Head Straight Flange:

Govrn. thk, tg = 12.0, tr = 6.825, c = 3.175 mm, E* = 1.0
Thickness Ratio = tr *(E*)/(tg - c) = 0.773, Temp. Reduction = 23 °F

Min Metal Temp. w/o impact per UCS-66, Curve B	-10 °F
Min Metal Temp. at Required thickness (UCS 66.1)	-32 °F
Min Metal Temp. w/o impact per UG-20(f)	-20 °F

Cylindrical Shell From 20 To 30 SA-516 70 , UCS-66 Crv. B at 200 °F

SHELL
Material UNS Number: K02700

Required Thickness due to Internal Pressure [tr]:
= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
= (160.589*752.475)/(20000.0*1.0-0.6*160.589)
= 6.0712 + 3.1750 = 9.2462 mm

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:
Less Operating Hydrostatic Head Pressure of 0.589 psig
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (20000.0*1.0*6.825)/(752.475+0.6*6.825)
= 180 - 1 = 180 psig

Maximum Allowable Pressure, New and Cold [MAPNC]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (20000.0*1.0*10.0)/(749.3+0.6*10.0)
= 265 psig

Actual stress at given pressure and thickness, corroded [Sact]:
= (P*(R+0.6*t))/(E*t)
= (160.589*(752.475+0.6*6.825))/(1.0*6.825)

Element and Detail Weights:

From	To	Element Metal Wgt. kgm	Element ID Volume ltr	Corroded Metal Wgt. kgm	Corroded ID Volume ltr	Extra due Misc % kgm
10	20	276.079	528.838	203.033	535.212	...
20	30	1362.79	6545.05	932.064	6600.64	...
30	40	276.079	528.838	203.033	535.212	...
Total		1914	7602.73	1338	7671.06	0

Weight of Details:

From	Type	Weight of Detail kgm	X Offset, Dtl. Cent. mm	Y Offset, Dtl. Cent. mm	Z Offset Dtl. Cent. mm	Description
10	Liqd	105.725	-124.883	520.8	...	Liquid 10
10	Nozl	6.67294	-316.801	-400	...	N8-UTILITY CONNE
20	Sadl	272.596	623	1192.15	...	Lft Sdl
20	Sadl	272.596	3087	1192.15	...	New Sdl
20	Liqd	1519.46	1855	520.8	...	Liquid: 20
20	Nozl	24.7788	3425	822.465	...	N2-GAS OUTLET
20	Nozl	14.3601	3486	-797.89	...	N3-LIQUID OUTLET
20	Nozl	6.67294	1500	770.725	...	N4-PSV
20	Nozl	6.67294	3050	770.725	...	N5-PI
20	Nozl	6.96927	1518	-377.613	671.882	N11B-LSH
20	Nozl	6.80464	1518	-17.21	770.533	N11A-LSH
20	Nozl	6.67294	2261	-770.725	...	N10A-LSL
20	Nozl	6.67294	2261	-437.352	634.618	N10B-LSL
20	Nozl	6.67294	2700	770.725	...	N6A-LG/LIC
20	Nozl	6.67294	2700	-770.725	...	N6B-LG/LIC
20	Nozl	14.3601	1500	-797.89	...	N9A-DRAIN LINE
20	Nozl	14.3601	1850	-797.89	...	N9B-DRAIN LINE
20	Nozl	6.67294	1200	-770.725	...	N9C-DRAIN LINE
20	Nozl	6.67294	2350	770.725	...	N7-PSH/PSL
20	Nozl	6.67294	3454	-377.613	671.882	N12-TI/TW
20	Nozl	34.8032	950	850.659	...	N1-INLET
30	Liqd	105.725	174.883	520.8	...	Liquid 30
30	Nozl	404.024	424.65	...	...	M1-MAN HOLE

Total Weight of Each Detail Type:

Saddles	545.2
Liquid	1730.9
Nozzles	587.2
Sum of the Detail Weights	2863.3 kgm

Weight Summation Results: (kgm)

	Fabricated	Shop Test	Shipping	Erected	Empty	Operating
Main Elements	1914.9	1914.9	1914.9	1914.9	1914.9	1914.9
Saddles	545.2	545.2	545.2	545.2	545.2	545.2
Nozzles	587.2	587.2	587.2	587.2	587.2	587.2
Ope. Liquid	...	...	...	...	...	1730.9

Nozzle Flange MAWP Results: (psig & °F)

Nozzle Description	Flange Rating Ope.	Flange Rating Ambient	Design Temp	Class	Grade/ Group	Equiv. Press	Max Pressure UG-44(b)	Max Pressure 50%	Max Pressure DNV
N8-UTILITY CON	260.0	285.0	200	150	GR 1.1	...	...	...	...
N2-GAS OUTLET	260.0	285.0	200	150	GR 1.1	...	...	...	...
N3-LIQUID OUTL	260.0	285.0	200	150	GR 1.1	...	...	...	...
N4-PSV	260.0	285.0	200	150	GR 1.1	...	...	...	...
N5-PI	260.0	285.0	200	150	GR 1.1	...	...	...	...
N11B-LSH	260.0	285.0	200	150	GR 1.1	...	...	...	...
N11A-LSH	260.0	285.0	200	150	GR 1.1	...	...	...	...
N10A-LSL	260.0	285.0	200	150	GR 1.1	...	...	...	...
N10B-LSL	260.0	285.0	200	150	GR 1.1	...	...	...	...
N6A-LG/LIC	260.0	285.0	200	150	GR 1.1	...	...	...	...
N6B-LG/LIC	260.0	285.0	200	150	GR 1.1	...	...	...	...
N9A-DRAIN LINE	260.0	285.0	200	150	GR 1.1	...	...	...	...
N9B-DRAIN LINE	260.0	285.0	200	150	GR 1.1	...	...	...	...
N9C-DRAIN LINE	260.0	285.0	200	150	GR 1.1	...	...	...	...
N7-PSH/PSL	260.0	285.0	200	150	GR 1.1	...	...	...	...
N12-TI/TW	260.0	285.0	200	150	GR 1.1	...	...	...	...
N1-INLET	260.0	285.0	200	150	GR 1.1	...	...	...	...
M1-MAN HOLE	260.0	285.0	200	150	GR 1.1	...	...	...	...
Min Rating	260.0	285.0 psig [for Core Elements]					0.0	0.0	0.0

Pressure Ratings are per ASME B16.5 2013 Edition

Tugas Akhir

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