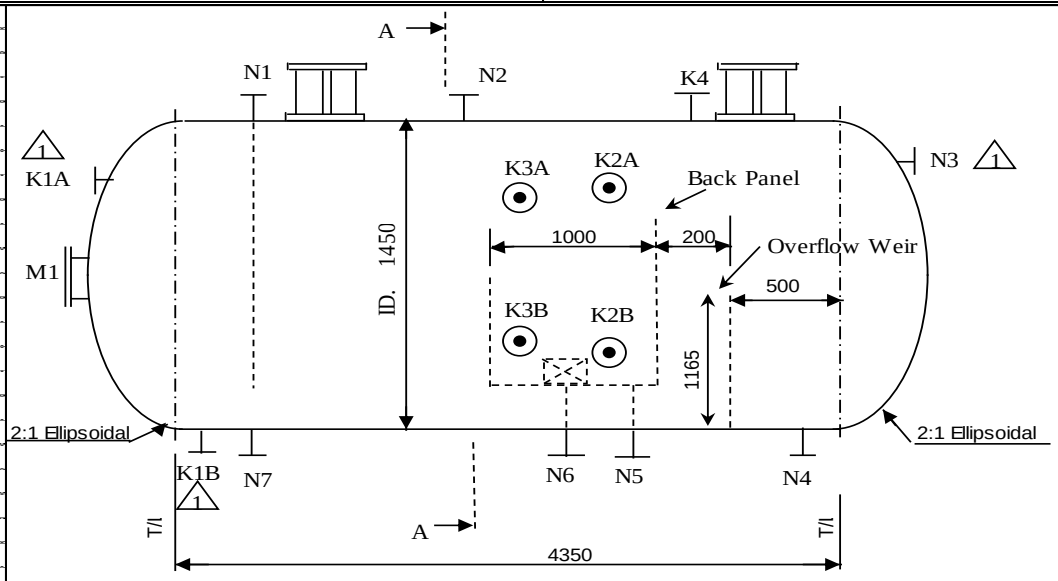
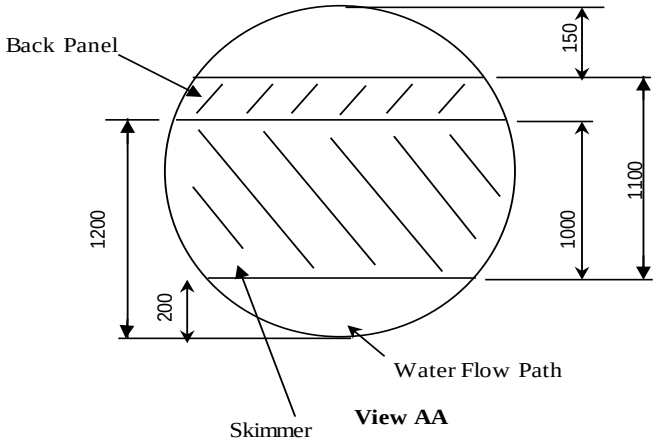
Lampiran 1. Geometri *Pressure Vessel Open Drains Drum*

Data Sheet for Unfired Pressure Vessel

Equipment Name :	Open Drains Drum	**Location:**	Arabian Gulf
Tag No. :	603-39V-03	**Plant Location :**	PS-3J
No. of Units :	1	**Manufacturer/Model :**	





Note: Back panel spans the whole vessel diameter

Levels relative to vessel bottom

LIQUID LEVELS		SKIMMER	WATER
LSHH	mm	1200	
LSH	mm	1050	
LSL	mm	350	
LSLL	mm	200	

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قطر للبترول Qatar Petroleum

Qatar Petroleum

Bul Hanine Arab "C" Gas Cap Recycling

Project No:	**022/00705**	**Rev:**
Document No:	**00705-MEC-DTS-229**	**1**

Lampiran 2. Data Desain

Data Sheet for Unfired Pressure Vessels

Equipment Name:	**Open Drains Drum**	**Location:**	Arabian Gulf
Tag No.:	603-39V-03	**Plant Location:**	PS-3J
No.of Units:	1	**Manufacturer/Model:**	

	DESIGN DATA				
1	Orientation		Horizontal	**CONSTRUCTION MATERIAL**	
2	Contents		HC, H_2S, Water, Oxygen	Part	Material Specification
3	Criticality Rating		3	Shell	SA516Gr60
4	Service		Lethal	Cladding/Lining of shell	-
5	Design Code		ASME Sec.VIII DIV.1	Heads	SA516Gr60
6	Code Stamp		Yes	Cladding/Lining of heads	-
7				Boot	-
8	Temperature			Reinforcing pads	SA516Gr60
9	Design - Upper/Lower	°C	100/4	Self Reinforcing Nozzles	-
10	Operating - Max. / Normal / Min.	°C	-/ 45 /-	Nozzle neck (pipes)	SA106Gr.B
11	Pressure			Forged Flanges	SA105
12	Design (Internal)	barg	3,5	Internal Flanges	-
13	Design External	barg	-	Welding elbow (External)	SA234WPB
14	Operating - Max/Norm/Min	barg	-/ 0.5 / -	Demister	-
15	Corrosion Allowance	mm	3	Baffles/Skimmer plates	SA516Gr60
16	Specific Gravity Liquid(HC/W)		Refer sheet 2 of 3	Distributor pipes	-
17	Gross Capacity	m^3	8	Base ring/plate	-
18	Vessel Dia (ID)	mm	1450	Vacuum stiffener rings	-
19	Vessel Length (T/L TO T/L)	mm	4350	Anode protection	-
20	Shop Hydrotest Pressure (N&C)		Per code	Saddles(Wrapper plate/ribs)	SA516Gr.60/A283Gr.C
21	Wind		BS CP3, Chapter V, PART	Internal attachments	SA516Gr60
22	Design Wind Speed	m/s	45	External attachments	SA 283 Gr C
23	Seismic		See note 6	External Bolts	SA 193 Gr B7 (note 2)
24	Shell Thickness (NOM)	mm	8 VTC	Nuts	SA 194 Gr 2H (note 2)
25	Min.Head Thickness(Top/Bot)	mm	8 VTC	Gaskets External	Spiral Wound (note 1)
26	SkirtThickness/Height	mm	-	Gaskets Internal	
27	Weld Joint Efficiencies:			Internal Bolts	SS 316
28	Shell		1,0	Nuts	SS 316
29	Head		1,0		
30	Inspection and Testing			**CONSTRUCTION**	
31	Third Party Inspection		Yes	Type of Heads	2:1 Ellipsoidal
32	Non Destructive Testing:			Type of support	Saddle
33	Radiography		100%	Platform/Ladder/Pipe Clip	Required
34	Ultrasonic		as per code	Insulation supports	Not Required
35	Magnetic Particle		100 %	Manway Davit	Required
36	Dye Penetrant		Yes	Earthing Boss	Required
37	Post Weld Heat Treatment		Yes	Lifting Lugs/Eyes/Trunions	Required
38	Material Impact Test Required		as per code	Name plate	Required, SS316
39	Certified Elevated Temp.Test Required		No	**ESTIMATED WEIGHTS**	
40	Insulation	mm	No	Empty Kg	2,800 VTC
41	Fireproofing	mm	No	Shipping Kg	VTA
42	Painting (External)		ES-Q-12 (note 5)	Operating Kg	8,500 VTC
43	Painting (Internal)		ES-Q-12 (note 7)	Field Test Kg	10,800 VTC

NOTES:

1. Gaskets shall be SS316L spiral wound graphite filled with SS316L internal and external rings. Gaskets shall be as per API-60
2. External bolting shall be hot dip galvanised as per BS 729 (BS EN ISO 1461:1999).
3. Indicated thickness of shell, head are minimum and vendor to confirm the thicknesses.
4. Inside diameter of 20"NB manway shall be 457 mm.
5. System 5 for equipment in splash zone to be used.
6. Refer Environmental data:1535-0-56-0001.
7. System 7 for internal linings to be used. Alternatively solvent free Epoxy coating may be considered if the proposed coating is

VTC: Vendor to confirm, VTA: Vendor to advise.

REV	DATE	ISSUE DESCRIPTION	ORIG	CHKD	APPRD.	PROJECT	CLIENT APPR.
1	30-Jul-01	APPROVED FOR DETAILED DESIGN	NVR	GMP	GMP	IDB	
0	24-06-2001	ISSUED FOR COMMENTS	NVR	GMP	CPS	IDB	

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Qatar Petroleum

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Bul Hanine Arab "C" Gas Cap Recycling

Project No:	**022/00705**	Rev:
Document No:	**00705-MEC-DTS-229**	1

Data Sheet for Unfired Pressure Vessel

Equipment Name : Open Drains Drum	**Location:** Arabian Gulf
Tag No. : 603-39V-03	**Plant Location :** PS-3J
No. of Units : 1	**Manufacturer/Model :**

1	**DESIGN DATA**					
2	**PROCESS DATA**					
3	Fluid Name		Condensate	Water		
4	Case					
5	Vapour Flow rate	Act m3/h	-			
6	Vapour Density @ Oper T/P	kg/m3	-			
7	Vapour Viscosity @ Oper. T/P	cP	-			
8	Vapour Molecular Weight		-			
9	Liquid HC Flow Rate	Act m3/h	50 (Remark 3)			
10	Liquid HC Density @ Oper. T/P	kg/m3	725	1000		
11	Liquid HC Viscosity @ Oper. T/P	cP	0,62	1		
12	Liquid HC Surface Tension	dyne/cm	21,2			
13	Slug Holding Liquid Volume	m3	0			
14	Water Flow Rate	Act m3/h	-			
15	Water Density @ Oper. T/P	kg/m3	-			
16	Water Viscosity @ Oper. T/P	cP	-			
17	Design Margin on Flow Rates	%	-			
18	Corrosive Compounds		H_2S, Water, Oxygen			
19	VESSEL INTERNALS					
20	Gas Demister/Vane Pack					
21	Vortex Breakers		Yes for Nozzle-N6			
22	**NOZZLE SCHEDULE**					

	Mark No	Size	Qty.	Flange		Service	Standout (mm)		Reinf Pad (mm)	
		NPS	Nos.	Rating	Type/Face		Ext	Int	Thick	Diam
24	N1	4"	1	150#	WN/RF	Fluid Inlet				
25	N2	6"	1	150#	WN/RF	Vent △1				
26	N3	2"	1	150#	WN/RF	Overflow				
27	N4	6"	1	150#	WN/RF	Water overflow to sea				
28	N5	2"	1	150#	WN/RF	Spare (oil outlet)				
29	N6	2"	1	150#	WN/RF	Oil outflow to pumps				
30	N7	2"	1	150#	WN/RF	Spare (water outlet)				
31										
32										
33	K1 A/B	4"	2	150#	WN/RF	Level Gauge/Transmitter				
34	K2 A/B	4"	2	150#	WN/RF	Level Gauge / Transmitter				
35	K3 A/B	2"	2	150#	WN/RF	Level Trip				
36	K4	2"	1	150#	WN/RF	Pressure Indicator				
37										
38	M1	20"	1	150#	WN/RF	Manway				
39										
40										
41										

