PV Elite Vessel Analysis Program: Input Data

Design Internal Pressure (for Hydrotest)	3.5154	KG/CM2
Design Internal Temperature	407	C
Type of Hydrotest	UG99-b Note [34]	
Hydrotest Position	Vertical	
Projection of Nozzle from Vessel Top	0.0000	mm.
Projection of Nozzle from Vessel Bottom	0.0000	mm.
Minimum Design Metal Temperature	19	C
Type of Construction	Welded	
Special Service	None	
Degree of Radiography	RT 1	
Miscellaneous Weight Percent	10.	
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	Y	
Perform a Corroded Hydrotest	Y	
Is this a Heat Exchanger	No	
User Defined Hydro. Press. (Used if > 0)	8.3000	KG/CM2
User defined MAWP	0.0000	KG/CM2
User defined MAPnc	0.0000	KG/CM2

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 98/02/05/IBC-03/STS-1		
Design Wind Speed		33.974	m/sec
Exposure Constant		C	
Importance Factor		1.15	
Roughness Factor		1	
Base Elevation		304.80	mm.
Percent Wind for Hydrotest		33.	
Using User defined Wind Press. Vs Elev.		N	
Height of Hill or Escarpment	H	0.0000	mm.
Distance Upwind of Crest	Lh	0.0000	mm.
Distance from Crest to the Vessel	x	0.0000	mm.
Height above Local Ground	z	0.0000	mm.
Type of Terrain (Hill, Escarpment)		Flat	
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	No Seismic
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

Complete Listing of Vessel Elements and Details:

Element From Node	10	
Element To Node	20	
Element Type	Skirt Sup.	
Description	BTM SKRT	
Distance "FROM" to "TO"	1200.0	mm.
Skirt Outside Diameter	3569.5	mm.
Diameter of Skirt at Base	3569.5	mm.
Skirt Thickness	20.000	mm.
Internal Corrosion Allowance	3.0000	mm.
Nominal Thickness	0.0000	mm.
External Corrosion Allowance	0.0000	mm.
Design Temperature Internal Pressure	407	C
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-283 C	
Allowable Stress, Ambient	1103.8	KG/CM2
Allowable Stress, Operating	1103.8	KG/CM2
Allowable Stress, Hydrotest	1898.3	KG/CM2
Material Density	7833.4	KG/CU-M
P Number Thickness	31.750	mm.
Yield Stress, Operating	1447.6	KG/CM2
UCS-66 Chart Curve Designation	A	
External Pressure Chart Name	CS-2	
UNS Number	K02401	
Product Form	Plate	
Efficiency, Longitudinal Seam	0.7	
Efficiency, Head-to-Skirt or Circ. Seam	0.7	

Element From Node	10	
Detail Type	Insulation	
Detail ID	FIREPRROFING2	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Insulation	1200.0	mm.
Thickness of Insulation	50.800	mm.
Density	2200.0	KG/CU.M

Element From Node	10	
Detail Type	Lining	
Detail ID	FIREPROOFING1	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Lining	1200.0	mm.
Thickness of Lining	50.800	mm.
Density	2200.0	KG/CU.M

Element From Node	10	
Detail Type	Weight	
Detail ID	TAILING LUG	
Dist. from "FROM" Node / Offset dist	200.00	mm.
Miscellaneous Weight	200.00	KG
Offset from Element Centerline	0.0000	mm.

Element From Node	20	
Element To Node	30	
Element Type	Skirt Sup.	
Description	INTER SKRT2	
Distance "FROM" to "TO"	3000.0	mm.
Skirt Outside Diameter	3569.5	mm.
Diameter of Skirt at Base	3569.5	mm.
Skirt Thickness	16.000	mm.
Internal Corrosion Allowance	3.0000	mm.
Nominal Thickness	0.0000	mm.
External Corrosion Allowance	0.0000	mm.
Design Temperature Internal Pressure	407	C
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-283 C	
Efficiency, Longitudinal Seam	0.7	
Efficiency, Head-to-Skirt or Circ. Seam	0.7	

Element From Node	20	
Detail Type	Insulation	
Detail ID	FIREPROOFING4	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Insulation	3000.0	mm.
Thickness of Insulation	50.000	mm.
Density	2200.0	KG/CU.M

Element From Node	20	
Detail Type	Lining	
Detail ID	FIREPROOFING3	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Lining	3000.0	mm.
Thickness of Lining	2.0000	mm.
Density	2200.0	KG/CU.M

Element From Node	30	
Element To Node	40	
Element Type	Skirt Sup.	
Description	INTER SKRT1	
Distance "FROM" to "TO"	3000.0	mm.
Skirt Outside Diameter	3569.5	mm.
Diameter of Skirt at Base	3569.5	mm.
Skirt Thickness	14.000	mm.
Internal Corrosion Allowance	3.0000	mm.
Nominal Thickness	0.0000	mm.
External Corrosion Allowance	0.0000	mm.
Design Temperature Internal Pressure	407	C
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-516 60	
Allowable Stress, Ambient	1202.2	KG/CM2
Allowable Stress, Operating	867.59	KG/CM2
Allowable Stress, Hydrotest	2024.8	KG/CM2
Material Density	7833.4	KG/CU-M
P Number Thickness	31.750	mm.
Yield Stress, Operating	1546.1	KG/CM2
UCS-66 Chart Curve Designation	C	
External Pressure Chart Name	CS-2	
UNS Number	K02100	
Product Form	Plate	

Efficiency, Longitudinal Seam	0.7	
Efficiency, Head-to-Skirt or Circ. Seam	0.7	
Element From Node	30	
Detail Type	Insulation	
Detail ID	FIREPROOFING6	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Insulation	3000.0	mm.
Thickness of Insulation	50.800	mm.
Density	2200.0	KG/CU.M
Element From Node	30	
Detail Type	Lining	
Detail ID	FIREPROOFING5	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Lining	3000.0	mm.
Thickness of Lining	50.800	mm.
Density	2200.0	KG/CU.M

Element From Node	40	
Element To Node	50	
Element Type	Skirt Sup.	
Description	TOP SKRT	
Distance "FROM" to "TO"	600.00	mm.
Skirt Outside Diameter	3569.5	mm.
Diameter of Skirt at Base	3536.9	mm.
Skirt Thickness	14.000	mm.
Internal Corrosion Allowance	3.0000	mm.
Nominal Thickness	0.0000	mm.
External Corrosion Allowance	0.0000	mm.
Design Temperature Internal Pressure	407	C
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-516 60	
Efficiency, Longitudinal Seam	0.7	
Efficiency, Head-to-Skirt or Circ. Seam	0.7	
Element From Node	40	
Detail Type	Platform	
Detail ID	PLTFM1	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Platform Start Angle (degrees)	0.	
Platform End Angle (degrees)	360.	
Platform Wind Area	2.48E+06	sq.mm.
Platform Weight	8604.1	KG
Platform Railing Weight	0.0000	KG/mm.
Platform Grating Weight	450.00	KG/SQ.M.
Platform Width	1219.2	mm.
Platform Height	1016.0	mm.
Platform Clearance or End Offset	88.900	mm.
Platform Force Coefficient	1.	
Ladder Layout Angle	0.	
Ladder Start Elevation	0.0000	mm.
Ladder End Elevation	0.0000	mm.
Unit Weight of Ladder	0.0000	KG/mm.
Platform Length (top head platform)	0.0000	mm.
Element From Node	40	
Detail Type	Insulation	
Detail ID	FIREPROOFING8	
Dist. from "FROM" Node / Offset dist	0.0000	mm.

Height/Length of Insulation	600.00	mm.
Thickness of Insulation	50.800	mm.
Density	2200.0	KG/CU.M

Element From Node	40	
Detail Type	Lining	
Detail ID	FIREPROOFING7	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Lining	600.00	mm.
Thickness of Lining	50.800	mm.
Density	2200.0	KG/CU.M

Element From Node	50	
Element To Node	60	
Element Type	Elliptical	
Description	BTM HD	
Distance "FROM" to "TO"	48.768	mm.
Inside Diameter	3511.6	mm.
Element Thickness	12.000	mm.
Internal Corrosion Allowance	0.0000	mm.
Nominal Thickness	14.000	mm.
External Corrosion Allowance	0.0000	mm.
Design Internal Pressure	3.5154	KG/CM2
Design Temperature Internal Pressure	407	C
Design External Pressure	1.0546	KG/CM2
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-516 60	
Efficiency, Longitudinal Seam	1.	
Efficiency, Circumferential Seam	1.	
Elliptical Head Factor	2.	

Element From Node	50	
Detail Type	Insulation	
Detail ID	INS: 10	
Dist. from "FROM" Node / Offset dist	-877.89	mm.
Height/Length of Insulation	926.66	mm.
Thickness of Insulation	20.066	mm.
Density	185.00	KG/CU.M

Element From Node	50	
Detail Type	Lining	
Detail ID	CLADDING	
Dist. from "FROM" Node / Offset dist	-877.89	mm.
Height/Length of Lining	926.66	mm.
Thickness of Lining	6.3500	mm.
Density	8009.2	KG/CU.M

Element From Node	60	
Element To Node	70	
Element Type	Cylinder	
Description	Shell1	
Distance "FROM" to "TO"	3048.0	mm.
Inside Diameter	3511.6	mm.
Element Thickness	12.000	mm.
Internal Corrosion Allowance	0.0000	mm.
Nominal Thickness	0.0000	mm.
External Corrosion Allowance	0.0000	mm.
Design Internal Pressure	3.5154	KG/CM2

Design Temperature Internal Pressure	407	C
Design External Pressure	1.0546	KG/CM2
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-516 60	
Efficiency, Longitudinal Seam	0.85	
Efficiency, Circumferential Seam	0.85	
Element From Node	60	
Detail Type	Insulation	
Detail ID	INS: 10	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Insulation	3048.0	mm.
Thickness of Insulation	20.066	mm.
Density	185.00	KG/CU.M
Element From Node	60	
Detail Type	Lining	
Detail ID	CLADDING	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Lining	3048.0	mm.
Thickness of Lining	6.3500	mm.
Density	8009.2	KG/CU.M
Element From Node	60	
Detail Type	Ring	
Detail ID	RING1	
Dist. from "FROM" Node / Offset dist	2438.4	mm.
Inside Diameter of Ring	3535.6	mm.
Thickness of Ring	11.938	mm.
Outside Diameter of Ring	3942.2	mm.
Material Name	SA-516 60	
Height of Section Ring	0.0000	mm.
Using Custom Stiffener Section	No	
Element From Node	60	
Detail Type	Nozzle	
Detail ID	1M	
Dist. from "FROM" Node / Offset dist	609.60	mm.
Nozzle Diameter	609.59998	mm
Nozzle Schedule	None	
Nozzle Class	150	
Layout Angle	0.	
Blind Flange (Y/N)	Y	
Weight of Nozzle (Used if > 0)	0.0000	KG
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-516 60	

Element From Node	70	
Element To Node	80	
Element Type	Cylinder	
Description	Shell2	
Distance "FROM" to "TO"	3048.0	mm.
Inside Diameter	3511.6	mm.
Element Thickness	12.000	mm.
Internal Corrosion Allowance	0.0000	mm.
Nominal Thickness	0.0000	mm.
External Corrosion Allowance	0.0000	mm.
Design Internal Pressure	3.5154	KG/CM2
Design Temperature Internal Pressure	407	C
Design External Pressure	1.0546	KG/CM2

Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-516 60	
Efficiency, Longitudinal Seam	0.85	
Efficiency, Circumferential Seam	0.85	
Element From Node	70	
Detail Type	Platform	
Detail ID	PLT2	
Dist. from "FROM" Node / Offset dist	2011.7	mm.
Platform Start Angle (degrees)	0.	
Platform End Angle (degrees)	180.	
Platform Wind Area	2.00E+06	sq.mm.
Platform Weight	3332.6	KG
Platform Railing Weight	0.0000	KG/mm.
Platform Grating Weight	450.00	KG/SQ.M.
Platform Width	1000.0	mm.
Platform Height	1000.0	mm.
Platform Clearance or End Offset	88.900	mm.
Platform Force Coefficient	1.	
Ladder Layout Angle	0.	
Ladder Start Elevation	0.0000	mm.
Ladder End Elevation	0.0000	mm.
Unit Weight of Ladder	0.0000	KG/mm.
Platform Length (top head platform)	0.0000	mm.
Element From Node	70	
Detail Type	Insulation	
Detail ID	INS: 10	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Insulation	3048.0	mm.
Thickness of Insulation	20.066	mm.
Density	185.00	KG/CU.M
Element From Node	70	
Detail Type	Lining	
Detail ID	CLADDING	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Lining	3048.0	mm.
Thickness of Lining	6.3500	mm.
Density	8009.2	KG/CU.M
Element From Node	70	
Detail Type	Ring	
Detail ID	RING2	
Dist. from "FROM" Node / Offset dist	1981.2	mm.
Inside Diameter of Ring	3535.6	mm.
Thickness of Ring	11.938	mm.
Outside Diameter of Ring	3941.9	mm.
Material Name	SA-516 60	
Height of Section Ring	0.0000	mm.
Using Custom Stiffener Section	No	
Element From Node	70	
Detail Type	Tray	
Detail ID	TRAY 1	
Dist. from "FROM" Node / Offset dist	2618.2	mm.
Tray Spacing	609.60	mm.
Number of Trays	1	
Tray Weight per Unit Area	49.975	KG/SQ.M.
Height of Liquid on Tray	0.0000	mm.
Density of Liquid on Tray	0.0000	KG/CU.M.
Support Ring and Bolting Bar Weight	80.000	KG