42	**REMARKS**
43	1. Nozzle sizes and elevations shall be confirmed during detailed engineering.
44	2. Skimmer dimensions are 1000 mm (L) x 1000 mm (H).
45	3. Liquid will be a hydrocarbon/water mixture
46	
47	
48	
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Qatar Petroleum

Bul Hanine Arab "C" Gas Cap Recycling

Project No:	**022/00705**	**Rev:**
Document No:	**00705-MEC-DTS-229**	**1**

Lampiran 3. Tegangan Izin SA-516 Gr.60

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TABLE A-1 (CONT'D)
BASIC ALLOWABLE STRESSES IN TENSION FOR METALS[1]

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Material	Spec. No.	P-No. or S-No. (5)	Grade	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Min. Temp. to 100	200	300
						Tensile	Yield			
Carbon Steel Pipes and Tubes (2)										
A 285 Gr. A	A 134	1	...	(8b)(57)	B	45	24	15.0	14.6	14.2
A 285 Gr. A	A 672	1	A45	(57)(59)(67)	B	45	24	15.0	14.6	14.2
Butt weld	API 5L	S-1	A25	(8a)	−20	45	25	15.0	15.0	14.5
Smls & ERW	API 5L	S-1	A25	(57)(59)	B	45	25	15.0	15.0	14.5
...	A 179	1	...	(57)(59)	−20	47	26	15.7	15.0	14.2
Type F	A 53	1	Gr. A	(8a)(77)	20	48	30	16.0	16.0	16.0
...	A 139	S-1	A	(8b)(77)	A	48	30	16.0	16.0	16.0
...	A 587	1	...	(57)(59)	−20	48	30	16.0	16.0	16.0
...	A 53	1	A	(57)(59)						
...	A 106	1	A	(57)						
...	A 135	1	A	(57)(59)	B	48	30	16.0	16.0	16.0
...	A 369	1	FPA	(57)						
...	API 5L	S-1	A	(57)(59)(77)						
A 285 Gr. B	A 134	1	...	(8b)(57)	B	50	27	16.7	16.4	16.0
A 285 Gr. B	A 672	1	A50	(57)(59)(67)	B	50	27	16.7	16.4	16.0
A 285 Gr. C	A 134	1	...	(8b)(57)	A	55	30	18.3	18.3	17.7
...	A 524	1	Gr. II	(57)	−20	55	30	18.3	18.3	17.7
...	A 333	1	1							
...	A 334	1	1	(57)(59)	−50	55	30	18.3	18.3	17.7
A 285 Gr. C	A 671	1	CA55	(59)(67)	A					
A 285 Gr. C	A 672	1	A55	(57)(59)(67)	A					
A 516 Gr. 55	A 672	1	C55	(57)(67)	C	55	30	18.3	18.3	17.7
A 516 Gr. 60	A 671	1	CC60	(57)(67)	C	60	32	20.0	19.5	18.9
A 515 Gr. 60	A 671	1	CB60							
A 515 Gr. 60	A 672	1	B60	(57)(67)	B	60	32	20.0	19.5	18.9
A 516 Gr. 60	A 672	1	C60	(57)(67)	C					
...	A 139	S-1	B	(8b)	A	60	35	20.0	20.0	20.0
...	A 135	1	B	(57)(59)	B					
...	A 524	1	Gr. 1	(57)	−20	60	35	20.0	20.0	20.0

Lampiran 4. Tegangan Luluh SA-516 Gr.60

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TABLE A-1 (CONT'D)
BASIC ALLOWABLE STRESSES IN TENSION FOR METALS[1]

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Material	Spec. No.	P-No. or S-No. (5)	Grade	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Min. Temp. to 100	200	300
						Tensile	Yield			
Carbon Steel Pipes and Tubes (2)										
A 285 Gr. A	A 134	1	...	(8b)(57)	B	45	24	15.0	14.6	14.2
A 285 Gr. A	A 672	1	A45	(57)(59)(67)	B	45	24	15.0	14.6	14.2
Butt weld	API 5L	S-1	A25	(8a)	−20	45	25	15.0	15.0	14.5
Smls & ERW	API 5L	S-1	A25	(57)(59)	B	45	25	15.0	15.0	14.5
...	A 179	1	...	(57)(59)	−20	47	26	15.7	15.0	14.2
Type F	A 53	1	Gr. A	(8a)(77)	20	48	30	16.0	16.0	16.0
...	A 139	S-1	A	(8b)(77)	A	48	30	16.0	16.0	16.0
...	A 587	1	...	(57)(59)	−20	48	30	16.0	16.0	16.0
...	A 53	1	A	(57)(59)						
...	A 106	1	A	(57)						
...	A 135	1	A	(57)(59)	B	48	30	16.0	16.0	16.0
...	A 369	1	FPA	(57)						
...	API 5L	S-1	A	(57)(59)(77)						
A 285 Gr. B	A 134	1	...	(8b)(57)	B	50	27	16.7	16.4	16.0
A 285 Gr. B	A 672	1	A50	(57)(59)(67)	B	50	27	16.7	16.4	16.0
A 285 Gr. C	A 134	1	...	(8b)(57)	A	55	30	18.3	18.3	17.7
...	A 524	1	Gr. II	(57)	−20	55	30	18.3	18.3	17.7
...	A 333	1	1							
...	A 334	1	1	(57)(59)	−50	55	30	18.3	18.3	17.7
A 285 Gr. C	A 671	1	CA55	(59)(67)	A					
A 285 Gr. C	A 672	1	A55	(57)(59)(67)	A					
A 516 Gr. 55	A 672	1	C55	(57)(67)	C	55	30	18.3	18.3	17.7
A 516 Gr. 60	A 671	1	CC60	(57)(67)	C	60	32	20.0	19.5	18.9
A 515 Gr. 60	A 671	1	CB60							
A 515 Gr. 60	A 672	1	B60	(57)(67)	B	60	32	20.0	19.5	18.9
A 516 Gr. 60	A 672	1	C60	(57)(67)	C					
...	A 139	S-1	B	(8b)	A	60	35	20.0	20.0	20.0
...	A 135	1	B	(57)(59)	B					
...	A 524	1	Gr. 1	(57)	−20	60	35	20.0	20.0	20.0

Lampiran 5. MAWP *Flange*

PRESSURE – TEMPERATURE RATINGS
FOR STEEL PIPE FLANGES AND FLANGED FITTINGS
American National Standard ANSI B16.5-1981

CLASS	150 lb.	300 lb.	400 lb.	600 lb.	900 lb.	1500 lb.	2500 lb.
HYDROSTATIC TEST PRESSURE, PSIG	450	1125	1500	2225	3350	5575	9275
TEMPERATURE, F	MAXIMUM ALLOWABLE NON-SHOCK PRESSURE PSIG.						
-20 to 100	285	740	990	1480	2220	3705	6170
200	260	675	900	1350	2025	3375	5625
300	230	655	875	1315	1970	3280	5470
400	200	635	845	1270	1900	3170	5280
500	170	600	800	1200	1795	2995	4990
600	140	550	730	1095	1640	2735	4560
650	125	535	715	1075	1610	2685	4475
700	110	535	710	1065	1600	2665	4440
750	95	505	670	1010	1510	2520	4200
800	80	410	550	825	1235	2060	3430
850	65	270	355	535	805	1340	2230
900	50	170	230	345	515	860	1430
950	35	105	140	205	310	515	860
1000	20	50	70	105	155	260	430

Lampiran 6. Tegangan Izin SA-516 Gr.60 Test hidrostatik

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TABLE A-1 (CONT'D)
BASIC ALLOWABLE STRESSES IN TENSION FOR METALS[1]

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Material	Spec. No.	P-No. or S-No. (5)	Grade	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Min. Temp. to 100	200	300
						Tensile	Yield			
Carbon Steel Pipes and Tubes (2)										
A 285 Gr. A	A 134	1	...	(8b)(57)	B	45	24	15.0	14.6	14.2
A 285 Gr. A	A 672	1	A45	(57)(59)(67)	B	45	24	15.0	14.6	14.2
Butt weld	API 5L	S-1	A25	(8a)	−20	45	25	15.0	15.0	14.5
Smls & ERW	API 5L	S-1	A25	(57)(59)	B	45	25	15.0	15.0	14.5
...	A 179	1	...	(57)(59)	−20	47	26	15.7	15.0	14.2
Type F	A 53	1	Gr. A	(8a)(77)	20	48	30	16.0	16.0	16.0
...	A 139	S-1	A	(8b)(77)	A	48	30	16.0	16.0	16.0
...	A 587	1	...	(57)(59)	−20	48	30	16.0	16.0	16.0
...	A 53	1	A	(57)(59)						
...	A 106	1	A	(57)						
...	A 135	1	A	(57)(59)	B	48	30	16.0	16.0	16.0
...	A 369	1	FPA	(57)						
...	API 5L	S-1	A	(57)(59)(77)						
A 285 Gr. B	A 134	1	...	(8b)(57)	B	50	27	16.7	16.4	16.0
A 285 Gr. B	A 672	1	A50	(57)(59)(67)	B	50	27	16.7	16.4	16.0
A 285 Gr. C	A 134	1	...	(8b)(57)	A	55	30	18.3	18.3	17.7
...	A 524	1	Gr. II	(57)	−20	55	30	18.3	18.3	17.7
...	A 333	1	1							
...	A 334	1	1	(57)(59)	−50	55	30	18.3	18.3	17.7
A 285 Gr. C	A 671	1	CA55	(59)(67)	A					
A 285 Gr. C	A 672	1	A55	(57)(59)(67)	A					
A 516 Gr. 55	A 672	1	C55	(57)(67)	C	55	30	18.3		17.7
A 516 Gr. 60	A 671	1	CC60	(57)(67)	C	60	32	20.0	19.5	18.9
A 515 Gr. 60	A 671	1	CB60							
A 515 Gr. 60	A 672	1	B60	(57)(67)	B	60	32	20.0	19.5	18.9
A 516 Gr. 60	A 672	1	C60	(57)(67)	C					
...	A 139	S-1	B	(8b)	A	60	35	20.0	20.0	20.0
...	A 135	1	B	(57)(59)	B					
...	A 524	1	Gr. 1	(57)	−20	60	35	20.0	20.0	20.0

Lampiran 7. Properti Pipa

PROPERTIES OF PIPE (con't.)

Nominal pipe size	Schedule No. Carbon & alloy steels	Schedule No. Stainless steels	Weight designation	Outside diam. in.	Inside diam. in.	Wall thickness in.	Weight per foot lb.	Wt. of water per ft. pipe lb.	Outside surface per ft. sq. ft.	Inside surface per ft. sq. ft.	Transverse area sq. in.
4 (CONT.)	...	...	....	4.500	4.090	.205	9.39	5.71	1.178	1.071	13.15
	40	40S	Std.	4.500	4.026	.237	10.79	5.51	1.178	1.055	12.73
	...	...	....	4.500	4.000	.250	11 35	5.45	1.178	1.049	12.57
	...	...	....	4.500	3.958	.271	12.24	5.35	1.178	1.038	12.31
	...	...	....	4.500	3.938	.281	12.67	5.27	1.178	1.031	12.17
	...	...	....	4.500	3.900	.300	13.42	5.19	1.178	1.023	11.96
	...	...		4.500	3.876	.312	14.00	5.12	1.178	1.013	11.80
	80	80S	X-Stg.	4.500	3.826	.337	14.98	4.98	1.178	1.002	11.50
	...	...		4.500	3.750	.375	16.52	4.78	1.178	.982	11.04
	120	...	....	4.500	3.624	.438	19.00	4.47	1.178	.949	10.32
	...	...	....	4.500	3.500	.500	21.36	4.16	1.178	.916	9.62
	160	...	....	4.500	3.438	.531	22.60	4.02	1.178	.900	9.28
	...	...	XX-Stg.	4.500	3.152	.674	27.54	3.38	1.178	.826	7.80
5	...	10S	....	5.563	5.295	.134	7.770	9.54	1.456	1.386	22.02
	40	40S	Std.	5.563	5.047	.258	14.62	8.66	1.456	1.321	20.01
	...	...	....	5.563	4.859	.352	19.59	8.06	1.456	1.272	18.60
	80	80S	X-Stg.	5.563	4.813	.375	20.78	7.87	1.456	1.260	18.19
	...	...	....	5.563	4.688	.437	23.95	7.47	1.456	1.227	17.26
	120	...	....	5.563	4.563	.500	27.10	7.08	1.456	1.195	16.35
	160	...	....	5.563	4.313	.625	32.96	6.32	1.456	1.129	14.61
	...	...	XX-Stg.	5.563	4.063	.750	38.55	5.62	1.456	1.064	12.97

Lampiran 8. Tegangan Izin SA-106 Gr.B

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TABLE A-1 (CONT'D)
BASIC ALLOWABLE STRESSES IN TENSION FOR METALS[1]

Numbers in Parentheses Refer to Notes for Appendix A Tables; Specifications Are ASTM Unless Otherwise Indicated

Material	Spec. No.	P-No. or S-No. (5)	Grade	Notes	Min. Temp., °F (6)	Specified Min. Strength, ksi		Min. Temp. to 100	200	300
						Tensile	Yield			
Carbon Steel (Cont'd) Pipes and Tubes (2) (Cont'd)										
...	A 53	1	B	(57)(59)	B					
...	A 106	1	B	(57)						
...	A 333									
...	A 334	1	6	(57)	−50	60	35	20.0	20.0	20.0
...	A 369	1	FPB	(57)	−20					
...	A 381	S-1	Y35	...	A					
...	API 5L	S-1	B	(57)(59)(77)	B					
...	A 139	S-1	C	(8b)	A	60	42			
...	A 139	S-1	D	(8b)	A	60	46	20.0	20.0	20.0
...	API 5L	S-1	X42	(55)(77)	A	60	42	20.0	20.0	20.0
...	A 381	S-1	Y42	...	A	60	42	20.0	20.0	20.0
...	A 381	S-1	Y48	...	A	62	48	20.6	19.7	18.7
...	API 5L	S-1	X46	(55)(77)	A	63	46	21.0	21.0	21.0
...	A 381	S-1	Y46	...	A	63	46	21.0	21.0	21.0
...	A 381	S-1	Y50	...	A	64	50	21.3	20.3	19.3
A 516 Gr. 65	A 671	1	CC65	(57)(67)	B	65	35	21.7	21.3	20.7
A 515 Gr. 65	A 671	1	CB65							
A 515 Gr. 65	A 672	1	B65	(57)(67)	A	65	35	21.7	21.3	20.7
A 516 Gr. 65	A 672	1	C65	(57)(67)	B					
...	A 139	S-1	E	(8b)	A	66	52	22.0	22.0	22.0
...	API 5L	S-1	X52	(55)(77)	A	66	52	22.0	22.0	22.0
...	A 381	S-1	Y52	...	A	66	52	22.0	22.0	22.0
A 516 Gr. 70	A 671	1	CC70	(57)(67)	B	70	38	23.3	23.1	22.5
A 515 Gr. 70	A 671	1	CB70							
A 515 Gr. 70	A 672	1	B70	(57)(67)	A	70	38	23.3	23.1	22.5
A 516 Gr. 70	A 672	1	C70	(57)(67)	B					
...	A 106	1	C	(57)	B	70	40	23.3	23.3	23.3
A 537 Cl. 1 (≤ 2½ in. thick)	A 671	1	CD70							
A 537 Cl. 1 (≤ 2½ in. thick)	A 672	1	D70	(67)	D	70	50	23.3	23.3	22.9
A 537 Cl. 1 (≤ 2½ in. thick)	A 691	1	CMSH70							
...	API 5L	S-1	X56	(51)(55)(71)(77)	A	71	56	23.7	23.7	23.7
...	A 381	S-1	Y56	(51)(55)(71)	A	71	56	23.7	23.7	23.7

Lampiran 9. *Cover Report* PV Elite 2014

DESIGN CALCULATION

In Accordance with ASME Section VIII Division 1

ASME Code Version : 2013

Analysis Performed by : SPLM Licensed User

Job File : G:\TA\PV\1.PVDB

Date of Analysis : Aug 18,2017

PV Elite 2014, January 2014

Perancangan Bejana Tekan Horizontal Open Drains Drum Tekanan Desain Internal 3,5 barg, Temperatur Desain 100C.

Nama : Arif Saifudin

NIm : 20130130088

Lampiran 10. Input Data

PV Elite Vessel Analysis Program: Input Data

Design Internal Pressure (for Hydrotest)	50.760 psig
Design Internal Temperature	212 °F
Type of Hydrotest	UG-99(b) Note [34]
Hydrotest Position	Horizontal
Projection of Nozzle from Vessel Top	0.0000 in
Projection of Nozzle from Vessel Bottom	0.0000 in
Minimum Design Metal Temperature	-20 °F
Type of Construction	Welded
Special Service	Lethal
Degree of Radiography	RT 1
Miscellaneous Weight Percent	0.0
Use Higher Longitudinal Stresses (Flag)	Y
Select t for Internal Pressure (Flag)	N
Select t for External Pressure (Flag)	N
Select t for Axial Stress (Flag)	N
Select Location for Stiff. Rings (Flag)	N
Consider Vortex Shedding	N
Perform a Corroded Hydrotest	N
Is this a Heat Exchanger	No
User Defined Hydro. Press. (Used if > 0)	0.0000 psig
User defined MAWP	0.0000 psig
User defined MAPnc	0.0000 psig

Load Case 1	NP+EW+WI+FW+BW

Load Case 2	NP+EW+EE+FS+BS
Load Case 3	NP+OW+WI+FW+BW
Load Case 4	NP+OW+EQ+FS+BS
Load Case 5	NP+HW+HI
Load Case 6	NP+HW+HE
Load Case 7	IP+OW+WI+FW+BW
Load Case 8	IP+OW+EQ+FS+BS
Load Case 9	EP+OW+WI+FW+BW
Load Case 10	EP+OW+EQ+FS+BS
Load Case 11	HP+HW+HI
Load Case 12	HP+HW+HE
Load Case 13	IP+WE+EW
Load Case 14	IP+WF+CW
Load Case 15	IP+VO+OW
Load Case 16	IP+VE+EW
Load Case 17	NP+VO+OW
Load Case 18	FS+BS+IP+OW
Load Case 19	FS+BS+EP+OW

Wind Design Code		ASCE-7 93
Basic Wind Speed	[V]	100.66 mile/hr
Surface Roughness Category		C: Open Terrain
Importance Factor		1.0
Type of Surface		Moderately Smooth
Base Elevation		0.0000 ft
Percent Wind for Hydrotest		33.0
Using User defined Wind Press. Vs Elev.		N
Damping Factor (Beta) for Wind (Ope)		0.0100

Damping Factor (Beta) for Wind (Empty)	0.0000
Damping Factor (Beta) for Wind (Filled)	0.0000
Seismic Design Code	UBC 94
UBC Seismic Zone (1=1,2=2a,3=2b,4=3,5=4)	3.000
UBC Importance Factor	1.000
UBC Soil Type	S1
UBC Horizontal Force Factor	3.000
UBC Percent Seismic for Hydrotest	0.000
Design Nozzle for Des. Press. + St. Head	Y
Consider MAP New and Cold in Noz. Design	N
Consider External Loads for Nozzle Des.	Y
Use ASME VIII-1 Appendix 1-9	N
Material Database Year	Current w/Addenda or Code Year

Configuration Directives:

Do not use Nozzle MDMT Interpretation VIII-1 01-37	No
Use Table G instead of exact equation for "A"	Yes
Shell Head Joints are Tapered	Yes
Compute "K" in corroded condition	Yes
Use Code Case 2286	No
Use the MAWP to compute the MDMT	Yes
Using Metric Material Databases, ASME II D	No

Complete Listing of Vessel Elements and Details:

Element From Node	10
Element To Node	20
Element Type	Elliptical
Description	
Distance "FROM" to "TO"	0.1666 ft
Inside Diameter	57.000 in
Element Thickness	0.2500 in
Internal Corrosion Allowance	0.1180 in
Nominal Thickness	0.3150 in
External Corrosion Allowance	0.0000 in
Design Internal Pressure	50.760 psig
Design Temperature Internal Pressure	212 °F
Design External Pressure	0.0000 psig
Design Temperature External Pressure	0 °F
Effective Diameter Multiplier	1.2
Material Name [Impact Tested]	SA-516 60
Allowable Stress, Ambient	19500. psi
Allowable Stress, Operating	19500. psi
Allowable Stress, Hydrotest	20000. psi
Material Density	0.2800 lb/in³
P Number Thickness	1.2500 in
Yield Stress, Operating	32000. psi
UCS-66 Chart Curve Designation	Impact Tested
External Pressure Chart Name	CS-2
UNS Number	K02100
Product Form	Plate
Efficiency, Longitudinal Seam	1.0

Efficiency, Circumferential Seam	1.0
Elliptical Head Factor	2.0

Element From Node	10
Detail Type	Liquid
Detail ID	WATER+CONDENSAT
Dist. from "FROM" Node / Offset dist	0.0000 ft
Height/Length of Liquid	4.7500 ft
Liquid Density	53.820 lb/ft³

Element From Node	10
Detail Type	Nozzle
Detail ID	K1A
Dist. from "FROM" Node / Offset dist	25.000 in
Nozzle Diameter	4.0 in.
Nozzle Schedule	None
Nozzle Class	150
Layout Angle	270.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl [Impact Tested]	SA-106 B

Element From Node	10
Detail Type	Nozzle
Detail ID	M1
Dist. from "FROM" Node / Offset dist	0.0000 in
Nozzle Diameter	20.0 in.