Element From Node	80	
Element To Node	90	
Element Type	Cylinder	
Description	SHELL3	
Distance "FROM" to "TO"	3048.0	mm.
Inside Diameter	3511.6	mm.
Element Thickness	12.000	mm.
Internal Corrosion Allowance	0.0000	mm.
Nominal Thickness	0.0000	mm.
External Corrosion Allowance	0.0000	mm.
Design Internal Pressure	3.5154	KG/CM2
Design Temperature Internal Pressure	407	C
Design External Pressure	1.0546	KG/CM2
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-516 60	
Efficiency, Longitudinal Seam	0.85	
Efficiency, Circumferential Seam	0.85	

Element From Node	80	
Detail Type	Insulation	
Detail ID	INS: 10	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Insulation	3048.0	mm.
Thickness of Insulation	20.066	mm.
Density	185.00	KG/CU.M

Element From Node	80	
Detail Type	Lining	
Detail ID	CLADDING	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Lining	3048.0	mm.
Thickness of Lining	6.3500	mm.
Density	8009.2	KG/CU.M

Element From Node	80	
Detail Type	Ring	
Detail ID	RING3	
Dist. from "FROM" Node / Offset dist	1524.0	mm.
Inside Diameter of Ring	3535.6	mm.
Thickness of Ring	11.938	mm.
Outside Diameter of Ring	3967.4	mm.
Material Name	SA-516 60	
Height of Section Ring	0.0000	mm.
Using Custom Stiffener Section	No	

Element From Node	80	
Detail Type	Tray	
Detail ID	TRAY 2-6	
Dist. from "FROM" Node / Offset dist	179.83	mm.
Tray Spacing	609.60	mm.
Number of Trays	5	
Tray Weight per Unit Area	50.000	KG/SQ.M.
Height of Liquid on Tray	0.0000	mm.
Density of Liquid on Tray	0.0000	KG/CU.M.
Support Ring and Bolting Bar Weight	400.00	KG

Element From Node	90	

Element To Node	100	
Element Type	Cylinder	
Description	SHELL4	
Distance "FROM" to "TO"	3048.0	mm.
Inside Diameter	3511.6	mm.
Element Thickness	12.000	mm.
Internal Corrosion Allowance	0.0000	mm.
Nominal Thickness	0.0000	mm.
External Corrosion Allowance	0.0000	mm.
Design Internal Pressure	3.5154	KG/CM2
Design Temperature Internal Pressure	407	C
Design External Pressure	1.0546	KG/CM2
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-516 60	
Efficiency, Longitudinal Seam	0.85	
Efficiency, Circumferential Seam	0.85	

Element From Node	90	
Detail Type	Platform	
Detail ID	PLT3	
Dist. from "FROM" Node / Offset dist	914.40	mm.
Platform Start Angle (degrees)	0.	
Platform End Angle (degrees)	180.	
Platform Wind Area	0.0000	sq.mm.
Platform Weight	3332.6	KG
Platform Railing Weight	0.0000	KG/mm.
Platform Grating Weight	450.00	KG/SQ.M.
Platform Width	1000.0	mm.
Platform Height	1000.0	mm.
Platform Clearance or End Offset	88.900	mm.
Platform Force Coefficient	0.	
Ladder Layout Angle	0.	
Ladder Start Elevation	0.0000	mm.
Ladder End Elevation	0.0000	mm.
Unit Weight of Ladder	0.0000	KG/mm.
Platform Length (top head platform)	0.0000	mm.

Element From Node	90	
Detail Type	Insulation	
Detail ID	INS: 10	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Insulation	3048.0	mm.
Thickness of Insulation	20.066	mm.
Density	185.00	KG/CU.M

Element From Node	90	
Detail Type	Lining	
Detail ID	CLADDING	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Lining	3048.0	mm.
Thickness of Lining	6.3500	mm.
Density	8009.2	KG/CU.M

Element From Node	90	
Detail Type	Ring	
Detail ID	RING4	
Dist. from "FROM" Node / Offset dist	1524.0	mm.
Inside Diameter of Ring	3535.6	mm.
Thickness of Ring	11.938	mm.
Outside Diameter of Ring	3940.7	mm.
Material Name	SA-516 60	
Height of Section Ring	0.0000	mm.

Using Custom Stiffener Section	No	
Element From Node	90	
Detail Type	Nozzle	
Detail ID	1M2	
Dist. from "FROM" Node / Offset dist	1219.2	mm.
Nozzle Diameter	609.59998	mm
Nozzle Schedule	None	
Nozzle Class	150	
Layout Angle	0.	
Blind Flange (Y/N)	Y	
Weight of Nozzle (Used if > 0)	0.0000	KG
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-516 60	
Element From Node	90	
Detail Type	Tray	
Detail ID	TRAY 7-8	
Dist. from "FROM" Node / Offset dist	179.83	mm.
Tray Spacing	609.60	mm.
Number of Trays	2	
Tray Weight per Unit Area	49.975	KG/SQ.M.
Height of Liquid on Tray	0.0000	mm.
Density of Liquid on Tray	0.0000	KG/CU.M.
Support Ring and Bolting Bar Weight	160.00	KG
Element From Node	90	
Detail Type	Weight	
Detail ID	CHMNY TRY1	
Dist. from "FROM" Node / Offset dist	790.00	mm.
Miscellaneous Weight	1000.0	KG
Offset from Element Centerline	0.0000	mm.

Element From Node	100	
Element To Node	110	
Element Type	Cylinder	
Description	SHELL5	
Distance "FROM" to "TO"	3048.0	mm.
Inside Diameter	3511.6	mm.
Element Thickness	12.000	mm.
Internal Corrosion Allowance	0.0000	mm.
Nominal Thickness	0.0000	mm.
External Corrosion Allowance	0.0000	mm.
Design Internal Pressure	3.5154	KG/CM2
Design Temperature Internal Pressure	407	C
Design External Pressure	1.0546	KG/CM2
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-516 60	
Efficiency, Longitudinal Seam	0.85	
Efficiency, Circumferential Seam	0.85	
Element From Node	100	
Detail Type	Platform	
Detail ID	PLAT4	
Dist. from "FROM" Node / Offset dist	3000.0	mm.
Platform Start Angle (degrees)	0.	
Platform End Angle (degrees)	180.	
Platform Wind Area	2.00E+06	sq.mm.
Platform Weight	3327.1	KG
Platform Railing Weight	0.0000	KG/mm.

Platform Grating Weight	450.00	KG/SQ.M.
Platform Width	1000.0	mm.
Platform Height	1000.0	mm.
Platform Clearance or End Offset	85.000	mm.
Platform Force Coefficient	1.	
Ladder Layout Angle	0.	
Ladder Start Elevation	0.0000	mm.
Ladder End Elevation	0.0000	mm.
Unit Weight of Ladder	0.0000	KG/mm.
Platform Length (top head platform)	0.0000	mm.
Element From Node	100	
Detail Type	Insulation	
Detail ID	INS: 10	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Insulation	3048.0	mm.
Thickness of Insulation	20.066	mm.
Density	185.00	KG/CU.M
Element From Node	100	
Detail Type	Lining	
Detail ID	CLADDING	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Lining	3048.0	mm.
Thickness of Lining	6.3500	mm.
Density	8009.2	KG/CU.M
Element From Node	100	
Detail Type	Ring	
Detail ID	RING5	
Dist. from "FROM" Node / Offset dist	1524.0	mm.
Inside Diameter of Ring	3535.6	mm.
Thickness of Ring	11.938	mm.
Outside Diameter of Ring	3967.4	mm.
Material Name	SA-516 60	
Height of Section Ring	0.0000	mm.
Using Custom Stiffener Section	No	
Element From Node	100	
Detail Type	Tray	
Detail ID	TRAY 9-11	
Dist. from "FROM" Node / Offset dist	1795.3	mm.
Tray Spacing	609.60	mm.
Number of Trays	3	
Tray Weight per Unit Area	49.975	KG/SQ.M.
Height of Liquid on Tray	0.0000	mm.
Density of Liquid on Tray	0.0000	KG/CU.M.
Support Ring and Bolting Bar Weight	240.00	KG
Element From Node	100	
Detail Type	Weight	
Detail ID	PLT + INSUL CLI	
Dist. from "FROM" Node / Offset dist	1524.0	mm.
Miscellaneous Weight	1000.0	KG
Offset from Element Centerline	0.0000	mm.
Element From Node	100	
Detail Type	Weight	
Detail ID	ANNULAR RING	
Dist. from "FROM" Node / Offset dist	500.00	mm.
Miscellaneous Weight	1000.0	KG
Offset from Element Centerline	0.0000	mm.

Element From Node	110	
Element To Node	120	
Element Type	Cylinder	
Description	SHELL6	
Distance "FROM" to "TO"	3048.0	mm.
Inside Diameter	3511.6	mm.
Element Thickness	12.000	mm.
Internal Corrosion Allowance	0.0000	mm.
Nominal Thickness	0.0000	mm.
External Corrosion Allowance	0.0000	mm.
Design Internal Pressure	3.5154	KG/CM2
Design Temperature Internal Pressure	407	C
Design External Pressure	1.0546	KG/CM2
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-516 60	
Efficiency, Longitudinal Seam	0.85	
Efficiency, Circumferential Seam	0.85	

Element From Node	110	
Detail Type	Insulation	
Detail ID	INS: 10	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Insulation	3048.0	mm.
Thickness of Insulation	20.066	mm.
Density	185.00	KG/CU.M

Element From Node	110	
Detail Type	Lining	
Detail ID	CLADDING	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Lining	3048.0	mm.
Thickness of Lining	6.3500	mm.
Density	8009.2	KG/CU.M

Element From Node	110	
Detail Type	Ring	
Detail ID	RING6	
Dist. from "FROM" Node / Offset dist	1524.0	mm.
Inside Diameter of Ring	3535.6	mm.
Thickness of Ring	8.8900	mm.
Outside Diameter of Ring	3967.4	mm.
Material Name	SA-516 60	
Height of Section Ring	0.0000	mm.
Using Custom Stiffener Section	No	

Element From Node	110	
Detail Type	Tray	
Detail ID	TRAY 12-16	
Dist. from "FROM" Node / Offset dist	576.07	mm.
Tray Spacing	609.60	mm.
Number of Trays	5	
Tray Weight per Unit Area	49.975	KG/SQ.M.
Height of Liquid on Tray	0.0000	mm.
Density of Liquid on Tray	0.0000	KG/CU.M.
Support Ring and Bolting Bar Weight	400.00	KG

Element From Node	120	
Element To Node	130	

Element Type	Cylinder	
Description	SHELL7	
Distance "FROM" to "TO"	3048.0	mm.
Inside Diameter	3511.6	mm.
Element Thickness	12.000	mm.
Internal Corrosion Allowance	0.0000	mm.
Nominal Thickness	0.0000	mm.
External Corrosion Allowance	0.0000	mm.
Design Internal Pressure	3.5154	KG/CM2
Design Temperature Internal Pressure	407	C
Design External Pressure	1.0546	KG/CM2
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-516 60	
Efficiency, Longitudinal Seam	0.85	
Efficiency, Circumferential Seam	0.85	

Element From Node	120	
Detail Type	Platform	
Detail ID	PLTA5	
Dist. from "FROM" Node / Offset dist	2000.0	mm.
Platform Start Angle (degrees)	0.	
Platform End Angle (degrees)	180.	
Platform Wind Area	2.00E+06	sq.mm.
Platform Weight	3327.1	KG
Platform Railing Weight	0.0000	KG/mm.
Platform Grating Weight	450.00	KG/SQ.M.
Platform Width	1000.0	mm.
Platform Height	1000.0	mm.
Platform Clearance or End Offset	85.000	mm.
Platform Force Coefficient	1.	
Ladder Layout Angle	0.	
Ladder Start Elevation	0.0000	mm.
Ladder End Elevation	0.0000	mm.
Unit Weight of Ladder	0.0000	KG/mm.
Platform Length (top head platform)	0.0000	mm.