Nozzle Schedule	None
Nozzle Class	300
Layout Angle	90.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-106 B

Element From Node	20
Element To Node	30
Element Type	Cylinder
Description	
Distance "FROM" to "TO"	14.270 ft
Inside Diameter	57.000 in
Element Thickness	0.3125 in
Internal Corrosion Allowance	0.1180 in
Nominal Thickness	0.3150 in
External Corrosion Allowance	0.0000 in
Design Internal Pressure	50.760 psig
Design Temperature Internal Pressure	212 °F
Design External Pressure	0.0000 psig
Design Temperature External Pressure	0 °F
Effective Diameter Multiplier	1.2
Material Name [Impact Tested]	SA-516 60
Efficiency, Longitudinal Seam	1.0
Efficiency, Circumferential Seam	1.0

Element From Node	20
Detail Type	Saddle
Detail ID	Lft Sdl
Dist. from "FROM" Node / Offset dist	3.0000 ft
Width of Saddle	12.500 in
Height of Saddle at Bottom	36.000 in
Saddle Contact Angle	120.0
Height of Composite Ring Stiffener	0.0000 in
Width of Wear Plate	11.000 in
Thickness of Wear Plate	0.3750 in
Contact Angle, Wear Plate (degrees)	132.0

Element From Node	20
Detail Type	Saddle
Detail ID	New Sdl
Dist. from "FROM" Node / Offset dist	11.270 ft
Width of Saddle	12.500 in
Height of Saddle at Bottom	36.000 in
Saddle Contact Angle	120.0
Height of Composite Ring Stiffener	0.0000 in
Width of Wear Plate	11.000 in
Thickness of Wear Plate	0.3750 in
Contact Angle, Wear Plate (degrees)	132.0

Element From Node	20
Detail Type	Liquid
Detail ID	WATER+CONDENSAT

Dist. from "FROM" Node / Offset dist	0.0000 ft
Height/Length of Liquid	4.7500 ft
Liquid Density	53.820 lb/ft³

Element From Node	20
Detail Type	Nozzle
Detail ID	N1
Dist. from "FROM" Node / Offset dist	1.7000 ft
Nozzle Diameter	4.0 in.
Nozzle Schedule	None
Nozzle Class	150
Layout Angle	280.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-106 B

Element From Node	20
Detail Type	Nozzle
Detail ID	N2
Dist. from "FROM" Node / Offset dist	5.0000 ft
Nozzle Diameter	6.0 in.
Nozzle Schedule	None
Nozzle Class	150
Layout Angle	280.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1

Nozzle Matl	SA-106 B

Element From Node	20
Detail Type	Nozzle
Detail ID	N4
Dist. from "FROM" Node / Offset dist	13.000 ft
Nozzle Diameter	6.0 in.
Nozzle Schedule	None
Nozzle Class	150
Layout Angle	90.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-106 B

Element From Node	20
Detail Type	Nozzle
Detail ID	N5
Dist. from "FROM" Node / Offset dist	9.0000 ft
Nozzle Diameter	2.0 in.
Nozzle Schedule	None
Nozzle Class	150
Layout Angle	90.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-106 B

Element From Node	20
Detail Type	Nozzle
Detail ID	N6
Dist. from "FROM" Node / Offset dist	8.0000 ft
Nozzle Diameter	2.0 in.
Nozzle Schedule	None
Nozzle Class	150
Layout Angle	90.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-106 B

Element From Node	20
Detail Type	Nozzle
Detail ID	N7
Dist. from "FROM" Node / Offset dist	1.7000 ft
Nozzle Diameter	2.0 in.
Nozzle Schedule	None
Nozzle Class	150
Layout Angle	90.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-106 B

Element From Node	20
Detail Type	Nozzle

Detail ID	K3A
Dist. from "FROM" Node / Offset dist	7.0000 ft
Nozzle Diameter	2.0 in.
Nozzle Schedule	None
Nozzle Class	150
Layout Angle	343.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-106 B

Element From Node	20
Detail Type	Nozzle
Detail ID	K3B
Dist. from "FROM" Node / Offset dist	7.0000 ft
Nozzle Diameter	2.0 in.
Nozzle Schedule	None
Nozzle Class	150
Layout Angle	27.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-106 B

Element From Node	20
Detail Type	Nozzle
Detail ID	K4
Dist. from "FROM" Node / Offset dist	10.000 ft

Nozzle Diameter	2.0 in.
Nozzle Schedule	None
Nozzle Class	150
Layout Angle	270.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-106 B

Element From Node	20
Detail Type	Nozzle
Detail ID	K1B
Dist. from "FROM" Node / Offset dist	0.7000 ft
Nozzle Diameter	4.0 in.
Nozzle Schedule	None
Nozzle Class	150
Layout Angle	90.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-106 B

Element From Node	20
Detail Type	Nozzle
Detail ID	K2A
Dist. from "FROM" Node / Offset dist	9.0000 ft
Nozzle Diameter	4.0 in.
Nozzle Schedule	None

Nozzle Class	150
Layout Angle	340.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-106 B

Element From Node	20
Detail Type	Nozzle
Detail ID	K2B
Dist. from "FROM" Node / Offset dist	9.0000 ft
Nozzle Diameter	4.0 in.
Nozzle Schedule	None
Nozzle Class	150
Layout Angle	30.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-106 B

Element From Node	30
Element To Node	40
Element Type	Elliptical
Description	
Distance "FROM" to "TO"	0.1666 ft
Inside Diameter	57.000 in

Element Thickness	0.2500 in
Internal Corrosion Allowance	0.1180 in
Nominal Thickness	0.3150 in
External Corrosion Allowance	0.0000 in
Design Internal Pressure	50.760 psig
Design Temperature Internal Pressure	212 °F
Design External Pressure	0.0000 psig
Design Temperature External Pressure	0 °F
Effective Diameter Multiplier	1.2
Material Name [Impact Tested]	SA-516 60
Efficiency, Longitudinal Seam	1.0
Efficiency, Circumferential Seam	1.0
Elliptical Head Factor	2.0

Element From Node	30
Detail Type	Liquid
Detail ID	WATER+CONDENSAT
Dist. from "FROM" Node / Offset dist	0.0000 ft
Height/Length of Liquid	4.7500 ft
Liquid Density	53.820 lb/ft³

Element From Node	30
Detail Type	Nozzle
Detail ID	N3
Dist. from "FROM" Node / Offset dist	20.000 in
Nozzle Diameter	2.0 in.
Nozzle Schedule	None
Nozzle Class	150

Layout Angle	270.0
Blind Flange (Y/N)	N
Weight of Nozzle (Used if > 0)	0.0000 lbf
Grade of Attached Flange	GR 1.1
Nozzle Matl	SA-106 B

Element Thickness, Pressure, Diameter and Allowable Stress :

From	To	Int. Press + Liq. Hd psig	Nominal Thickness in	Total Corr Allowance in	Element Diameter in	Allowable Stress(SE) psi
10	20	52.5390	0.31500	0.11800	57.0000	19500.0
20	30	52.5390	0.31500	0.11800	57.0000	19500.0
30	40	52.5390	0.31500	0.11800	57.0000	19500.0

Element Required Thickness and MAWP :

From	To	Design Pressure psig	M.A.W.P. Corroded psig	M.A.P. New & Cold psig	Minimum Thickness in	Required Thickness in
10	20	50.7600	88.6166	170.903	0.25000	0.19471
20	30	50.7600	130.213	212.418	0.31250	0.19523
30	40	50.7600	88.6166	170.903	0.25000	0.19471
Minimum			88.617	170.902		

MAWP: 88.617 psig, limited by: Elliptical Head.

Lmapiran 11. Perhitungan Tebal *HeadI*

Internal Pressure Calculation Results :

ASME Code, Section VIII, Division 1, 2013

Elliptical Head From 10 To 20 SA-516 60 at 212 °F

Material UNS Number: K02100

Required Thickness due to Internal Pressure [tr]:

= (P*D*Kcor)/(2*S*E-0.2*P) Appendix 1-4(c)

= (52.539*57.2360*0.995)/(2*19500.00*1.00-0.2*52.539)

= 0.0767 + 0.1180 = 0.1947 in

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:

Less Operating Hydrostatic Head Pressure of 1.779 psig

= (2*S*E*t)/(Kcor*D+0.2*t) per Appendix 1-4 (c)

= (2*19500.00*1.00*0.1320)/(0.995*57.2360+0.2*0.1320)

= 90.396 - 1.779 = 88.617 psig

Maximum Allowable Pressure, New and Cold [MAPNC]:

= (2*S*E*t)/(K*D+0.2*t) per Appendix 1-4 (c)

= (2*19500.00*1.00*0.2500)/(1.000*57.0000+0.2*0.2500)

= 170.903 psig

Actual stress at given pressure and thickness, corroded [Sact]:

= (P*(Kcor*D+0.2*t))/(2*E*t)

= (52.539*(0.995*57.2360+0.2*0.1320))/(2*1.00*0.1320)

= 11333.628 psi

Straight Flange Required Thickness:

= (P*R)/(S*E-0.6*P) + c per UG-27 (c)(1)

= (52.539*28.6180)/(19500.00*1.00-0.6*52.539)+0.118

= 0.195 in

Straight Flange Maximum Allowable Working Pressure:

Less Operating Hydrostatic Head Pressure of 1.779 psig

= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)

= (19500.00 * 1.00 * 0.1970)/(28.6180 + 0.6 * 0.1970)

= 133.682 - 1.779 = 131.903 psig

Factor K, corroded condition [Kcor]:

= (2 + (Inside Diameter/(2 * Inside Head Depth))2)/6

= (2 + (57.236/(2 * 14.368))2)/6

= 0.994536

Percent Elong. per UCS-79, VIII-1-01-57 (75*tnom/Rf)*(1-Rf/Ro) 2.399 %

MDMT Calculations in the Knuckle Portion:

Note: This Element/Detail was specified as being Impact Tested.

MDMT Calculations in the Head Straight Flange:

Lampiran 12. Perhitungan Tebal *Shell*

Note: This Element/Detail was specified as being Impact Tested.

Note: Post Weld Heat Treatment is required for this Element/Joint.

Cylindrical Shell From 20 To 30 SA-516 60 at 212 °F

Material UNS Number: K02100

Required Thickness due to Internal Pressure [tr]:

= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (52.539*28.6180)/(19500.00*1.00-0.6*52.539)

= 0.0772 + 0.1180 = 0.1952 in

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:

Less Operating Hydrostatic Head Pressure of 1.779 psig

= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)

= (19500.00*1.00*0.1945)/(28.6180+0.6*0.1945)

= 131.992 - 1.779 = 130.213 psig

Maximum Allowable Pressure, New and Cold [MAPNC]:

= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)

= (19500.00*1.00*0.3125)/(28.5000+0.6*0.3125)

= 212.418 psig

Actual stress at given pressure and thickness, corroded [Sact]:

= (P*(R+0.6*t))/(E*t)

= (52.539*(28.6180+0.6*0.1945))/(1.00*0.1945)

= 7761.913 psi

Percent Elongation per UCS-79 (50*tnom/Rf)*(1-Rf/Ro) 0.550 %

Minimum Design Metal Temperature Results:

Note: This Element/Detail was specified as being Impact Tested.

Note: Post Weld Heat Treatment is required for this Element/Joint.

Elliptical Head From 30 To 40 SA-516 60 at 212 °F

Material UNS Number: K02100

Required Thickness due to Internal Pressure [tr]:

= (P*D*Kcor)/(2*S*E-0.2*P) Appendix 1-4(c)

= (52.539*57.2360*0.995)/(2*19500.00*1.00-0.2*52.539)

= 0.0767 + 0.1180 = 0.1947 in

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:

Less Operating Hydrostatic Head Pressure of 1.779 psig

= (2*S*E*t)/(Kcor*D+0.2*t) per Appendix 1-4 (c)

= (2*19500.00*1.00*0.1320)/(0.995*57.2360+0.2*0.1320)

= 90.396 - 1.779 = 88.617 psig

Maximum Allowable Pressure, New and Cold [MAPNC]:

= (2*S*E*t)/(K*D+0.2*t) per Appendix 1-4 (c)

= (2*19500.00*1.00*0.2500)/(1.000*57.0000+0.2*0.2500)

= 170.903 psig

Actual stress at given pressure and thickness, corroded [Sact]:

= (P*(Kcor*D+0.2*t))/(2*E*t)

= (52.539*(0.995*57.2360+0.2*0.1320))/(2*1.00*0.1320)

= 11333.628 psi

Straight Flange Required Thickness:

= (P*R)/(S*E-0.6*P) + c per UG-27 (c)(1)

= (52.539*28.6180)/(19500.00*1.00-0.6*52.539)+0.118

= 0.195 in

Straight Flange Maximum Allowable Working Pressure:

Less Operating Hydrostatic Head Pressure of 1.779 psig

= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)

= (19500.00 * 1.00 * 0.1970)/(28.6180 + 0.6 * 0.1970)

= 133.682 - 1.779 = 131.903 psig

Factor K, corroded condition [Kcor]:

= (2 + (Inside Diameter/(2 * Inside Head Depth))2)/6

= (2 + (57.236/(2 * 14.368))2)/6

= 0.994536

Percent Elong. per UCS-79, VIII-1-01-57 (75*tnom/Rf)*(1-Rf/Ro) 2.399 %

MDMT Calculations in the Knuckle Portion:

Note: This Element/Detail was specified as being Impact Tested.

MDMT Calculations in the Head Straight Flange:

Note: This Element/Detail was specified as being Impact Tested.

Note: Post Weld Heat Treatment is required for this Element/Joint.

Hydrostatic Test Pressure Results:

Pressure per UG99b	= 1.3 * M.A.W.P. * Sa/S	115.202 psig
Pressure per UG99b[34]	= 1.3 * Design Pres * Sa/S	65.988 psig
Pressure per UG99c	= 1.3 * M.A.P. - Head(Hyd)	220.114 psig
Pressure per UG100	= 1.1 * M.A.W.P. * Sa/S	97.478 psig
Pressure per PED	= 1.43 * MAWP	126.722 psig

UG-99(b) Note 34, Test Pressure Calculation:

= Test Factor * Design Pressure * Stress Ratio

= 1.3 * 50.760 * 1.000

= 65.988 psig

Horizontal Test performed per: UG-99b (Note 34)

Please note that Nozzle, Shell, Head, Flange, etc MAWPs are all considered when determining the hydrotest pressure for those test types that are based on the MAWP of the vessel.

Stresses on Elements due to Test Pressure:

From	To	Stress	Allowable	Ratio	Pressure
10	20	7764.1	20000.0	0.388	68.05
20	30	6246.7	20000.0	0.312	68.05
30	40	7764.1	20000.0	0.388	68.05

Elements Suitable for Internal Pressure.

Lampiran 13. MAWP *Flange*

Nozzle Flange MAWP Results :

Nozzle Description	Operating psig	Ambient psig	Temperature °F	Class	Grade|Group
K1A	256.4	285.0	212	150	GR 1.1
M1	677.0	740.0	212	300	GR 1.1
N1	256.4	285.0	212	150	GR 1.1
N2	256.4	285.0	212	150	GR 1.1
N4	256.4	285.0	212	150	GR 1.1
N5	256.4	285.0	212	150	GR 1.1
N6	256.4	285.0	212	150	GR 1.1
N7	256.4	285.0	212	150	GR 1.1
K3A	256.4	285.0	212	150	GR 1.1
K3B	256.4	285.0	212	150	GR 1.1
K4	256.4	285.0	212	150	GR 1.1
K1B	256.4	285.0	212	150	GR 1.1
K2A	256.4	285.0	212	150	GR 1.1
K2B	256.4	285.0	212	150	GR 1.1
N3	256.4	285.0	212	150	GR 1.1

Minimum Rating 256.400 285.000 psig (for Core Elements)

Note: ANSI Ratings are per ANSI/ASME B16.5 2009 Edition

Lampiran 14. Perhitungan *Nozzle* k1

INPUT VALUES, Nozzle Description: K1A From : 10

Pressure for Reinforcement Calculations	P	52.426 psig
Temperature for Internal Pressure	Temp	212 °F
Shell Material [Impact Tested]		SA-516 60
Shell Allowable Stress at Temperature	S	19500.00 psi
Shell Allowable Stress At Ambient	Sa	19500.00 psi
Inside Diameter of Elliptical Head	D	57.0000 in
Aspect Ratio of Elliptical Head	Ar	2.00
Head Finished (Minimum) Thickness	t	0.2500 in
Head Internal Corrosion Allowance	c	0.1180 in
Head External Corrosion Allowance	co	0.0000 in
Distance from Head Centerline	L1	25.0000 in
User Entered Minimum Design Metal Temperature		-20.00 °F

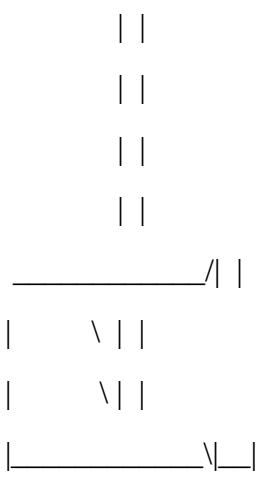
Type of Element Connected to the Shell : Nozzle

Material [Impact Tested]		SA-106 B
Material UNS Number		K03006
Material Specification/Type		Smls. pipe
Allowable Stress at Temperature	Sn	17100.00 psi
Allowable Stress At Ambient	Sna	17100.00 psi

Diameter Basis (for tr calc only)		ID
Layout Angle		270.00 deg
Diameter		4.0000 in.
Size and Thickness Basis		Actual
Actual Thickness	tn	0.7500 in
Flange Material		SA-106 B
Flange Type		Weld Neck Flange
Corrosion Allowance	can	0.1180 in
Joint Efficiency of Shell Seam at Nozzle	E1	1.00
Joint Efficiency of Nozzle Neck	En	1.00
Outside Projection	ho	2.0625 in
Weld leg size between Nozzle and Pad/Shell	Wo	1.0000 in
Groove weld depth between Nozzle and Vessel	Wgnv	0.2500 in
Inside Projection	h	0.0000 in
Weld leg size, Inside Element to Shell	Wi	0.0000 in
ASME Code Weld Type per UW-16		None
Class of attached Flange		150
Grade of attached Flange		GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: K1A

ASME Code, Section VIII, Div. 1, 2013, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	4.000 in.
Actual Thickness Used in Calculation	0.750 in.

Note: Post Weld Heat Treating is required for this Nozzle Geometry!

Nozzle input data check completed without errors.

Reqd thk per UG-37(a)of Elliptical Head, Tr [Int. Press]

= (P*D*K)/(2*S*E-0.2*P) Appendix 1-4(c)

= (52.43*57.2360*0.995)/(2*19500.00*1.00-0.2*52.43)

= 0.0765 in

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]

= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (52.43*2.12)/(17100*1.00-0.6*52.43)

= 0.0065 in

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	Dl	8.4720 in
Parallel to Vessel Wall, opening length	d	4.2360 in
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	0.3300 in

Weld Strength Reduction Factor [fr1]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr2]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr3]:

= min(fr2, fr4)

= min(0.9 , 1.0)

= 0.877

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	0.336	NA	NA in²
Area in Shell	A1	0.226	NA	NA in²

Area in Nozzle Wall	A2	0.362	NA	NA in²
Area in Inward Nozzle	A3	0.000	NA	NA in²
Area in Welds	A41+A42+A43	0.483	NA	NA in²
Area in Element	A5	0.000	NA	NA in²
TOTAL AREA AVAILABLE	Atot	1.072	NA	NA in²

Lampiran 15. Perhitungan *Nozzle* M1

INPUT VALUES, Nozzle Description: M1 From : 10

Pressure for Reinforcement Calculations	P	51.648 psig
Temperature for Internal Pressure	Temp	212 °F
Shell Material [Impact Tested]		SA-516 60
Shell Allowable Stress at Temperature	S	19500.00 psi
Shell Allowable Stress At Ambient	Sa	19500.00 psi
Inside Diameter of Elliptical Head	D	57.0000 in
Aspect Ratio of Elliptical Head	Ar	2.00
Head Finished (Minimum) Thickness	t	0.2500 in
Head Internal Corrosion Allowance	c	0.1180 in
Head External Corrosion Allowance	co	0.0000 in
Distance from Head Centerline	L1	0.0000 in
User Entered Minimum Design Metal Temperature		-20.00 °F

Type of Element Connected to the Shell : Nozzle

Material		SA-106 B
Material UNS Number		K03006
Material Specification/Type		Smls. pipe
Allowable Stress at Temperature	Sn	17100.00 psi
Allowable Stress At Ambient	Sna	17100.00 psi

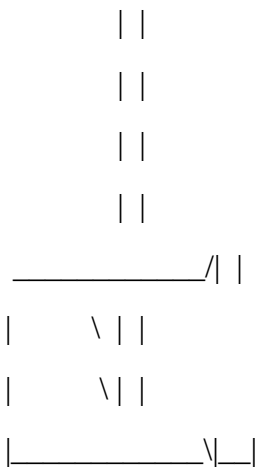
Diameter Basis (for tr calc only)		ID
Layout Angle		90.00 deg
Diameter		20.0000 in.
Size and Thickness Basis		Actual
Actual Thickness	tn	1.5600 in
Flange Material		SA-106 B
Flange Type		Weld Neck Flange
Corrosion Allowance	can	0.1180 in
Joint Efficiency of Shell Seam at Nozzle	E1	1.00
Joint Efficiency of Nozzle Neck	En	1.00
Outside Projection	ho	2.5000 in
Weld leg size between Nozzle and Pad/Shell	Wo	2.5000 in
Groove weld depth between Nozzle and Vessel	Wgnv	0.2500 in
Inside Projection	h	0.0000 in
Weld leg size, Inside Element to Shell	Wi	0.0000 in
ASME Code Weld Type per UW-16		None

This is a Manway or Access Opening.

Class of attached Flange	300
Grade of attached Flange	GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: M1

ASME Code, Section VIII, Div. 1, 2013, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	20.000 in.
Actual Thickness Used in Calculation	1.560 in.