Element From Node	120	
Detail Type	Insulation	
Detail ID	INS: 10	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Insulation	3048.0	mm.
Thickness of Insulation	20.066	mm.
Density	185.00	KG/CU.M

Element From Node	120	
Detail Type	Lining	
Detail ID	CLADDING	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Lining	3048.0	mm.
Thickness of Lining	6.3500	mm.
Density	8009.2	KG/CU.M

Element From Node	120	
Detail Type	Ring	
Detail ID	RING7	
Dist. from "FROM" Node / Offset dist	1524.0	mm.
Inside Diameter of Ring	3535.6	mm.
Thickness of Ring	8.8900	mm.
Outside Diameter of Ring	3967.4	mm.
Material Name	SA-516 60	
Height of Section Ring	0.0000	mm.
Using Custom Stiffener Section	No	

Element From Node	120	
Detail Type	Nozzle	
Detail ID	1M3	
Dist. from "FROM" Node / Offset dist	1219.2	mm.
Nozzle Diameter	609.59998	mm
Nozzle Schedule	None	
Nozzle Class	150	
Layout Angle	0.	
Blind Flange (Y/N)	Y	
Weight of Nozzle (Used if > 0)	0.0000	KG
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-516 60	

Element From Node	120	
Detail Type	Tray	
Detail ID	TRAY 17	
Dist. from "FROM" Node / Offset dist	576.07	mm.
Tray Spacing	609.60	mm.
Number of Trays	1	
Tray Weight per Unit Area	49.975	KG/SQ.M.
Height of Liquid on Tray	0.0000	mm.
Density of Liquid on Tray	0.0000	KG/CU.M.
Support Ring and Bolting Bar Weight	80.000	KG

Element From Node	120	
Detail Type	Tray	
Detail ID	TRAY 18	
Dist. from "FROM" Node / Offset dist	1795.3	mm.
Tray Spacing	0.0000	mm.
Number of Trays	1	
Tray Weight per Unit Area	49.975	KG/SQ.M.
Height of Liquid on Tray	0.0000	mm.
Density of Liquid on Tray	0.0000	KG/CU.M.
Support Ring and Bolting Bar Weight	80.000	KG

Element From Node	120	
Detail Type	Tray	
Detail ID	TRAY 19	
Dist. from "FROM" Node / Offset dist	3014.5	mm.
Tray Spacing	0.0000	mm.
Number of Trays	1	
Tray Weight per Unit Area	109.95	KG/SQ.M.
Height of Liquid on Tray	0.0000	mm.
Density of Liquid on Tray	0.0000	KG/CU.M.
Support Ring and Bolting Bar Weight	80.000	KG

Element From Node	120	
Detail Type	Weight	
Detail ID	CHMNY TRY2	
Dist. from "FROM" Node / Offset dist	0.002325	mm.
Miscellaneous Weight	1000.0	KG
Offset from Element Centerline	0.0000	mm.

Element From Node	130	
Element To Node	140	
Element Type	Cylinder	
Description	SHELL8	
Distance "FROM" to "TO"	1795.3	mm.
Inside Diameter	3511.6	mm.
Element Thickness	12.000	mm.

Internal Corrosion Allowance	0.0000	mm.
Nominal Thickness	0.0000	mm.
External Corrosion Allowance	0.0000	mm.
Design Internal Pressure	3.5154	KG/CM2
Design Temperature Internal Pressure	407	C
Design External Pressure	1.0546	KG/CM2
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-516 60	
Efficiency, Longitudinal Seam	0.85	
Efficiency, Circumferential Seam	0.85	

Element From Node	130	
Detail Type	Insulation	
Detail ID	INS: 10	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Insulation	1795.3	mm.
Thickness of Insulation	20.066	mm.
Density	185.00	KG/CU.M

Element From Node	130	
Detail Type	Lining	
Detail ID	CLADDING	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Lining	1795.3	mm.
Thickness of Lining	3.1750	mm.
Density	8000.0	KG/CU.M

Element From Node	130	
Detail Type	Ring	
Detail ID	RING8	
Dist. from "FROM" Node / Offset dist	914.40	mm.
Inside Diameter of Ring	3535.6	mm.
Thickness of Ring	8.8900	mm.
Outside Diameter of Ring	3967.4	mm.
Material Name	SA-516 60	
Height of Section Ring	0.0000	mm.
Using Custom Stiffener Section	No	

Element From Node	130	
Detail Type	Tray	
Detail ID	TRAY 20-22	
Dist. from "FROM" Node / Offset dist	576.07	mm.
Tray Spacing	609.35	mm.
Number of Trays	3	
Tray Weight per Unit Area	109.95	KG/SQ.M.
Height of Liquid on Tray	0.0000	mm.
Density of Liquid on Tray	0.0000	KG/CU.M.
Support Ring and Bolting Bar Weight	220.00	KG

Element From Node	140	
Element To Node	150	
Element Type	Cylinder	
Description	SHELL9	
Distance "FROM" to "TO"	1322.8	mm.
Inside Diameter	3505.2	mm.
Element Thickness	16.000	mm.
Internal Corrosion Allowance	6.3500	mm.
Nominal Thickness	0.0000	mm.
External Corrosion Allowance	0.0000	mm.
Design Internal Pressure	3.5154	KG/CM2

Design Temperature Internal Pressure	407	C
Design External Pressure	1.0546	KG/CM2
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-516 60	
Efficiency, Longitudinal Seam	0.85	
Efficiency, Circumferential Seam	0.85	

Element From Node	140	
Detail Type	Platform	
Detail ID	PLAT6	
Dist. from "FROM" Node / Offset dist	500.00	mm.
Platform Start Angle (degrees)	0.	
Platform End Angle (degrees)	180.	
Platform Wind Area	2.00E+06	sq.mm.
Platform Weight	4253.3	KG
Platform Railing Weight	0.0000	KG/mm.
Platform Grating Weight	450.00	KG/SQ.M.
Platform Width	1000.0	mm.
Platform Height	1000.0	mm.
Platform Clearance or End Offset	85.000	mm.
Platform Force Coefficient	1.	
Ladder Layout Angle	0.	
Ladder Start Elevation	0.0000	mm.
Ladder End Elevation	25000.	mm.
Unit Weight of Ladder	0.03700	KG/mm.
Platform Length (top head platform)	0.0000	mm.

Element From Node	140	
Detail Type	Insulation	
Detail ID	INS: 10	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Insulation	1322.8	mm.
Thickness of Insulation	20.066	mm.
Density	185.00	KG/CU.M

Element From Node	140	
Detail Type	Ring	
Detail ID	RING9	
Dist. from "FROM" Node / Offset dist	609.60	mm.
Inside Diameter of Ring	3537.2	mm.
Thickness of Ring	15.240	mm.
Outside Diameter of Ring	3816.6	mm.
Material Name	SA-516 60	
Height of Section Ring	0.0000	mm.
Using Custom Stiffener Section	No	

Element From Node	140	
Detail Type	Nozzle	
Detail ID	1M4	
Dist. from "FROM" Node / Offset dist	609.60	mm.
Nozzle Diameter	609.59998	mm
Nozzle Schedule	None	
Nozzle Class	150	
Layout Angle	0.	
Blind Flange (Y/N)	Y	
Weight of Nozzle (Used if > 0)	0.0000	KG
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-516 60	

Element From Node	140	
Detail Type	Weight	
Detail ID	DISTRIBUTOR WEI	

Dist. from "FROM" Node / Offset dist	1066.8	mm.
Miscellaneous Weight	100.00	KG
Offset from Element Centerline	0.0000	mm.

Element From Node	140	
Detail Type	Weight	
Detail ID	LIFTING LUG1	
Dist. from "FROM" Node / Offset dist	1066.8	mm.
Miscellaneous Weight	200.00	KG
Offset from Element Centerline	1752.6	mm.

Element From Node	140	
Detail Type	Weight	
Detail ID	LIFTING LUG2	
Dist. from "FROM" Node / Offset dist	1066.8	mm.
Miscellaneous Weight	200.00	KG
Offset from Element Centerline	1752.6	mm.

Element From Node	140	
Detail Type	Weight	
Detail ID	PIPE DAVIT	
Dist. from "FROM" Node / Offset dist	1066.8	mm.
Miscellaneous Weight	200.00	KG
Offset from Element Centerline	1752.6	mm.

Element From Node	140	
Detail Type	Weight	
Detail ID	OVRHD	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Miscellaneous Weight	1890.0	KG
Offset from Element Centerline	2160.0	mm.

Element From Node	150	
Element To Node	160	
Element Type	Elliptical	
Description	TOP HD	
Distance "FROM" to "TO"	48.768	mm.
Inside Diameter	3505.2	mm.
Element Thickness	18.000	mm.
Internal Corrosion Allowance	6.3500	mm.
Nominal Thickness	20.000	mm.
External Corrosion Allowance	0.0000	mm.
Design Internal Pressure	3.5154	KG/CM2
Design Temperature Internal Pressure	407	C
Design External Pressure	1.0546	KG/CM2
Design Temperature External Pressure	407	C
Effective Diameter Multiplier	1.21	
Material Name	SA-516 60	
Efficiency, Longitudinal Seam	1.	
Efficiency, Circumferential Seam	1.	
Elliptical Head Factor	2.	

Element From Node	150	
Detail Type	Platform	
Detail ID	TOP PLT	
Dist. from "FROM" Node / Offset dist	876.30	mm.
Platform Start Angle (degrees)	0.	
Platform End Angle (degrees)	0.	
Platform Wind Area	3.56E+06	sq.mm.
Platform Weight	5529.9	KG
Platform Railing Weight	0.0000	KG/mm.

Platform Grating Weight	450.00	KG/SQ.M.
Platform Width	3505.0	mm.
Platform Height	1016.0	mm.
Platform Clearance or End Offset	1752.5	mm.
Platform Force Coefficient	1.	
Ladder Layout Angle	0.	
Ladder Start Elevation	0.0000	mm.
Ladder End Elevation	0.0000	mm.
Unit Weight of Ladder	0.0000	KG/mm.
Platform Length (top head platform)	3505.0	mm.
Element From Node	150	
Detail Type	Insulation	
Detail ID	INS: 10	
Dist. from "FROM" Node / Offset dist	0.0000	mm.
Height/Length of Insulation	925.07	mm.
Thickness of Insulation	20.066	mm.
Density	185.00	KG/CU.M
Element From Node	150	
Detail Type	Nozzle	
Detail ID	VAPOR OL	
Dist. from "FROM" Node / Offset dist	1436.8	mm.
Nozzle Diameter	304.79999	mm
Nozzle Schedule	None	
Nozzle Class	150	
Layout Angle	45.	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	0.0000	KG
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-516 60	

XY Coordinate Calculations

From	To	X (Horiz.) mm.	Y (Vert.) mm.	DX (Horiz.) mm.	DY (Vert.) mm.
BTM SKRT		0.00000	1200.00	0.00000	1200.00
INTER SKRT		0.00000	4200.00	0.00000	3000.00
INTER SKRT		0.00000	7200.00	0.00000	3000.00
TOP SKRT		0.00000	7800.00	0.00000	600.000
BTM HD		0.00000	7848.77	0.00000	48.7680
Shell1		0.00000	10896.8	0.00000	3048.00
Shell2		0.00000	13944.8	0.00000	3048.00
SHELL3		0.00000	16992.8	0.00000	3048.00
SHELL4		0.00000	20040.8	0.00000	3048.00
SHELL5		0.00000	23088.8	0.00000	3048.00
SHELL6		0.00000	26136.8	0.00000	3048.00
SHELL7		0.00000	29184.8	0.00000	3048.00
SHELL8		0.00000	30980.0	0.00000	1795.27
SHELL9		0.00000	32302.9	0.00000	1322.83
TOP HD		0.00000	32351.6	0.00000	48.7680

Element Thickness, Pressure, Diameter and Allowable Stress :

From	To	Int. Press + Liq. Hd KG/CM2	Nominal Thickness mm.	Total Corr Allowance mm.	Element Diameter mm.	Allowable Stress(SE) KG/CM2
BTM SKRT		0.00000	...	3.00000	3569.46	0.00000
INTER SKRT		0.00000	...	3.00000	3569.46	0.00000
INTER SKRT		0.00000	...	3.00000	3569.46	0.00000
TOP SKRT		0.00000	...	3.00000	3569.46	0.00000
BTM HD		3.51535	14.0000	0.00000	3511.55	867.588
Shell1		3.51535	...	0.00000	3511.55	737.450
Shell2		3.51535	...	0.00000	3511.55	737.450
SHELL3		3.51535	...	0.00000	3511.55	737.450
SHELL4		3.51535	...	0.00000	3511.55	737.450
SHELL5		3.51535	...	0.00000	3511.55	737.450
SHELL6		3.51535	...	0.00000	3511.55	737.450
SHELL7		3.51535	...	0.00000	3511.55	737.450
SHELL8		3.51535	...	0.00000	3511.55	737.450
SHELL9		3.51535	...	6.35000	3505.20	737.450
TOP HD		3.51535	20.0000	6.35000	3505.20	867.588

Element Required Thickness and MAWP :

From	To	Design Pressure KG/CM2	M.A.W.P. Corroded KG/CM2	M.A.P. New & Cold KG/CM2	Minimum Thickness mm.	Required Thickness mm.
BTM SKRT		0.00000	No Calc	No Calc	20.0000	No Calc
INTER SKRT		0.00000	No Calc	No Calc	16.0000	No Calc
INTER SKRT		0.00000	No Calc	No Calc	14.0000	No Calc
TOP SKRT		0.00000	No Calc	No Calc	14.0000	No Calc
BTM HD		3.51535	5.92556	8.21127	12.0000	7.11705
Shell1		3.51535	5.01958	6.95583	12.0000	8.39361
Shell2		3.51535	5.01958	6.95583	12.0000	8.39361
SHELL3		3.51535	5.01958	6.95583	12.0000	8.39361
SHELL4		3.51535	5.01958	6.95583	12.0000	8.39361
SHELL5		3.51535	5.01958	6.95583	12.0000	8.39361
SHELL6		3.51535	5.01958	6.95583	12.0000	8.39361
SHELL7		3.51535	5.01958	6.95583	12.0000	8.39361
SHELL8		3.51535	5.01958	6.95583	12.0000	8.39361
SHELL9		3.51535	4.03255	9.27851	16.0000	14.7588
TOP HD		3.51535	5.74247	12.3350	18.0000	13.4799
Minimum			4.033	6.956		

MAWP: 4.032 KG/CM2, limited by: Nozzle Reinforcment.