Note: Post Weld Heat Treating is required for this Nozzle Geometry!

Nozzle input data check completed without errors.

Reqd thk per UG-37(a)of Elliptical Head, Tr [Int. Press]

= (P*K1*D))/(2*S*E-0.2*P) per UG-37(a)(3)

= (51.65*0.896*57.2360)/(2 *19500.00*1.00-0.2*51.65)

= 0.0680 in

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]

= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (51.65*10.12)/(17100*1.00-0.6*51.65)

= 0.0306 in

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	Dl	40.4720 in
Parallel to Vessel Wall, opening length	d	20.2360 in
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	0.3300 in

Weld Strength Reduction Factor [fr1]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr2]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr3]:

= min(fr2, fr4)

= min(0.9 , 1.0)

= 0.877

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design External	Mapnc
Area Required	Ar 1.400	NA	NA in²

Area in Shell	A1	1.273	NA	NA in²
Area in Nozzle Wall	A2	0.817	NA	NA in²
Area in Inward Nozzle	A3	0.000	NA	NA in²
Area in Welds	A41+A42+A43	1.351	NA	NA in²
Area in Element	A5	0.000	NA	NA in²
TOTAL AREA AVAILABLE	Atot	3.441	NA	NA in²

Lampiran 16. Perhitungan Nozzle N1

INPUT VALUES, Nozzle Description: N1 From : 20

Pressure for Reinforcement Calculations	P	52.522 psig
Temperature for Internal Pressure	Temp	212 °F
Shell Material [Impact Tested]		SA-516 60
Shell Allowable Stress at Temperature	S	19500.00 psi
Shell Allowable Stress At Ambient	Sa	19500.00 psi
Inside Diameter of Cylindrical Shell	D	57.0000 in
Shell Finished (Minimum) Thickness	t	0.3125 in
Shell Internal Corrosion Allowance	c	0.1180 in
Shell External Corrosion Allowance	co	0.0000 in
Distance from Bottom/Left Tangent		1.8666 ft
User Entered Minimum Design Metal Temperature		-20.00 °F

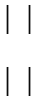
Type of Element Connected to the Shell : Nozzle

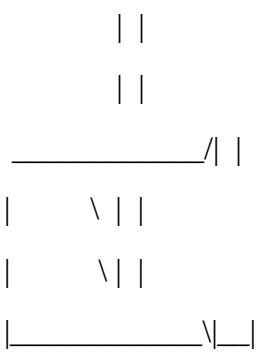
Material		SA-106 B
Material UNS Number		K03006
Material Specification/Type		Smls. pipe
Allowable Stress at Temperature	Sn	17100.00 psi
Allowable Stress At Ambient	Sna	17100.00 psi
Diameter Basis (for tr calc only)		ID
Layout Angle		280.00 deg

Diameter		4.0000 in.
Size and Thickness Basis		Actual
Actual Thickness	tn	0.8800 in
Flange Material		SA-106 B
Flange Type		Long Weld Neck
Corrosion Allowance	can	0.1180 in
Joint Efficiency of Shell Seam at Nozzle	E1	1.00
Joint Efficiency of Nozzle Neck	En	1.00
Outside Projection	ho	1.7500 in
Weld leg size between Nozzle and Pad/Shell	Wo	0.3750 in
Groove weld depth between Nozzle and Vessel	Wgnv	0.2800 in
Inside Projection	h	0.0000 in
Weld leg size, Inside Element to Shell	Wi	0.0000 in
ASME Code Weld Type per UW-16		None
Class of attached Flange		150
Grade of attached Flange		GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)





Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: N1

ASME Code, Section VIII, Div. 1, 2013, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	4.000 in.
Actual Thickness Used in Calculation	0.880 in.

Note: Post Weld Heat Treating is required for this Nozzle Geometry!

Nozzle input data check completed without errors.

Reqd thk per UG-37(a)of Cylindrical Shell, Tr [Int. Press]

= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (52.52*28.6180)/(19500*1.00-0.6*52.52)

= 0.0772 in

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]

= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (52.52*2.12)/(17100*1.00-0.6*52.52)

= 0.0065 in

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	Dl	8.4720	in
Parallel to Vessel Wall, opening length	d	4.2360	in
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	0.4862	in

Weld Strength Reduction Factor [fr1]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr2]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr3]:

= min(fr2, fr4)

= min(0.9 , 1.0)

= 0.877

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	0.342	NA	NA in²
Area in Shell	A1	0.475	NA	NA in²
Area in Nozzle Wall	A2	0.644	NA	NA in²
Area in Inward Nozzle	A3	0.000	NA	NA in²

Area in Welds	A41+A42+A43	0.123	NA	NA	in^2
Area in Element	A5	0.000	NA	NA	in^2
TOTAL AREA AVAILABLE	Atot	1.242	NA	NA	in^2

Lampiran 17. Perhitungan *Nozzle* N2

INPUT VALUES, Nozzle Description: N2 From : 20

Pressure for Reinforcement Calculations	P	52.522 psig
Temperature for Internal Pressure	Temp	212 °F
Shell Material [Impact Tested]		SA-516 60
Shell Allowable Stress at Temperature	S	19500.00 psi
Shell Allowable Stress At Ambient	Sa	19500.00 psi
Inside Diameter of Cylindrical Shell	D	57.0000 in
Shell Finished (Minimum) Thickness	t	0.3125 in
Shell Internal Corrosion Allowance	c	0.1180 in
Shell External Corrosion Allowance	co	0.0000 in
Distance from Bottom/Left Tangent		5.1666 ft
User Entered Minimum Design Metal Temperature		-20.00 °F

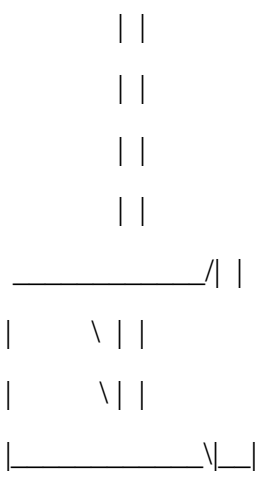
Type of Element Connected to the Shell : Nozzle

Material		SA-106 B
Material UNS Number		K03006
Material Specification/Type		Smls. pipe
Allowable Stress at Temperature	Sn	17100.00 psi
Allowable Stress At Ambient	Sna	17100.00 psi

Diameter Basis (for tr calc only)		ID
Layout Angle		280.00 deg
Diameter		6.0000 in.
Size and Thickness Basis		Actual
Actual Thickness	tn	0.8800 in
Flange Material		SA-106 B
Flange Type		Long Weld Neck
Corrosion Allowance	can	0.1180 in
Joint Efficiency of Shell Seam at Nozzle	E1	1.00
Joint Efficiency of Nozzle Neck	En	1.00
Outside Projection	ho	2.0000 in
Weld leg size between Nozzle and Pad/Shell	Wo	0.5000 in
Groove weld depth between Nozzle and Vessel	Wgnv	0.2800 in
Inside Projection	h	0.0000 in
Weld leg size, Inside Element to Shell	Wi	0.0000 in
ASME Code Weld Type per UW-16		None
Class of attached Flange		150
Grade of attached Flange		GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: N2

ASME Code, Section VIII, Div. 1, 2013, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	6.000 in.
Actual Thickness Used in Calculation	0.880 in.

Note: Post Weld Heat Treating is required for this Nozzle Geometry!

Nozzle input data check completed without errors.

Reqd thk per UG-37(a)of Cylindrical Shell, Tr [Int. Press]

= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (52.52*28.6180)/(19500*1.00-0.6*52.52)

= 0.0772 in

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]

= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (52.52*3.12)/(17100*1.00-0.6*52.52)

= 0.0096 in

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	Dl	12.4720 in
Parallel to Vessel Wall, opening length	d	6.2360 in
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	0.4862 in

Weld Strength Reduction Factor [fr1]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr2]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr3]:

= min(fr2, fr4)

= min(0.9 , 1.0)

= 0.877

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	0.496	NA	NA in²
Area in Shell	A1	0.709	NA	NA in²

Area in Nozzle Wall	A2	0.642	NA	NA in²
Area in Inward Nozzle	A3	0.000	NA	NA in²
Area in Welds	A41+A42+A43	0.219	NA	NA in²
Area in Element	A5	0.000	NA	NA in²
TOTAL AREA AVAILABLE	Atot	1.570	NA	NA in²

Lampiran 18. Perhitungan *Nozzle* N4

INPUT VALUES, Nozzle Description: N4 From : 20

Pressure for Reinforcement Calculations	P	50.760 psig
Temperature for Internal Pressure	Temp	212 °F
Shell Material [Impact Tested]		SA-516 60
Shell Allowable Stress at Temperature	S	19500.00 psi
Shell Allowable Stress At Ambient	Sa	19500.00 psi
Inside Diameter of Cylindrical Shell	D	57.0000 in
Shell Finished (Minimum) Thickness	t	0.3125 in
Shell Internal Corrosion Allowance	c	0.1180 in
Shell External Corrosion Allowance	co	0.0000 in
Distance from Bottom/Left Tangent		13.1666 ft
User Entered Minimum Design Metal Temperature		-20.00 °F

Type of Element Connected to the Shell : Nozzle

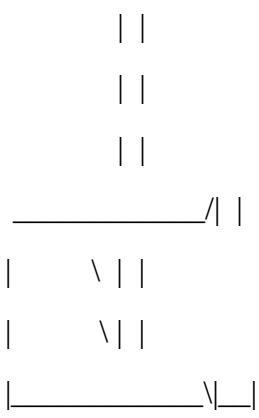
Material		SA-106 B
Material UNS Number		K03006
Material Specification/Type		Smls. pipe
Allowable Stress at Temperature	Sn	17100.00 psi
Allowable Stress At Ambient	Sna	17100.00 psi
Diameter Basis (for tr calc only)		ID

Layout Angle		90.00 deg
Diameter		6.0000 in.
Size and Thickness Basis		Actual
Actual Thickness	tn	0.8800 in
Flange Material		SA-106 B
Flange Type		Long Weld Neck
Corrosion Allowance	can	0.1180 in
Joint Efficiency of Shell Seam at Nozzle	E1	1.00
Joint Efficiency of Nozzle Neck	En	1.00
Outside Projection	ho	2.0000 in
Weld leg size between Nozzle and Pad/Shell	Wo	0.5000 in
Groove weld depth between Nozzle and Vessel	Wgnv	0.2800 in
Inside Projection	h	0.0000 in
Weld leg size, Inside Element to Shell	Wi	0.0000 in
ASME Code Weld Type per UW-16		None
Class of attached Flange		150
Grade of attached Flange		GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)

| |



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: N4

ASME Code, Section VIII, Div. 1, 2013, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	6.000 in.
Actual Thickness Used in Calculation	0.880 in.

Note: Post Weld Heat Treating is required for this Nozzle Geometry!

Nozzle input data check completed without errors.

Reqd thk per UG-37(a)of Cylindrical Shell, Tr [Int. Press]

= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (50.76*28.6180)/(19500*1.00-0.6*50.76)

= 0.0746 in

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]

= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (50.76*3.12)/(17100*1.00-0.6*50.76)

= 0.0093 in

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	Dl	12.4720	in
Parallel to Vessel Wall, opening length	d	6.2360	in
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	0.4862	in

Weld Strength Reduction Factor [fr1]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr2]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr3]:

= min(fr2, fr4)

= min(0.9 , 1.0)

= 0.877

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	0.479	NA	NA in²
Area in Shell	A1	0.725	NA	NA in²
Area in Nozzle Wall	A2	0.642	NA	NA in²

Area in Inward Nozzle	A3	0.000	NA	NA	in²
Area in Welds	A41+A42+A43	0.219	NA	NA	in²
Area in Element	A5	0.000	NA	NA	in²
TOTAL AREA AVAILABLE	Atot	1.586	NA	NA	in²

Lampiran 19. Perhitungan Nozzle K1B

INPUT VALUES, Nozzle Description: K1B From : 20

Pressure for Reinforcement Calculations	P	50.760 psig
Temperature for Internal Pressure	Temp	212 °F
Shell Material [Impact Tested]		SA-516 60
Shell Allowable Stress at Temperature	S	19500.00 psi
Shell Allowable Stress At Ambient	Sa	19500.00 psi
Inside Diameter of Cylindrical Shell	D	57.0000 in
Shell Finished (Minimum) Thickness	t	0.3125 in
Shell Internal Corrosion Allowance	c	0.1180 in
Shell External Corrosion Allowance	co	0.0000 in
Distance from Bottom/Left Tangent		0.8666 ft
User Entered Minimum Design Metal Temperature		-20.00 °F

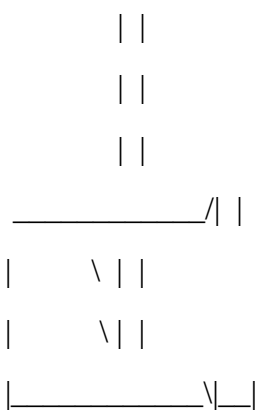
Type of Element Connected to the Shell : Nozzle

Material		SA-106 B
Material UNS Number		K03006
Material Specification/Type		Smls. pipe
Allowable Stress at Temperature	Sn	17100.00 psi
Allowable Stress At Ambient	Sna	17100.00 psi
Diameter Basis (for tr calc only)		ID

Layout Angle		90.00 deg
Diameter		4.0000 in.
Size and Thickness Basis		Actual
Actual Thickness	tn	0.7500 in
Flange Material		SA-106 B
Flange Type		Long Weld Neck
Corrosion Allowance	can	0.1180 in
Joint Efficiency of Shell Seam at Nozzle	E1	1.00
Joint Efficiency of Nozzle Neck	En	1.00
Outside Projection	ho	2.0625 in
Weld leg size between Nozzle and Pad/Shell	Wo	0.5000 in
Groove weld depth between Nozzle and Vessel	Wgnv	0.2800 in
Inside Projection	h	0.0000 in
Weld leg size, Inside Element to Shell	Wi	0.0000 in
ASME Code Weld Type per UW-16		None
Class of attached Flange		150
Grade of attached Flange		GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: K1B

ASME Code, Section VIII, Div. 1, 2013, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	4.000 in.
Actual Thickness Used in Calculation	0.750 in.

Note: Post Weld Heat Treating is required for this Nozzle Geometry!

Nozzle input data check completed without errors.

Reqd thk per UG-37(a)of Cylindrical Shell, Tr [Int. Press]

= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (50.76*28.6180)/(19500*1.00-0.6*50.76)

= 0.0746 in

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]

= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (50.76*2.12)/(17100*1.00-0.6*50.76)

= 0.0063 in

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	Dl	8.4720 in
Parallel to Vessel Wall, opening length	d	4.2360 in
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	0.4862 in

Weld Strength Reduction Factor [fr1]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr2]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr3]:

= min(fr2, fr4)

= min(0.9 , 1.0)

= 0.877

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	0.328	NA	NA in²
Area in Shell	A1	0.489	NA	NA in²
Area in Nozzle Wall	A2	0.534	NA	NA in²

Area in Inward Nozzle	A3	0.000	NA	NA	in²
Area in Welds	A41+A42+A43	0.219	NA	NA	in²
Area in Element	A5	0.000	NA	NA	in²
TOTAL AREA AVAILABLE	Atot	1.242	NA	NA	in²

Lampiran 20. Perhitungan Nozzle K2A

INPUT VALUES, Nozzle Description: K2A From : 20

Pressure for Reinforcement Calculations	P	51.951 psig
Temperature for Internal Pressure	Temp	212 °F
Shell Material [Impact Tested]		SA-516 60
Shell Allowable Stress at Temperature	S	19500.00 psi
Shell Allowable Stress At Ambient	Sa	19500.00 psi
Inside Diameter of Cylindrical Shell	D	57.0000 in
Shell Finished (Minimum) Thickness	t	0.3125 in
Shell Internal Corrosion Allowance	c	0.1180 in
Shell External Corrosion Allowance	co	0.0000 in
Distance from Bottom/Left Tangent		9.1666 ft
User Entered Minimum Design Metal Temperature		-20.00 °F

Type of Element Connected to the Shell : Nozzle

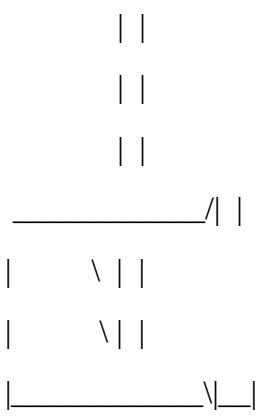
Material		SA-106 B
Material UNS Number		K03006
Material Specification/Type		Smls. pipe
Allowable Stress at Temperature	Sn	17100.00 psi
Allowable Stress At Ambient	Sna	17100.00 psi
Diameter Basis (for tr calc only)		ID

Layout Angle		340.00 deg
Diameter		4.0000 in.
Size and Thickness Basis		Actual
Actual Thickness	tn	0.7500 in
Flange Material		SA-106 B
Flange Type		Long Weld Neck
Corrosion Allowance	can	0.1180 in
Joint Efficiency of Shell Seam at Nozzle	E1	1.00
Joint Efficiency of Nozzle Neck	En	1.00
Outside Projection	ho	2.0625 in
Weld leg size between Nozzle and Pad/Shell	Wo	0.5000 in
Groove weld depth between Nozzle and Vessel	Wgnv	0.2800 in
Inside Projection	h	0.0000 in
Weld leg size, Inside Element to Shell	Wi	0.0000 in
ASME Code Weld Type per UW-16		None
Class of attached Flange		150
Grade of attached Flange		GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)

| |



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: K2A

ASME Code, Section VIII, Div. 1, 2013, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	4.000 in.
Actual Thickness Used in Calculation	0.750 in.

Note: Post Weld Heat Treating is required for this Nozzle Geometry!

Nozzle input data check completed without errors.

Reqd thk per UG-37(a)of Cylindrical Shell, Tr [Int. Press]

= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (51.95*28.6180)/(19500*1.00-0.6*51.95)

= 0.0764 in

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]

= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (51.95*2.12)/(17100*1.00-0.6*51.95)

= 0.0064 in

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	Dl	8.4720	in
Parallel to Vessel Wall, opening length	d	4.2360	in
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	0.4862	in

Weld Strength Reduction Factor [fr1]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr2]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr3]:

= min(fr2, fr4)

= min(0.9 , 1.0)

= 0.877

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	0.335	NA	NA in²
Area in Shell	A1	0.482	NA	NA in²
Area in Nozzle Wall	A2	0.533	NA	NA in²

Area in Inward Nozzle	A3	0.000	NA	NA	in²
Area in Welds	A41+A42+A43	0.219	NA	NA	in²
Area in Element	A5	0.000	NA	NA	in²
TOTAL AREA AVAILABLE	Atot	1.235	NA	NA	in²

Lampiran 20. Perhitungan Nozzle K2B

INPUT VALUES, Nozzle Description: K2B From : 20

Pressure for Reinforcement Calculations	P	51.204 psig
Temperature for Internal Pressure	Temp	212 °F
Shell Material [Impact Tested]		SA-516 60
Shell Allowable Stress at Temperature	S	19500.00 psi
Shell Allowable Stress At Ambient	Sa	19500.00 psi
Inside Diameter of Cylindrical Shell	D	57.0000 in
Shell Finished (Minimum) Thickness	t	0.3125 in
Shell Internal Corrosion Allowance	c	0.1180 in
Shell External Corrosion Allowance	co	0.0000 in
Distance from Bottom/Left Tangent		9.1666 ft
User Entered Minimum Design Metal Temperature		-20.00 °F

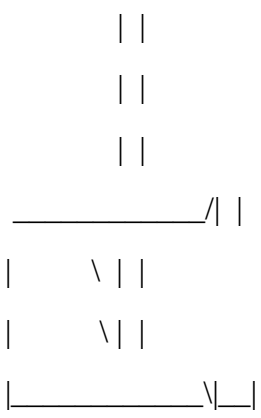
Type of Element Connected to the Shell : Nozzle

Material		SA-106 B
Material UNS Number		K03006
Material Specification/Type		Smls. pipe
Allowable Stress at Temperature	Sn	17100.00 psi
Allowable Stress At Ambient	Sna	17100.00 psi
Diameter Basis (for tr calc only)		ID

Layout Angle		30.00 deg
Diameter		4.0000 in.
Size and Thickness Basis		Actual
Actual Thickness	tn	0.7500 in
Flange Material		SA-106 B
Flange Type		Weld Neck Flange
Corrosion Allowance	can	0.1180 in
Joint Efficiency of Shell Seam at Nozzle	E1	1.00
Joint Efficiency of Nozzle Neck	En	1.00
Outside Projection	ho	2.0625 in
Weld leg size between Nozzle and Pad/Shell	Wo	0.5000 in
Groove weld depth between Nozzle and Vessel	Wgnv	0.2800 in
Inside Projection	h	0.0000 in
Weld leg size, Inside Element to Shell	Wi	0.0000 in
ASME Code Weld Type per UW-16		None
Class of attached Flange		150
Grade of attached Flange		GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch (may not represent actual weld type/configuration)



Insert/Set-in Nozzle No Pad, no Inside projection

Reinforcement CALCULATION, Description: K2B

ASME Code, Section VIII, Div. 1, 2013, UG-37 to UG-45

Actual Inside Diameter Used in Calculation	4.000 in.
Actual Thickness Used in Calculation	0.750 in.

Note: Post Weld Heat Treating is required for this Nozzle Geometry!

Nozzle input data check completed without errors.