Internal Pressure Calculation Results :

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Elliptical Head From 50 To 60 SA-516 60 , UCS-66 Crv. C at 407 C

BTM HD

Required Thickness due to Internal Pressure [tr]:
= (P*D*K)/(2*S*E-0.2*P) Appendix 1-4(c)
= (3.515*3511.5500*1.000)/(2*867.59*1.00-0.2*3.515)
= 7.1170 + 0.0000 = 7.1170 mm.

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:
= (2*S*E*t)/(K*D+0.2*t) per Appendix 1-4 (c)
= (2*867.59*1.00*12.0000)/(1.000*3511.5500+0.2*12.0000)
= 5.926 KG/CM2

Maximum Allowable Pressure, New and Cold [MAPNC]:
= (2*S*E*t)/(K*D+0.2*t) per Appendix 1-4 (c)
= (2*1202.25*1.00*12.0000)/(1.000*3511.5500+0.2*12.0000)
= 8.211 KG/CM2

Actual stress at given pressure and thickness, corroded [Sact]:
= (P*(K*D+0.2*t))/(2*E*t)
= (3.515*(1.000*3511.5500+0.2*12.0000))/(2*1.00*12.0000)
= 514.698 KG/CM2

Straight Flange Required Thickness:
= (P*R)/(S*E-0.6*P) + c per UG-27 (c)(1)
= (3.515*1755.7750)/(867.59*1.00-0.6*3.515)+0.000
= 7.131 mm.

Straight Flange Maximum Allowable Working Pressure:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (867.59 * 1.00 * 14.0000) / (1755.7750 + 0.6 * 14.0000)
= 6.885 KG/CM2

Percent Elongation per UCS-79 (75*tnom/Rf)*(1-Rf/Ro) 1.752 %

MDMT Calculations in the Knuckle Portion:

Govrn. thk, tg = 12.000 , tr = 5.891 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.491 , Temp. Reduction = 35 C

Min Metal Temp. w/o impact per UCS-66	-39	C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit	-56	C
Min Metal Temp. at Required thickness (UCS 66.1)	-65	C

MDMT Calculations in the Head Straight Flange:

Govrn. thk, tg = 14.000 , tr = 5.901 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.421 , Temp. Reduction = 52 C

Min Metal Temp. w/o impact per UCS-66	-36	C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit	-52	C
Min Metal Temp. at Required thickness (UCS 66.1)	-65	C

Cylindrical Shell From 60 To 70 SA-516 60 , UCS-66 Crv. C at 407 C

Shell1

Required Thickness due to Internal Pressure [tr]:
= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
= (3.515*1755.7750)/(867.59*0.85-0.6*3.515)
= 8.3936 + 0.0000 = 8.3936 mm.

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (867.59*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 5.020 KG/CM2

Maximum Allowable Pressure, New and Cold [MAPNC]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (1202.25*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 6.956 KG/CM2

Actual stress at given pressure and thickness, corroded [Sact]:
= (P*(R+0.6*t))/(E*t)
= (3.515*(1755.7750+0.6*12.0000))/(0.85*12.0000)

= 607.596 KG/CM2

Percent Elongation per UCS-79 (50*tnom/Rf)*(1-Rf/Ro) 0.341 %

Minimum Design Metal Temperature Results:

Govrn. thk, tg = 12.000 , tr = 6.945 , c = 0.0000 mm. , E* = 0.85
Stress Ratio = tr * (E*) / (tg - c) = 0.492 , Temp. Reduction = 35 C

Min Metal Temp. w/o impact per UCS-66	-39	C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit	-56	C
Min Metal Temp. at Required thickness (UCS 66.1)	-65	C

Cylindrical Shell From 70 To 80 SA-516 60 , UCS-66 Crv. C at 407 C

Shell2

Required Thickness due to Internal Pressure [tr]:
= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
= (3.515*1755.7750)/(867.59*0.85-0.6*3.515)
= 8.3936 + 0.0000 = 8.3936 mm.

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (867.59*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 5.020 KG/CM2

Maximum Allowable Pressure, New and Cold [MAPNC]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (1202.25*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 6.956 KG/CM2

Actual stress at given pressure and thickness, corroded [Sact]:
= (P*(R+0.6*t))/(E*t)
= (3.515*(1755.7750+0.6*12.0000))/(0.85*12.0000)
= 607.596 KG/CM2

Percent Elongation per UCS-79 (50*tnom/Rf)*(1-Rf/Ro) 0.341 %

Minimum Design Metal Temperature Results:

Govrn. thk, tg = 12.000 , tr = 6.945 , c = 0.0000 mm. , E* = 0.85
Stress Ratio = tr * (E*) / (tg - c) = 0.492 , Temp. Reduction = 35 C

Min Metal Temp. w/o impact per UCS-66	-39	C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit	-56	C
Min Metal Temp. at Required thickness (UCS 66.1)	-65	C

Cylindrical Shell From 80 To 90 SA-516 60 , UCS-66 Crv. C at 407 C

SHELL3

Required Thickness due to Internal Pressure [tr]:
= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
= (3.515*1755.7750)/(867.59*0.85-0.6*3.515)
= 8.3936 + 0.0000 = 8.3936 mm.

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (867.59*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 5.020 KG/CM2

Maximum Allowable Pressure, New and Cold [MAPNC]:

= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (1202.25*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 6.956 KG/CM2

Actual stress at given pressure and thickness, corroded [Sact]:
= (P*(R+0.6*t))/(E*t)
= (3.515*(1755.7750+0.6*12.0000))/(0.85*12.0000)
= 607.596 KG/CM2

Percent Elongation per UCS-79 (50*tnom/Rf)*(1-Rf/Ro) 0.341 %

Minimum Design Metal Temperature Results:

Govrn. thk, tg = 12.000 , tr = 6.945 , c = 0.0000 mm. , E* = 0.85
Stress Ratio = tr * (E*) / (tg - c) = 0.492 , Temp. Reduction = 35 C

Min Metal Temp. w/o impact per UCS-66 -39 C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit -56 C
Min Metal Temp. at Required thickness (UCS 66.1) -65 C

Cylindrical Shell From 90 To 100 SA-516 60 , UCS-66 Crv. C at 407 C

SHELL4

Required Thickness due to Internal Pressure [tr]:
= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
= (3.515*1755.7750)/(867.59*0.85-0.6*3.515)
= 8.3936 + 0.0000 = 8.3936 mm.

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (867.59*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 5.020 KG/CM2

Maximum Allowable Pressure, New and Cold [MAPNC]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (1202.25*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 6.956 KG/CM2

Actual stress at given pressure and thickness, corroded [Sact]:
= (P*(R+0.6*t))/(E*t)
= (3.515*(1755.7750+0.6*12.0000))/(0.85*12.0000)
= 607.596 KG/CM2

Percent Elongation per UCS-79 (50*tnom/Rf)*(1-Rf/Ro) 0.341 %

Minimum Design Metal Temperature Results:

Govrn. thk, tg = 12.000 , tr = 6.945 , c = 0.0000 mm. , E* = 0.85
Stress Ratio = tr * (E*) / (tg - c) = 0.492 , Temp. Reduction = 35 C

Min Metal Temp. w/o impact per UCS-66 -39 C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit -56 C
Min Metal Temp. at Required thickness (UCS 66.1) -65 C

Cylindrical Shell From 100 To 110 SA-516 60 , UCS-66 Crv. C at 407 C

SHELL5

Required Thickness due to Internal Pressure [tr]:
= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
= (3.515*1755.7750)/(867.59*0.85-0.6*3.515)
= 8.3936 + 0.0000 = 8.3936 mm.

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (867.59*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 5.020 KG/CM2

Maximum Allowable Pressure, New and Cold [MAPNC]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (1202.25*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 6.956 KG/CM2

Actual stress at given pressure and thickness, corroded [Sact]:
= (P*(R+0.6*t))/(E*t)
= (3.515*(1755.7750+0.6*12.0000))/(0.85*12.0000)
= 607.596 KG/CM2

Percent Elongation per UCS-79 (50*tnom/Rf)*(1-Rf/Ro) 0.341 %

Minimum Design Metal Temperature Results:

Govrn. thk, tg = 12.000 , tr = 6.945 , c = 0.0000 mm. , E* = 0.85
Stress Ratio = tr * (E*) / (tg - c) = 0.492 , Temp. Reduction = 35 C

Min Metal Temp. w/o impact per UCS-66 -39 C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit -56 C
Min Metal Temp. at Required thickness (UCS 66.1) -65 C

Cylindrical Shell From 110 To 120 SA-516 60 , UCS-66 Crv. C at 407 C

SHELL6

Required Thickness due to Internal Pressure [tr]:
= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
= (3.515*1755.7750)/(867.59*0.85-0.6*3.515)
= 8.3936 + 0.0000 = 8.3936 mm.

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (867.59*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 5.020 KG/CM2

Maximum Allowable Pressure, New and Cold [MAPNC]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (1202.25*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 6.956 KG/CM2

Actual stress at given pressure and thickness, corroded [Sact]:
= (P*(R+0.6*t))/(E*t)
= (3.515*(1755.7750+0.6*12.0000))/(0.85*12.0000)
= 607.596 KG/CM2

Percent Elongation per UCS-79 (50*tnom/Rf)*(1-Rf/Ro) 0.341 %

Minimum Design Metal Temperature Results:

Govrn. thk, tg = 12.000 , tr = 6.945 , c = 0.0000 mm. , E* = 0.85
Stress Ratio = tr * (E*) / (tg - c) = 0.492 , Temp. Reduction = 35 C

Min Metal Temp. w/o impact per UCS-66 -39 C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit -56 C
Min Metal Temp. at Required thickness (UCS 66.1) -65 C

Cylindrical Shell From 120 To 130 SA-516 60 , UCS-66 Crv. C at 407 C

SHELL7

Required Thickness due to Internal Pressure [tr]:
= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
= (3.515*1755.7750)/(867.59*0.85-0.6*3.515)
= 8.3936 + 0.0000 = 8.3936 mm.

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (867.59*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 5.020 KG/CM2

Maximum Allowable Pressure, New and Cold [MAPNC]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (1202.25*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 6.956 KG/CM2

Actual stress at given pressure and thickness, corroded [Sact]:
= (P*(R+0.6*t))/(E*t)
= (3.515*(1755.7750+0.6*12.0000))/(0.85*12.0000)
= 607.596 KG/CM2

Percent Elongation per UCS-79 (50*tnom/Rf)*(1-Rf/Ro) 0.341 %

Minimum Design Metal Temperature Results:

Govrn. thk, tg = 12.000 , tr = 6.945 , c = 0.0000 mm. , E* = 0.85
Stress Ratio = tr * (E*) / (tg - c) = 0.492 , Temp. Reduction = 35 C

Min Metal Temp. w/o impact per UCS-66 -39 C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit -56 C
Min Metal Temp. at Required thickness (UCS 66.1) -65 C

Cylindrical Shell From 130 To 140 SA-516 60 , UCS-66 Crv. C at 407 C

SHELL8

Required Thickness due to Internal Pressure [tr]:
= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
= (3.515*1755.7750)/(867.59*0.85-0.6*3.515)
= 8.3936 + 0.0000 = 8.3936 mm.