Reqd thk per UG-37(a)of Cylindrical Shell, Tr [Int. Press]
= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
= (51.20*28.6180)/(19500*1.00-0.6*51.20)
= 0.0753 in

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]
= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)

= (51.20*2.12)/(17100*1.00-0.6*51.20)

= 0.0064 in

UG-40, Limits of Reinforcement : [Internal Pressure]

Parallel to Vessel Wall (Diameter Limit)	Dl	8.4720	in
Parallel to Vessel Wall, opening length	d	4.2360	in
Normal to Vessel Wall (Thickness Limit), no pad	Tlnp	0.4862	in

Weld Strength Reduction Factor [fr1]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr2]:

= min(1, Sn/S)

= min(1, 17100.0/19500.0)

= 0.877

Weld Strength Reduction Factor [fr3]:

= min(fr2, fr4)

= min(0.9 , 1.0)

= 0.877

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc
Area Required	Ar	0.331	NA	NA in²
Area in Shell	A1	0.487	NA	NA in²
Area in Nozzle Wall	A2	0.534	NA	NA in²

Area in Inward Nozzle	A3	0.000	NA	NA	in²
Area in Welds	A41+A42+A43	0.219	NA	NA	in²
Area in Element	A5	0.000	NA	NA	in²
TOTAL AREA AVAILABLE	Atot	1.239	NA	NA	in²

Lampiran 22. *Nozzle Schedule*

Nozzle Schedule:

Description	Nominal Size in.	Flange Sch/Type Cls	Noz. O/Dia in.	Wall Thk in	Re-Pad ODia in	Re-Pad Thick in	Cut Length in
N5	2.000	150 LWN	3.060	0.530	-	-	2.60
N6	2.000	150 LWN	3.060	0.530	-	-	2.60
N7	2.000	150 LWN	3.060	0.530	-	-	2.60
K3A	2.000	150 LWN	3.060	0.530	-	-	2.60
K3B	2.000	150 LWN	3.060	0.530	-	-	2.60
K4	2.000	150 LWN	3.060	0.530	-	-	2.60
N3	2.000	150 WNF	3.060	0.530	-	-	3.20
K1A	4.000	150 WNF	5.500	0.750	-	-	2.39
N1	4.000	150 LWN	5.760	0.880	-	-	2.21
K1B	4.000	150 LWN	5.500	0.750	-	-	2.51
K2A	4.000	150 LWN	5.500	0.750	-	-	2.51
K2B	4.000	150 WNF	5.500	0.750	-	-	2.51
N2	6.000	150 LWN	7.760	0.880	-	-	2.58
N4	6.000	150 LWN	7.760	0.880	-	-	2.58
M1	20.000	300 WNF	23.120	1.560	-	-	4.06

General Notes for the above table:

The Cut Length is the Outside Projection + Inside Projection + Drop + In Plane Shell Thickness. This value does not include weld gaps, nor does it account for shrinkage.

In the case of Oblique Nozzles, the Outside Diameter must
be increased. The Re-Pad WIDTH around the nozzle is calculated as follows:
Width of Pad = (Pad Outside Dia. (per above) - Nozzle Outside Dia.)/2

For hub nozzles, the thickness and diameter shown are those of the smaller
and thinner section.

Nozzle Material and Weld Fillet Leg Size Details:

Nozzle	Material	Shl Grve Weld in	Noz Shl/Pad Weld in	Pad OD Weld in	Pad Grve Weld in	Inside Weld in
N5	SA-106 B	0.280	0.500	-	-	-
N6	SA-106 B	0.280	0.500	-	-	-
N7	SA-106 B	0.280	0.500	-	-	-
K3A	SA-106 B	0.280	0.500	-	-	-
K3B	SA-106 B	0.280	0.500	-	-	-
K4	SA-106 B	0.280	0.500	-	-	-
N3	SA-106 B	0.250	0.375	-	-	-
K1A	SA-106 B	0.250	1.000	-	-	-
N1	SA-106 B	0.280	0.375	-	-	-
K1B	SA-106 B	0.280	0.500	-	-	-
K2A	SA-106 B	0.280	0.500	-	-	-
K2B	SA-106 B	0.280	0.500	-	-	-
N2	SA-106 B	0.280	0.500	-	-	-
N4	SA-106 B	0.280	0.500	-	-	-
M1	SA-106 B	0.250	2.500	-	-	-

Note: The Outside projections below do not include the flange thickness.

Nozzle Miscellaneous Data:

Nozzle	Elevation/Distance From Datum ft	Layout Angle deg.	Projection Outside in	Inside in	Installed In Component
N5	9.000	90.00	2.25	0.00	Node: 20
N6	8.000	90.00	2.25	0.00	Node: 20
N7	1.700	90.00	2.25	0.00	Node: 20
K3A	7.000	343.00	2.25	0.00	Node: 20
K3B	7.000	27.00	2.25	0.00	Node: 20
K4	10.000	270.00	2.25	0.00	Node: 20
N3		270.00	2.25	0.00	Node: 30
K1A		270.00	2.06	0.00	Node: 10
N1	1.700	280.00	1.75	0.00	Node: 20
K1B	0.700	90.00	2.06	0.00	Node: 20
K2A	9.000	340.00	2.06	0.00	Node: 20
K2B	9.000	30.00	2.06	0.00	Node: 20
N2	5.000	280.00	2.00	0.00	Node: 20
N4	13.000	90.00	2.00	0.00	Node: 20
M1		90.00	2.50	0.00	Node: 10

Nozzle Calculation Summary:

Description	MAWP psig	Ext psig	MAPNC	UG45 [tr]	Weld Path	Areas or Stresses
K1A	88.62	...	...	OK 0.195	OK	Passed
M1	88.62	...	...	...	OK	Passed
N1	122.22	...	...	OK 0.195	OK	Passed
N2	108.66	...	...	OK 0.195	OK	Passed
N4	110.42	...	...	OK 0.193	OK	Passed
N5	130.21	...	...	OK 0.193	OK	NoCalc[*]
N6	130.21	...	...	OK 0.193	OK	NoCalc[*]
N7	130.21	...	...	OK 0.193	OK	NoCalc[*]
K3A	130.21	...	...	OK 0.194	OK	NoCalc[*]
K3B	130.21	...	...	OK 0.193	OK	NoCalc[*]
K4	130.21	...	...	OK 0.195	OK	NoCalc[*]
K1B	123.28	...	...	OK 0.193	OK	Passed
K2A	122.08	...	...	OK 0.194	OK	Passed
K2B	122.83	...	...	OK 0.193	OK	Passed
N3	88.62	...	...	OK 0.194	OK	NoCalc[*]
N3	88.62	...	...	OK 0.194	OK	NoCalc[*]

Min. - Nozzles 88.62 N3

Min. Shell&Flgs 88.62 30 40 170.90

Computed Vessel M.A.W.P. 88.62 psig

[*] - This was a small opening and the areas were not computed or

the MAWP of this connection could not be computed because
the longitudinal bending stress was greater than the hoop stress.

Note: MAWPs (Internal Case) shown above are at the High Point.

Check the Spatial Relationship between the Nozzles

From Node	Nozzle Description	X Coordinate,	Layout Angle,	Dia. Limit
10	K1A	0.000	270.000	8.472
10	M1	0.000	90.000	40.472
20	N1	22.399	280.000	8.472
20	N2	61.999	280.000	12.472
20	N4	157.999	90.000	12.472
20	N5	109.999	90.000	4.472
20	N6	97.999	90.000	4.472
20	N7	22.399	90.000	4.472
20	K3A	85.999	343.000	4.472
20	K3B	85.999	27.000	4.472
20	K4	121.999	270.000	4.472
20	K1B	10.399	90.000	8.472
20	K2A	109.999	340.000	8.472
20	K2B	109.999	30.000	8.472
30	N3	0.000	270.000	4.472

The nozzle spacing is computed by the following:

$= Sqrt(ll^2 + lc^2)$ where

ll - Arc length along the inside vessel surface in the long. direction.

lc - Arc length along the inside vessel surface in the circ. direction

If any interferences/violations are found, they will be noted below.
No interference violations have been detected !

ASME Code, Section VIII, Division 1, 2013

Diameter Spec : 57.000 in ID	
Vessel Design Length, Tangent to Tangent	14.60 ft
Specified Datum Line Distance	0.17 ft
Shell Material	SA-516 60 [Impact Tested]
Nozzle Material	SA-106 B [Impact Tested]
Internal Design Temperature	212 °F
Internal Design Pressure	50.760 psig
External Design Temperature	0 °F
Maximum Allowable Working Pressure	88.617 psig
Hydrostatic Test Pressure	65.988 psig
Required Minimum Design Metal Temperature	-20 °F
Warmest Computed Minimum Design Metal Temperature	-20 °F

Wind Design Code	ASCE-93
Earthquake Design Code	UBC-94

Element Pressures and MAWP: psig

Element Desc	Design Pres. + Stat. head	External Pressure	M.A.W.P	Corrosion Allowance
Ellipse	52.539	0.000	88.617	0.1180
Cylinder	52.539	0.000	130.213	0.1180
Ellipse	52.539	0.000	88.617	0.1180

Liquid Level: 4.75 ft Dens.: 53.820 lb/ft³ Sp. Gr.: 0.862

Element Type	"To" Elev ft	Length ft	Element Thk in Int.	Ext.	Req'd Thk Long	Circ	Joint Eff Long	Circ
Ellipse	0.00	0.167	0.315	0.195	0.181	1.00	1.00	
Cylinder	14.27	14.270	0.315	0.195	No Calc	1.00	1.00	
Ellipse	14.44	0.167	0.315	0.195	0.181	1.00	1.00	

Element thicknesses are shown as Nominal if specified, otherwise are Minimum

Saddle Parameters:

Saddle Width	12.500 in
Saddle Bearing Angle	120.000 deg.
Centerline Dimension	36.000 in
Wear Pad Width	11.000 in

Wear Pad Thickness	0.375 in
Wear Pad Bearing Angle	132.000 deg.
Distance from Saddle to Tangent	16.250 in

Baseplate Length	48.000 in
Baseplate Thickness	0.750 in
Baseplate Width	9.000 in
Number of Ribs (including outside ribs)	1
Rib Thickness	0.375 in
Web Thickness	9.000 in
Height of Center Web	12.000 in

Summary of Maximum Saddle Loads, Operating Case :

Maximum Vertical Saddle Load	18021.68 lbf
Maximum Transverse Saddle Shear Load	2287.40 lbf
Maximum Longitudinal Saddle Shear Load	4574.79 lbf

Summary of Maximum Saddle Loads, Hydrotest Case :

Maximum Vertical Saddle Load	15557.44 lbf
Maximum Transverse Saddle Shear Load	226.53 lbf
Maximum Longitudinal Saddle Shear Load	149.00 lbf

Weights:

Fabricated - Bare W/O Removable Internals	11074.6 lbm
Shop Test - Fabricated + Water (Full)	28973.0 lbm
Shipping - Fab. + Rem. Intls.+ Shipping App.	11074.6 lbm
Erected - Fab. + Rem. Intls.+ Insul. (etc)	11074.6 lbm
Empty - Fab. + Intls. + Details + Wghts.	11074.6 lbm

Operating - Empty + Operating Liquid (No CA)	26512.0 lbm
Field Test - Empty Weight + Water (Full)	28973.0 lbm