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (867.59*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 5.020 KG/CM2

Maximum Allowable Pressure, New and Cold [MAPNC]:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (1202.25*0.85*12.0000)/(1755.7750+0.6*12.0000)
= 6.956 KG/CM2

Actual stress at given pressure and thickness, corroded [Sact]:
= (P*(R+0.6*t))/(E*t)
= (3.515*(1755.7750+0.6*12.0000))/(0.85*12.0000)
= 607.596 KG/CM2

Percent Elongation per UCS-79 (50*tnom/Rf)*(1-Rf/Ro) 0.341 %

Minimum Design Metal Temperature Results:

Govrn. thk, tg = 12.000 , tr = 6.945 , c = 0.0000 mm. , E* = 0.85

Stress Ratio = tr * (E*) / (tg - c) = 0.492 , Temp. Reduction = 35 C

```
Min Metal Temp. w/o impact per UCS-66                    -39  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -56  C
Min Metal Temp. at Required thickness (UCS 66.1)         -65  C
```

Cylindrical Shell From 140 To 150 SA-516 60 , UCS-66 Crv. C at 407 C

SHELL9

Required Thickness due to Internal Pressure [tr]:
```
 = (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
 = (3.515*1758.9500)/(867.59*0.85-0.6*3.515)
 = 8.4088 + 6.3500 = 14.7588 mm.
```

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:
```
 = (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
 = (867.59*0.85*9.6500)/(1758.9500+0.6*9.6500)
 = 4.033 KG/CM2
```

Maximum Allowable Pressure, New and Cold [MAPNC]:
```
 = (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
 = (1202.25*0.85*16.0000)/(1752.6000+0.6*16.0000)
 = 9.279 KG/CM2
```

Actual stress at given pressure and thickness, corroded [Sact]:
```
 = (P*(R+0.6*t))/(E*t)
 = (3.515*(1758.9500+0.6*9.6500))/(0.85*9.6500)
 = 756.316 KG/CM2
```

```
Percent Elongation per UCS-79  (50*tnom/Rf)*(1-Rf/Ro)  0.454 %
```

Minimum Design Metal Temperature Results:

Govrn. thk, tg = 16.000 , tr = 6.957 , c = 6.3500 mm. , E* = 0.85
Stress Ratio = tr * (E*) / (tg - c) = 0.613 , Temp. Reduction = 22 C

```
Min Metal Temp. w/o impact per UCS-66                    -32  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -49  C
Min Metal Temp. at Required thickness (UCS 66.1)         -65  C
```

Elliptical Head From 150 To 160 SA-516 60 , UCS-66 Crv. C at 407 C

TOP HD

Required Thickness due to Internal Pressure [tr]:
```
 = (P*D*K)/(2*S*E-0.2*P) Appendix 1-4(c)
 = (3.515*3517.8999*1.000)/(2*867.59*1.00-0.2*3.515)
 = 7.1299 + 6.3500 = 13.4799 mm.
```

Max. Allowable Working Pressure at given Thickness, corroded [MAWP]:
```
 = (2*S*E*t)/(K*D+0.2*t) per Appendix 1-4 (c)
 = (2*867.59*1.00*11.6500)/(1.000*3517.8999+0.2*11.6500)
 = 5.742 KG/CM2
```

Maximum Allowable Pressure, New and Cold [MAPNC]:
```
 = (2*S*E*t)/(K*D+0.2*t) per Appendix 1-4 (c)
 = (2*1202.25*1.00*18.0000)/(1.000*3505.2000+0.2*18.0000)
 = 12.335 KG/CM2
```

Actual stress at given pressure and thickness, corroded [Sact]:
```
 = (P*(K*D+0.2*t))/(2*E*t)
 = (3.515*(1.000*3517.8999+0.2*11.6500))/(2*1.00*11.6500)
```

= 531.109 KG/CM2

Straight Flange Required Thickness:
= (P*R)/(S*E-0.6*P) + c per UG-27 (c)(1)
= (3.515*1758.9500)/(867.59*1.00-0.6*3.515)+6.350
= 13.494 mm.

Straight Flange Maximum Allowable Working Pressure:
= (S*E*t)/(R+0.6*t) per UG-27 (c)(1)
= (867.59 * 1.00 * 13.6500) / (1758.9500 + 0.6 * 13.6500)
= 6.702 KG/CM2

Percent Elongation per UCS-79 (75*tnom/Rf)*(1-Rf/Ro) 2.503 %

MDMT Calculations in the Knuckle Portion:

Govrn. thk, tg = 18.000 , tr = 5.902 , c = 6.3500 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.507 , Temp. Reduction = 33 C

Min Metal Temp. w/o impact per UCS-66	-29	C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit	-46	C
Min Metal Temp. at Required thickness (UCS 66.1)	-65	C

MDMT Calculations in the Head Straight Flange:

Govrn. thk, tg = 20.000 , tr = 5.912 , c = 6.3500 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.433 , Temp. Reduction = 48 C

Min Metal Temp. w/o impact per UCS-66	-27	C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit	-43	C
Min Metal Temp. at Required thickness (UCS 66.1)	-65	C

Hydrostatic Test Pressure Results:

Pressure per UG99b = 1.3 * M.A.W.P. * Sa/S	7.264	KG/CM2
Pressure per UG99b[34] = 1.3 * Design Pres * Sa/S	6.333	KG/CM2
Pressure per UG99c = 1.3 * M.A.P. - Head(Hyd)	6.506	KG/CM2
Pressure per UG100 = 1.1 * M.A.W.P. * Sa/S	6.147	KG/CM2
User Defined Hydrostatic Test Pressure at High Point	8.300	KG/CM2

UG-99(b) Note 34, Test Pressure Calculation:
= Test Factor * Design Pressure * Stress Ratio
= 1.3 * 3.515 * 1.386
= 8.300 KG/CM2

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

Stresses on Elements due to Hydrostatic Test Pressure:

From To	Stress	Allowable	Ratio	Pressure
BTM HD	1600.2	2024.8	0.790	10.93
Shell1	1873.0	2024.8	0.925	10.84
Shell2	1820.4	2024.8	0.899	10.53
SHELL3	1767.7	2024.8	0.873	10.23
SHELL4	1715.1	2024.8	0.847	9.92
SHELL5	1662.4	2024.8	0.821	9.62
SHELL6	1609.7	2024.8	0.795	9.31
SHELL7	1557.1	2024.8	0.769	9.01
SHELL8	1504.4	2024.8	0.743	8.70
SHELL9	1834.1	2024.8	0.906	8.52
TOP HD	1268.0	2024.8	0.626	8.39

Elements Suitable for Internal Pressure.

External Pressure Calculation Results :

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Elliptical Head From 50 to 60 Ext. Chart: CS-2 at 407 C

BTM HD

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	D/t	Factor A	B
12.000	3535.55	294.63	0.0004714	387.69

EMAP = B/(K0*D/t) = 387.6890 /(0.9000 *294.6292) = 1.4621 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	D/t	Factor A	B
10.192	3535.55	346.89	0.0004004	329.28

EMAP = B/(K0*D/t) = 329.2774 /(0.9000 *346.8944) = 1.0547 KG/CM2

Cylindrical Shell From 60 to RING1 Ext. Chart: CS-2 at 407 C

Shell1

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	2779.80	294.63	0.7862	0.0003382	278.16

EMAP = (4*B)/(3*(D/t)) = (4*278.1591)/(3*294.6292) = 1.2588 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
11.185	3535.55	2779.80	316.09	0.7862	0.0003040	250.02

EMAP = (4*B)/(3*(D/t)) = (4*250.0243)/(3*316.0859) = 1.0547 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.86	294.63	0.9333	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0539)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From RING1 to 70 Ext. Chart: CS-2 at 407 C

Shell1

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	2590.80	294.63	0.7328	0.0003638	299.20

EMAP = (4*B)/(3*(D/t)) = (4*299.2036)/(3*294.6292) = 1.3540 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
10.866	3535.55	2590.80	325.37	0.7328	0.0003129	257.36

EMAP = (4*B)/(3*(D/t)) = (4*257.3588)/(3*325.3679) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.92	294.63	0.9334	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0493)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From 70 to RING2 Ext. Chart: CS-2 at 407 C

Shell2

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	2590.80	294.63	0.7328	0.0003638	299.20

EMAP = (4*B)/(3*(D/t)) = (4*299.2036)/(3*294.6292) = 1.3540 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
10.866	3535.55	2590.80	325.37	0.7328	0.0003129	257.36

EMAP = (4*B)/(3*(D/t)) = (4*257.3588)/(3*325.3679) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.92	294.63	0.9334	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0493)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From RING2 to 80 Ext. Chart: CS-2 at 407 C

Shell2

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	2590.80	294.63	0.7328	0.0003638	299.20

EMAP = (4*B)/(3*(D/t)) = (4*299.2036)/(3*294.6292) = 1.3540 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
10.866	3535.55	2590.80	325.37	0.7328	0.0003129	257.36

EMAP = (4*B)/(3*(D/t)) = (4*257.3588)/(3*325.3679) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.92	294.63	0.9334	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0493)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From 80 to RING3 Ext. Chart: CS-2 at 407 C

SHELL3

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	2590.80	294.63	0.7328	0.0003638	299.20

EMAP = (4*B)/(3*(D/t)) = (4*299.2036)/(3*294.6292) = 1.3540 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
10.866	3535.55	2590.80	325.37	0.7328	0.0003129	257.36

EMAP = (4*B)/(3*(D/t)) = (4*257.3588)/(3*325.3679) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.92	294.63	0.9334	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0493)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From RING3 to 90 Ext. Chart: CS-2 at 407 C

SHELL3

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3048.00	294.63	0.8621	0.0003075	252.92

EMAP = (4*B)/(3*(D/t)) = (4*252.9154)/(3*294.6292) = 1.1446 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
11.616	3535.55	3048.00	304.37	0.8621	0.0002927	240.75

EMAP = (4*B)/(3*(D/t)) = (4*240.7497)/(3*304.3703) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.88	294.63	0.9333	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0525)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From 90 to RING4 Ext. Chart: CS-2 at 407 C

SHELL4

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3048.00	294.63	0.8621	0.0003075	252.92

EMAP = (4*B)/(3*(D/t)) = (4*252.9154)/(3*294.6292) = 1.1446 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
11.616	3535.55	3048.00	304.37	0.8621	0.0002927	240.75

EMAP = (4*B)/(3*(D/t)) = (4*240.7497)/(3*304.3703) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.88	294.63	0.9333	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0525)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From RING4 to 100 Ext. Chart: CS-2 at 407 C

SHELL4

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3048.00	294.63	0.8621	0.0003075	252.92

EMAP = (4*B)/(3*(D/t)) = (4*252.9154)/(3*294.6292) = 1.1446 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
11.616	3535.55	3048.00	304.37	0.8621	0.0002927	240.75

EMAP = (4*B)/(3*(D/t)) = (4*240.7497)/(3*304.3703) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.88	294.63	0.9333	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0525)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From 100 to RING5 Ext. Chart: CS-2 at 407 C

SHELL5

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3048.00	294.63	0.8621	0.0003075	252.92

EMAP = (4*B)/(3*(D/t)) = (4*252.9154)/(3*294.6292) = 1.1446 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
11.616	3535.55	3048.00	304.37	0.8621	0.0002927	240.75

EMAP = (4*B)/(3*(D/t)) = (4*240.7497)/(3*304.3703) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.88	294.63	0.9333	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0525)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From RING5 to 110 Ext. Chart: CS-2 at 407 C

SHELL5

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3048.00	294.63	0.8621	0.0003075	252.92

EMAP = (4*B)/(3*(D/t)) = (4*252.9154)/(3*294.6292) = 1.1446 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
11.616	3535.55	3048.00	304.37	0.8621	0.0002927	240.75

EMAP = (4*B)/(3*(D/t)) = (4*240.7497)/(3*304.3703) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.88	294.63	0.9333	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0525)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From 110 to RING6 Ext. Chart: CS-2 at 407 C

SHELL6

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3048.00	294.63	0.8621	0.0003075	252.92

EMAP = (4*B)/(3*(D/t)) = (4*252.9154)/(3*294.6292) = 1.1446 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
11.616	3535.55	3048.00	304.37	0.8621	0.0002927	240.75

EMAP = (4*B)/(3*(D/t)) = (4*240.7497)/(3*304.3703) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.88	294.63	0.9333	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0525)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From RING6 to 120 Ext. Chart: CS-2 at 407 C

SHELL6

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3048.00	294.63	0.8621	0.0003075	252.92

EMAP = (4*B)/(3*(D/t)) = (4*252.9154)/(3*294.6292) = 1.1446 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
11.616	3535.55	3048.00	304.37	0.8621	0.0002927	240.75

EMAP = (4*B)/(3*(D/t)) = (4*240.7497)/(3*304.3703) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.88	294.63	0.9333	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0525)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From 120 to RING7 Ext. Chart: CS-2 at 407 C

SHELL7

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3048.00	294.63	0.8621	0.0003075	252.92

EMAP = (4*B)/(3*(D/t)) = (4*252.9154)/(3*294.6292) = 1.1446 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
11.616	3535.55	3048.00	304.37	0.8621	0.0002927	240.75

EMAP = (4*B)/(3*(D/t)) = (4*240.7497)/(3*304.3703) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.88	294.63	0.9333	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0525)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From RING7 to 130 Ext. Chart: CS-2 at 407 C

SHELL7

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	2438.40	294.63	0.6897	0.0003874	318.64

EMAP = (4*B)/(3*(D/t)) = (4*318.6428)/(3*294.6292) = 1.4420 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
10.599	3535.55	2438.40	333.59	0.6897	0.0003208	263.86

EMAP = (4*B)/(3*(D/t)) = (4*263.8607)/(3*333.5856) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.88	294.63	0.9333	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0526)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From 130 to RING8 Ext. Chart: CS-2 at 407 C

SHELL8

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	2438.40	294.63	0.6897	0.0003874	318.64

EMAP = (4*B)/(3*(D/t)) = (4*318.6428)/(3*294.6292) = 1.4420 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
10.599	3535.55	2438.40	333.59	0.6897	0.0003208	263.86

EMAP = (4*B)/(3*(D/t)) = (4*263.8607)/(3*333.5856) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.88	294.63	0.9333	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0526)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From RING8 to 140 Ext. Chart: CS-2 at 407 C

SHELL8

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	1490.47	294.63	0.4216	0.0006502	464.36

EMAP = (4*B)/(3*(D/t)) = (4*464.3604)/(3*294.6292) = 2.1014 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
8.642	3535.55	1490.47	409.09	0.4216	0.0003935	323.58

EMAP = (4*B)/(3*(D/t)) = (4*323.5844)/(3*409.0897) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
12.000	3535.55	3299.90	294.63	0.9333	0.0002834	233.05

EMAP = (4*B)/(3*(D/t)) = (4*233.0513)/(3*294.6292) = 1.0547 KG/CM2

Cylindrical Shell From 140 to RING9 Ext. Chart: CS-2 at 407 C

SHELL9

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
9.650	3537.20	1490.47	366.55	0.4214	0.0004656	382.91

EMAP = (4*B)/(3*(D/t)) = (4*382.9123)/(3*366.5492) = 1.3929 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
8.645	3537.20	1490.47	409.17	0.4214	0.0003935	323.65

EMAP = (4*B)/(3*(D/t)) = (4*323.6455)/(3*409.1711) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
9.650	3537.20	1941.68	366.55	0.5489	0.0003526	289.95

EMAP = (4*B)/(3*(D/t)) = (4*289.9506)/(3*366.5492) = 1.0547 KG/CM2

Cylindrical Shell From RING9 to 150 Ext. Chart: CS-2 at 407 C

SHELL9

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
9.650	3537.20	1054.10	366.55	0.2980	0.0006748	469.35

EMAP = (4*B)/(3*(D/t)) = (4*469.3489)/(3*366.5492) = 1.7073 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
7.473	3537.20	1054.10	473.32	0.2980	0.0004552	374.39

EMAP = (4*B)/(3*(D/t)) = (4*374.3888)/(3*473.3190) = 1.0546 KG/CM2

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
9.650	3537.20	1941.72	366.55	0.5489	0.0003526	289.94

EMAP = (4*B)/(3*(D/t)) = (4*289.9447)/(3*366.5492) = 1.0547 KG/CM2

Elliptical Head From 150 to 160 Ext. Chart: CS-2 at 407 C

TOP HD

Elastic Modulus from Chart: CS-2 at 407 C : 0.16448E+07 KG/CM2

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	D/t	Factor A	B
11.650	3541.20	303.97	0.0004569	375.78

EMAP = B/(K0*D/t) = 375.7808 /(0.9000 *303.9657) = 1.3736 KG/CM2

Results for Required Thickness (Tca):

Tca	OD	D/t	Factor A	B
10.208	3541.20	346.90	0.0004004	329.28

EMAP = B/(K0*D/t) = 329.2752 /(0.9000 *346.8967) = 1.0547 KG/CM2

Stiffening Ring Calculations for : RING1, SA-516 60

Effective Length of Shell = 226.57 mm.

	Area (sq.mm.)	Distance (mm.)	Area*Dist
Shell:	2719.068	6.0000	16314.406
Ring :	2427.444	113.6625	275909.375
Total:	5146.512		292223.781

Centroid of Ring plus Shell = 56.781 mm.

	Inertia	Distance	A*Dist²
Shell:	32626.680	50.7809	7011668.500
Ring :	8362211.500	-56.8816	7854024.000
Total:	8394838.000		14865692.000

Available Moment of Inertia, Ring plus Shell 23259556.000 mm**4

Required Stress in Ring plus Shell BREQ = 216.71 KG/CM2
Required Strain in Ring plus Shell AREQ = 0.0002630

Required Moment of Inertia, Ring plus Shell
= (OD² * SLEN * (TCA+ARING/SLEN) * AREQ)/ 10.9
= (3535.5500²*2685.2983*(12.0000+2427.4443/2685.2983)*0.0002630)/10.9
= 10450928.0000 mm**4

Stiffening Ring Calculations for : RING2, SA-516 60

Effective Length of Shell = 226.57 mm.

	Area (sq.mm.)	Distance (mm.)	Area*Dist
Shell:	2719.068	6.0000	16314.406
Ring :	2425.952	113.6000	275588.125

Total:	5145.020		291902.531	
Centroid of Ring plus Shell		=	56.735	mm.
	Inertia	Distance	A*Dist²	
Shell:	32626.680	50.7350	6998981.000	
Ring :	8346799.000	-56.8650	7844633.500	
Total:	8379425.500		14843614.000	
Available Moment of Inertia, Ring plus Shell			23222070.000	mm**4

Required Stress in Ring plus Shell	BREQ	216.17	KG/CM2
Required Strain in Ring plus Shell	AREQ	0.0002620	

Required Moment of Inertia, Ring plus Shell
= (OD² * SLEN * (TCA+ARING/SLEN) * AREQ)/ 10.9
= (3535.5500²*2590.8000*(12.0000+2425.9521/2590.8000)*0.0002620)/10.9
= 10070027.0000 mm**4

Results for Stiffening Ring Weld Calculations per UG-30

Given Stiffening Ring Fillet Weld Size	Wleg	7.112	mm.
Stiffening Ring Attachment Style		CONTINUOUS	
Location of Stiffening Ring		EXTERNAL	
Radial Pressure Load	Pext*Slen	27.32	KG /mm.
The Radial Shear Load	V	965.81	KG
The First Moment of the Area (Ring + Shell)	Q	137943.27	mm.³
Weld Shear Flow due to Rad. Shear Load	VQ/I	5.74	KG /mm
The Weld Allowable Stress	.55*S	477.17	KG/CM2
Minimum Weld Leg Size Min(.25,TCA,TRING)	Wldmin	6.35	mm.
The Weld Allowable Load	2* WLeg*.55*S	67.86	KG /mm
The Combined Weld Load SRSS of VQ/I and Pext*Slen		27.91	KG /mm

Stiffening Ring Calculations for : RING3, SA-516 60

Effective Length of Shell			226.57	mm.
	Area (sq.mm.)	Distance (mm.)	Area*Dist	
Shell:	2719.068	6.0000	16314.406	
Ring :	2577.574	119.9500	309179.969	
Total:	5296.642		325494.375	
Centroid of Ring plus Shell		=	61.453	mm.
	Inertia	Distance	A*Dist²	
Shell:	32626.680	55.4530	8361221.000	
Ring :	10011675.000	-58.4970	8820204.000	
Total:	10044302.000		17181424.000	
Available Moment of Inertia, Ring plus Shell			27224602.000	mm**4

Required Stress in Ring plus Shell	BREQ	216.54	KG/CM2
Required Strain in Ring plus Shell	AREQ	0.0002620	

Required Moment of Inertia, Ring plus Shell
= (OD² * SLEN * (TCA+ARING/SLEN) * AREQ)/ 10.9
= (3535.5500²*2819.3999*(12.0000+2577.5740/2819.3999)*0.0002620)/10.9
= 10939801.0000 mm**4

Stiffening Ring Calculations for : RING4, SA-516 60

Effective Length of Shell			226.57	mm.
	Area (sq.mm.)	Distance (mm.)	Area*Dist	
Shell:	2719.068	6.0000	16314.406	
Ring :	2418.371	113.2825	273959.000	
Total:	5137.438		290273.406	
Centroid of Ring plus Shell		=	56.502	mm.
	Inertia	Distance	A*Dist²	
Shell:	32626.680	50.5016	6934737.000	
Ring :	8268787.500	-56.7809	7796994.500	
Total:	8301414.500		14731732.000	
Available Moment of Inertia, Ring plus Shell			23032182.000	mm**4

Required Stress in Ring plus Shell BREQ 218.59 KG/CM2
Required Strain in Ring plus Shell AREQ 0.0002650

Required Moment of Inertia, Ring plus Shell
= (OD² * SLEN * (TCA+ARING/SLEN) * AREQ)/ 10.9
= (3535.5500²*3048.0000*(12.0000+2418.3706/3048.0000)*0.0002650)/10.9
= 11850347.0000 mm**4

Stiffening Ring Calculations for : RING5, SA-516 60

Effective Length of Shell 226.57 mm.

	Area (sq.mm.)	Distance (mm.)	Area*Dist
Shell:	2719.068	6.0000	16314.406
Ring :	2577.574	119.9500	309179.969
Total:	5296.642		325494.375

Centroid of Ring plus Shell = 61.453 mm.

	Inertia	Distance	A*Dist²
Shell:	32626.680	55.4530	8361221.000
Ring :	10011675.000	-58.4970	8820204.000
Total:	10044302.000		17181424.000

Available Moment of Inertia, Ring plus Shell 27224602.000 mm**4

Required Stress in Ring plus Shell BREQ 217.70 KG/CM2
Required Strain in Ring plus Shell AREQ 0.0002640

Required Moment of Inertia, Ring plus Shell
= (OD² * SLEN * (TCA+ARING/SLEN) * AREQ)/ 10.9
= (3535.5500²*3048.0000*(12.0000+2577.5740/3048.0000)*0.0002640)/10.9
= 11853825.0000 mm**4

Stiffening Ring Calculations for : RING6, SA-516 60

Effective Length of Shell 226.57 mm.

	Area (sq.mm.)	Distance (mm.)	Area*Dist
Shell:	2719.068	6.0000	16314.406
Ring :	1919.470	119.9500	230240.406
Total:	4638.538		246554.812

Centroid of Ring plus Shell = 53.154 mm.

	Inertia	Distance	A*Dist²
Shell:	32626.680	47.1536	6045735.500
Ring :	7455503.500	-66.7964	8564219.000
Total:	7488130.000		14609954.000

Available Moment of Inertia, Ring plus Shell 22097128.000 mm**4

Required Stress in Ring plus Shell BREQ 221.42 KG/CM2
Required Strain in Ring plus Shell AREQ 0.0002680

Required Moment of Inertia, Ring plus Shell
= (OD² * SLEN * (TCA+ARING/SLEN) * AREQ)/ 10.9
= (3535.5500²*3048.0000*(12.0000+1919.4700/3048.0000)*0.0002680)/10.9
= 11831180.0000 mm**4

Stiffening Ring Calculations for : RING7, SA-516 60

Effective Length of Shell 226.57 mm.

	Area (sq.mm.)	Distance (mm.)	Area*Dist
Shell:	2719.068	6.0000	16314.406
Ring :	1919.470	119.9500	230240.406
Total:	4638.538		246554.812

Centroid of Ring plus Shell = 53.154 mm.

	Inertia	Distance	A*Dist²
Shell:	32626.680	47.1536	6045735.500
Ring :	7455503.500	-66.7964	8564219.000
Total:	7488130.000		14609954.000

Available Moment of Inertia, Ring plus Shell 22097128.000 mm**4

Required Stress in Ring plus Shell BREQ 220.20 KG/CM2
Required Strain in Ring plus Shell AREQ 0.0002670

Required Moment of Inertia, Ring plus Shell
= (OD² * SLEN * (TCA+ARING/SLEN) * AREQ)/ 10.9
= (3535.5500²*2743.2000*(12.0000+1919.4700/2743.2000)*0.0002670)/10.9
= 10667100.0000 mm**4

Stiffening Ring Calculations for : RING8, SA-516 60

Effective Length of Shell 226.57 mm.

	Area (sq.mm.)	Distance (mm.)	Area*Dist
Shell:	2719.068	6.0000	16314.406
Ring :	1919.470	119.9500	230240.406
Total:	4638.538		246554.812

Centroid of Ring plus Shell = 53.154 mm.

	Inertia	Distance	A*Dist²
Shell:	32626.680	47.1536	6045735.500
Ring :	7455503.500	-66.7964	8564219.000
Total:	7488130.000		14609954.000

Available Moment of Inertia, Ring plus Shell 22097128.000 mm**4

Required Stress in Ring plus Shell BREQ 215.49 KG/CM2
Required Strain in Ring plus Shell AREQ 0.0002610

Required Moment of Inertia, Ring plus Shell
= (OD² * SLEN * (TCA+ARING/SLEN) * AREQ)/ 10.9
= (3535.5500²*1964.4359*(12.0000+1919.4700/1964.4359)*0.0002610)/10.9
= 7630258.0000 mm**4

Stiffening Ring Calculations for : RING9, SA-516 60

Effective Length of Shell 203.23 mm.

	Area (sq.mm.)	Distance (mm.)	Area*Dist
Shell:	1961.284	4.8250	9463.193
Ring :	2129.160	79.5000	169268.234
Total:	4090.444		178731.422

Centroid of Ring plus Shell = 43.695 mm.

	Inertia	Distance	A*Dist²
Shell:	15218.975	38.8699	2963238.750
Ring :	3462513.500	-35.8051	2729598.500
Total:	3477732.500		5692837.000

Available Moment of Inertia, Ring plus Shell 9170197.000 mm**4

Required Stress in Ring plus Shell BREQ 247.08 KG/CM2
Required Strain in Ring plus Shell AREQ 0.0002990

Required Moment of Inertia, Ring plus Shell
= (OD² * SLEN * (TCA+ARING/SLEN) * AREQ)/ 10.9
= (3537.2000²*1272.2860*(9.6500+2129.1602/1272.2860)*0.0002990)/10.9
= 4944507.0000 mm**4

External Pressure Calculations

From	To	Section Length mm.	Outside Diameter mm.	Corroded Thickness mm.	Factor A	Factor B KG/CM2
10	20	No Calc	0.00000	0.00000	No Calc	No Calc
20	30	No Calc	0.00000	0.00000	No Calc	No Calc
30	40	No Calc	0.00000	0.00000	No Calc	No Calc
40	50	No Calc	0.00000	0.00000	No Calc	No Calc
50	60	No Calc	3535.55	12.0000	0.00047140	387.689
60	Ring	2779.80	3535.55	12.0000	0.00033822	278.159
Ring	70	2590.80	3535.55	12.0000	0.00036381	299.204
70	Ring	2590.80	3535.55	12.0000	0.00036381	299.204

Ring	80	2590.80	3535.55	12.0000	0.00036381	299.204
80	Ring	2590.80	3535.55	12.0000	0.00036381	299.204
Ring	90	3048.00	3535.55	12.0000	0.00030753	252.915
90	Ring	3048.00	3535.55	12.0000	0.00030753	252.915
Ring	100	3048.00	3535.55	12.0000	0.00030753	252.915
100	Ring	3048.00	3535.55	12.0000	0.00030753	252.915
Ring	110	3048.00	3535.55	12.0000	0.00030753	252.915
110	Ring	3048.00	3535.55	12.0000	0.00030753	252.915
Ring	120	3048.00	3535.55	12.0000	0.00030753	252.915
120	Ring	3048.00	3535.55	12.0000	0.00030753	252.915
Ring	130	2438.40	3535.55	12.0000	0.00038745	318.643
130	Ring	2438.40	3535.55	12.0000	0.00038745	318.643
Ring	140	1490.47	3535.55	12.0000	0.00065020	464.360
140	Ring	1490.47	3537.20	9.65000	0.00046559	382.912
Ring	150	1054.10	3537.20	9.65000	0.00067484	469.349
150	160	No Calc	3541.20	11.6500	0.00045692	375.781

External Pressure Calculations

From	To	External Actual T. mm.	External Required T. mm.	External Des. Press. KG/CM2	External M.A.W.P. KG/CM2
10	20	0.00000	No Calc	0.00000	No Calc
20	30	0.00000	No Calc	0.00000	No Calc
30	40	0.00000	No Calc	0.00000	No Calc
40	50	0.00000	No Calc	0.00000	No Calc
50	60	12.0000	10.1920	1.05461	1.46206
60	Ring	12.0000	11.1854	1.05461	1.25880
Ring	70	12.0000	10.8663	1.05461	1.35403
70	Ring	12.0000	10.8663	1.05461	1.35403
Ring	80	12.0000	10.8663	1.05461	1.35403
80	Ring	12.0000	10.8663	1.05461	1.35403
Ring	90	12.0000	11.6159	1.05461	1.14456
90	Ring	12.0000	11.6159	1.05461	1.14456
Ring	100	12.0000	11.6159	1.05461	1.14456
100	Ring	12.0000	11.6159	1.05461	1.14456
Ring	110	12.0000	11.6159	1.05461	1.14456
110	Ring	12.0000	11.6159	1.05461	1.14456
Ring	120	12.0000	11.6159	1.05461	1.14456
120	Ring	12.0000	11.6159	1.05461	1.14456
Ring	130	12.0000	10.5986	1.05461	1.44201
130	Ring	12.0000	10.5986	1.05461	1.44201
Ring	140	12.0000	8.64248	1.05461	2.10145
140	Ring	16.0000	14.9948	1.05461	1.39285
Ring	150	16.0000	13.8232	1.05461	1.70727
150	160	18.0000	16.5582	1.05461	1.37362
Minimum					1.145

External Pressure Calculations

From	To	Actual Len. Bet. Stiff. mm.	Allow. Len. Bet. Stiff. mm.	Ring Inertia Required mm**4	Ring Inertia Available mm**4
10	20	No Calc	No Calc	No Calc	No Calc
20	30	No Calc	No Calc	No Calc	No Calc
30	40	No Calc	No Calc	No Calc	No Calc
40	50	No Calc	No Calc	No Calc	No Calc
50	60	No Calc	No Calc	No Calc	No Calc
60	Ring	2779.80	3299.86	No Calc	No Calc
Ring	70	2590.80	3299.92	10.45E+06	23.26E+06
70	Ring	2590.80	3299.92	No Calc	No Calc
Ring	80	2590.80	3299.92	10.07E+06	23.22E+06
80	Ring	2590.80	3299.92	No Calc	No Calc

Ring	90	3048.00	3299.88	10.94E+06	27.22E+06
90	Ring	3048.00	3299.88	No Calc	No Calc
Ring	100	3048.00	3299.88	11.85E+06	23.03E+06
100	Ring	3048.00	3299.88	No Calc	No Calc
Ring	110	3048.00	3299.88	11.85E+06	27.22E+06
110	Ring	3048.00	3299.88	No Calc	No Calc
Ring	120	3048.00	3299.88	11.83E+06	22.10E+06
120	Ring	3048.00	3299.88	No Calc	No Calc
Ring	130	2438.40	3299.88	10.67E+06	22.10E+06
130	Ring	2438.40	3299.88	No Calc	No Calc
Ring	140	1490.47	3299.90	7.630E+06	22.10E+06
140	Ring	1490.47	1941.68	No Calc	No Calc
Ring	150	1054.10	1941.72	4.945E+06	9.170E+06
150	160	No Calc	No Calc	No Calc	No Calc

Elements Suitable for External Pressure.

Element and Detail Weights

From	To	Element Metal Wgt. KG	Element ID Volume mm3	Corroded Metal Wgt. KG	Corroded ID Volume mm3	Extra due Misc % KG
10	20	3871.20	0.00000	3558.31	0.00000	387.120
20	30	4196.67	0.00000	3412.67	0.00000	419.667
30	40	3674.13	0.00000	2889.25	0.00000	367.413
40	50	731.745	0.00000	653.726	0.00000	73.1745
50	60	1690.34	6.140E+09	1690.34	6.140E+09	169.034
60	70	3170.96	29.52E+09	3170.96	29.52E+09	317.096
70	80	3170.96	29.52E+09	3170.96	29.52E+09	317.096
80	90	3170.96	29.52E+09	3170.96	29.52E+09	317.096
90	100	3170.96	29.52E+09	3170.96	29.52E+09	317.096
100	110	3170.96	29.52E+09	3170.96	29.52E+09	317.096
110	120	3170.96	29.52E+09	3170.96	29.52E+09	317.096
120	130	3170.96	29.52E+09	3170.96	29.52E+09	317.096
130	140	1867.69	17.39E+09	1867.69	17.39E+09	186.769
140	150	1833.70	12.76E+09	1107.94	12.86E+09	183.370
150	160	2414.30	6.108E+09	1647.76	6.173E+09	241.430
Total		42476	0.249E+12	39024	0.249E+12	4247

Weight of Details

From	Type	Weight of Detail KG	X Offset, Dtl. Cent. mm.	Y Offset, Dtl. Cent. mm.	Description
10	Insl	1525.01	0.00000	600.000	FIREPRROFING2
10	Lini	1465.36	0.00000	600.000	FIREPROOFING1
10	Wght	200.000	0.00000	200.000	TAILING LUG
20	Insl	3751.63	0.00000	1500.00	FIREPROOFING4
20	Lini	146.584	0.00000	1500.00	FIREPROOFING3
30	Insl	3812.53	0.00000	1500.00	FIREPROOFING6
30	Lini	3676.04	0.00000	1500.00	FIREPROOFING5
40	Plat	9464.51	-0.00002	0.00000	PLTFM1
40	Insl	762.505	0.00000	300.000	FIREPROOFING8
40	Lini	735.209	0.00000	300.000	FIREPROOFING7
50	Insl	67.3613	0.00000	-414.560	INS: 10
50	Lini	909.786	0.00000	-414.560	CLADDING
60	Insl	126.365	0.00000	1524.00	INS: 10
60	Lini	1706.70	0.00000	1524.00	CLADDING
60	Ring	245.623	0.00000	2438.40	RING1
60	Nozl	444.751	2060.57	609.600	1M
70	Plat	3665.92	394.116	2011.68	PLT2
70	Insl	126.365	0.00000	1524.00	INS: 10
70	Lini	1706.70	0.00000	1524.00	CLADDING
70	Ring	245.463	0.00000	1981.20	RING2
70	Tray	620.551	0.00000	2618.23	TRAY 1
80	Insl	126.365	0.00000	1524.00	INS: 10
80	Lini	1706.70	0.00000	1524.00	CLADDING
80	Ring	261.691	0.00000	1524.00	RING3
80	Tray	4864.08	0.00000	1399.03	TRAY 2-6
90	Plat	3665.92	394.116	914.400	PLT3
90	Insl	126.365	0.00000	1524.00	INS: 10
90	Lini	1706.70	0.00000	1524.00	CLADDING
90	Ring	244.655	0.00000	1524.00	RING4
90	Nozl	444.751	2060.57	1219.20	1M2
90	Tray	1417.10	0.00000	484.632	TRAY 7-8
90	Wght	1000.00	0.00000	790.001	CHMNY TRY1
100	Plat	3659.84	394.116	3000.00	PLAT4
100	Insl	126.365	0.00000	1524.00	INS: 10

100	Lini	1706.70	0.00000	1524.00	CLADDING
100	Ring	261.691	0.00000	1524.00	RING5
100	Tray	2389.65	0.00000	2404.87	TRAY 9-11
100	Wght	1000.00	0.00000	1524.00	PLT + INSUL CLI
100	Wght	1000.00	0.00000	500.002	ANNULAR RING
110	Insl	126.365	0.00000	1524.00	INS: 10
110	Lini	1706.70	0.00000	1524.00	CLADDING
110	Ring	194.876	0.00000	1524.00	RING6
110	Tray	4862.76	0.00000	1795.27	TRAY 12-16
120	Plat	3659.84	394.116	2000.00	PLTA5
120	Insl	126.365	0.00000	1524.00	INS: 10
120	Lini	1706.70	0.00000	1524.00	CLADDING
120	Ring	194.876	0.00000	1524.00	RING7
120	Nozl	444.751	2060.57	1219.20	1M3
120	Tray	620.551	0.00000	576.072	TRAY 17
120	Tray	620.551	0.00000	1795.27	TRAY 18
120	Tray	1259.65	0.00000	3014.47	TRAY 19
120	Wght	1000.00	0.00000	0.0023254	CHMNY TRY2
130	Insl	74.4289	0.00000	897.636	INS: 10
130	Lini	502.487	0.00000	897.635	CLADDING
130	Ring	194.876	0.00000	914.400	RING8
130	Tray	4240.96	0.00000	1185.42	TRAY 20-22
140	Plat	4678.63	393.977	500.000	PLAT6
140	Insl	54.8678	0.00000	661.416	INS: 10
140	Ring	211.869	0.00000	609.600	RING9
140	Nozl	541.378	2057.40	609.602	1M4
140	Wght	100.000	0.00000	1066.80	DISTRIBUTOR WEI
140	Wght	200.000	1752.60	1066.80	LIFTING LUG1
140	Wght	200.000	1752.60	1066.80	LIFTING LUG2
140	Wght	200.000	1752.60	1066.80	PIPE DAVIT
140	Wght	1890.00	2160.00	0.00000	OVRHD
150	Plat	6082.88	0.00000	876.300	TOP PLT
150	Insl	64.2494	0.00000	462.534	INS: 10
150	Nozl	133.040	0.00000	73.0250	VAPOR OL

Note: The individual tray liquid weights are listed below, but these weights are included in the tray weights above.

70	Tliq	0.00	0.00000	2618.22998
80	Tliq	0.00	0.00000	1399.03198
90	Tliq	0.00	0.00000	484.63199
100	Tliq	0.00	0.00000	2404.86987
110	Tliq	0.00	0.00000	1795.27197
120	Tliq	0.00	0.00000	576.07202
120	Tliq	0.00	0.00000	1795.27002
120	Tliq	0.00	0.00000	3014.46997
130	Tliq	0.00	0.00000	1185.41797

Total Weight of Each Detail Type

Total Weight of Platforms	34877.5
Total Weight of Insulation	10997.1
Total Weight of Lining	19382.4
Total Weight of Stiffeners	2055.6
Total Weight of Nozzles	2008.7
Total Weight of Trays	14273.9
Total Weight of Tray Bolting Weight	6622.0
Total Weight of Weights	6790.0
Sum of the Detail Weights	97007.2 KG

Weight Summary

Fabricated Wt.	- Bare Weight W/O Removable Internals	62210.4 KG
Shop Test Wt.	- Fabricated Weight + Water (Full)	311081.7 KG
Shipping Wt.	- Fab. Wt + Rem. Intls.+ Shipping App.	141741.3 KG
Erected Wt.	- Fab. Wt + Rem. Intls.+ Insul. (etc)	143631.3 KG
Ope. Wt. no Liq	- Fab. Wt + Intls. + Details + Wghts.	143631.3 KG
Operating Wt.	- Empty Wt. + Operating Liquid (No CA)	141841.3 KG
Field Test Wt.	- Empty Weight + Water (Full)	386972.7 KG
Mass of the Upper 1/3 of the Vertical Vessel		56660.3 KG

Outside Surface Areas of Elements

From	To	Surface Area sq.mm.
10	20	13.46E+06
20	30	33.64E+06
30	40	33.64E+06
40	50	6.729E+06
50	60	14.12E+06
60	70	33.86E+06
70	80	33.86E+06
80	90	33.86E+06
90	100	33.86E+06
100	110	33.86E+06
110	120	33.86E+06
120	130	33.86E+06
130	140	19.94E+06
140	150	14.70E+06
150	160	14.17E+06
Total		387406624.000 sq.mm.

Element and Detail Weights

From	To	Total Ele. Empty Wgt. KG	Total. Ele. Oper. Wgt. KG	Total. Ele. Hydro. Wgt. KG	Total Dtl. Offset Mom. KG-M	Oper. Wgt. No Liquid KG
10	20	7448.69	7448.69	7104.51	0.00000	7448.69
20	30	8514.55	8514.55	7652.15	0.00000	8514.55
30	40	11530.1	11530.1	10666.7	0.00000	11530.1
40	50	11767.1	11767.1	11681.3	0.00016329	11767.1
50	60	2836.52	2836.52	8972.90	0.00000	2836.52
60	70	6011.49	6011.49	35511.3	916.266	6011.49
70	80	9853.05	9853.05	39352.9	1444.52	9853.05
80	90	10446.9	10446.9	39946.7	0.00000	10446.9
90	100	12093.5	12093.5	41593.4	2360.78	12093.5
100	110	13632.3	13632.3	43132.1	1442.12	13632.3
110	120	10378.8	10378.8	39878.6	0.00000	10378.8
120	130	13121.3	13121.3	42621.2	2358.39	13121.3
130	140	7067.21	7067.21	24442.6	0.00000	7067.21
140	150	9993.81	8203.81	20154.8	4007.88	8203.81
150	160	8935.90	8935.90	14261.6	0.00000	8935.90

Cumulative Vessel Weight

From	To	Cumulative Ope Wgt. No Liquid KG	Cumulative Oper. Wgt. KG	Cumulative Hydro. Wgt. KG
10	20	141841.	141841.	386973.
20	30	134393.	134393.	379868.
30	40	125878.	125878.	372216.
40	50	114348.	114348.	361549.
50	60	102581.	102581.	349868.

60	70	99744.3	99744.3	340895.
70	80	93732.8	93732.8	305384.
80	90	83879.7	83879.7	266031.
90	100	73432.9	73432.9	226084.
100	110	61339.3	61339.3	184491.
110	120	47707.0	47707.0	141359.
120	130	37328.3	37328.3	101480.
130	140	24206.9	24206.9	58858.9
140	150	17139.7	17139.7	34416.3
150	160	8935.90	8935.90	14261.6

Note: The cumulative operating weights no liquid in the column above are the cumulative operating weights minus the operating liquid weight minus any weights absent in the empty condition.

Cumulative Vessel Moment

From	To	Cumulative Empty Mom. KG-M	Cumulative Oper. Mom. KG-M	Cumulative Hydro. Mom. KG-M
10	20	12530.0	12530.0	12530.0
20	30	12530.0	12530.0	12530.0
30	40	12530.0	12530.0	12530.0
40	50	12530.0	12530.0	12530.0
50	60	12530.0	12530.0	12530.0
60	70	12530.0	12530.0	12530.0
70	80	11613.7	11613.7	11613.7
80	90	10169.2	10169.2	10169.2
90	100	10169.2	10169.2	10169.2
100	110	7808.40	7808.40	7808.40
110	120	6366.27	6366.27	6366.27
120	130	6366.27	6366.27	6366.27
130	140	4007.88	4007.88	4007.88
140	150	4007.88	4007.88	4007.88
150	160	0.00000	0.00000	0.00000

Nozzle Flange MAWP Results :

Nozzle Description	Flange Rating Operating KG/CM2	Ambient KG/CM2	Temperature C	Class	Grade|Group
1M	6.4	20.0	407	150	GR 1.1
1M2	6.4	20.0	407	150	GR 1.1
1M3	6.4	20.0	407	150	GR 1.1
1M4	6.4	20.0	407	150	GR 1.1
VAPOR OL	6.4	20.0	407	150	GR 1.1
Minimum Rating	6.363	20.037	KG/CM2		

Note: ANSI Ratings are per ANSI/ASME B16.5 2003 Edition

The Natural Frequencies for the vessel have been computed iteratively by solving a system of matrices. These matrices describe the mass and the stiffness of the vessel. This is the generalized eigenvalue/ eigenvector problem and is referenced in some mathematical texts.

The Natural Frequency for the Vessel (Empty.) is 1.37378 Hz.

The Natural Frequency for the Vessel (Ope...) is 1.37378 Hz.

The Natural Frequency for the Vessel (Filled) is 0.88128 Hz.

Wind Analysis Results

Vortex Shedding Loads, per NBC 1990 Supplement, pages 149-150

Compute the critical wind speed using the weighted average
diameter of the top one-third of the vessel [Vh(ope)]
= Fn(ope) * Davg / 0.2 * 0.6818
= 1.3738 * 11.5235 / 0.2 * 0.6818
= 53.968 mile/hr ; 24.126 m/sec

Compute the aspect ratio (gamma) for the entire structure [Gamma]
= (Total Height)² / Sum of the Wind Area
= 32351.64² / .11882E+09 = 8.8094

Determine the Velocity Pressure Qh(ope) (English Units only)
= 0.5 * 0.0668 * Rho * Vh(ope)²
= 0.5 * 0.0668 * 0.0749 * 53.968² = 7.293 psf ; 35.5885 KG/SQ.M.

Compute the equivalent force per unit area which will act on the top
one-third of the vessel [F/area]:
= (qh(ope)*C1)/[(Gamma)½*(Beta(ope)-(C2*Rho*Davg²/M3))½]
=(7.293*2.2)/[(8.81)½*(0.0100-(0.60*0.0749*292.6965²/5.3))½]
= 292.7970 KG/SQ.M.

Platform Load Calculations

ID	Wind Area sq.mm.	Elevation mm.	Pressure KG/SQ.M.	Force KG	Cf
PLTFM1	2477570.00	7504.80	0.00	0.00	1.00
PLT2	2000120.00	13213.25	0.00	0.00	1.00
PLT3	0.00	18211.97	0.00	0.00	0.00
PLAT4	2000120.00	23345.57	292.80	585.76	1.00
PLTA5	2000120.00	28441.56	292.80	585.76	1.00
PLAT6	2000120.00	31784.84	292.80	585.76	1.00
TOP PLT	3561300.00	33483.97	292.80	1042.98	1.00

Wind Loads on Masses/Equipment/Piping

ID	Wind Area sq.mm.	Elevation mm.	Pressure KG/SQ.M.	Force KG
TAILING LUG	0.00	504.80	0.00	0.00
CHMNY TRY1	0.00	18087.57	0.00	0.00
PLT + INSUL C	0.00	21869.57	292.80	0.00
ANNULAR RING	0.00	20845.57	0.00	0.00
CHMNY TRY2	0.00	26441.57	292.80	0.00
DISTRIBUTOR W	0.00	32351.64	292.80	0.00
LIFTING LUG1	0.00	32351.64	292.80	0.00
LIFTING LUG2	0.00	32351.64	292.80	0.00
PIPE DAVIT	0.00	32351.64	292.80	0.00
OVRHD	0.00	31284.84	292.80	0.00

The following table contains results for Vortex Shedding Case (Ope).

Wind Load Calculation

		Wind	Wind	Wind	Height	Element

From	To	Height mm.	Diameter mm.	Area sq.mm.	Factor KG/SQ.M.	Wind Load KG
10	20	904.800	4441.98	5.331E+06	0.00000	0.00000
20	30	3004.80	4440.05	13.32E+06	0.00000	0.00000
30	40	6004.80	4441.98	13.33E+06	0.00000	0.00000
40	50	7805.26	4422.32	2.654E+06	0.00000	0.00000
50	60	8129.18	4326.58	211012.	0.00000	0.00000
60	70	9677.57	4326.58	13.19E+06	0.00000	0.00000
70	80	12725.6	4326.58	13.19E+06	0.00000	0.00000
80	90	15773.6	4326.58	13.19E+06	0.00000	0.00000
90	100	18821.6	4326.58	13.19E+06	0.00000	0.00000
100	110	21869.6	4326.58	13.19E+06	0.00000	625.299
110	120	24917.6	4326.58	13.19E+06	292.797	2367.08
120	130	27965.6	4326.58	13.19E+06	292.797	2962.82
130	140	30387.2	4326.58	7.768E+06	292.797	1394.21
140	150	31946.3	4328.57	5.726E+06	292.797	1610.59
150	160	33018.3	4333.41	3.324E+06	292.797	1654.21

End of Vortex Shedding Calculations
Wind Load Results per ASCE-7 98/02/05:

Note: Per Section 1609 of IBC 2003/06 these results are also applicable for the determination of Wind Loads on structures (1609.1.1).

User Entered Importance Factor is		1.150	
Gust Effect Factor (Ope)(G or Gf)	Dynamic	0.932	
User entered Beta Value (Operating Case)		0.0100	
Shape Factor (Cf)		0.613	
User Entered Basic Wind Speed		34.0	m/sec

Sample Calculation for the First Element

The ASCE code performs all calculations in Imperial Units only. The wind pressure is therefore computed in these units.

Value of [Alpha] and [Zg]
Exposure Category = 3 (C) thus from Table C6-2:
Alpha = 9.500 : Zg = 274320.000 mm.

Effective Height [z]
= Centroid Hgt. + Vessel Base Elevation
= 600.000 + 304.800 = 904.800 mm.
= 2.969 ft. Imperial Units

Compute [Kz]
Because z (2.969 ft.) < 15 ft.
= 2.01 * (15 / Zg) ^(2 / Alpha)
= 2.01 * (15 / 900.000)^(2 / 9.500)
= 0.849

1) The shear force as calculated above doesnot consider the effect of operating wind and is purely based on Vortex Shedding.
And the same shear force (vortex case) is used to calculate moment (page 52).
Please clarify the same.

Type of Hill: No Hill

Directionality Factor for round structures [Kd]:
= 0.95 per [6-6 ASCE-7 98][6-4 ASCE-7 02/05]

As there is No Hill Present: [Kzt]
K1 = 0, K2 = 0, K3 = 0

Topographical Factor [Kzt]
= (1 + K1 * K2 * K3)²
= (1 + 0.000 * 0.000 * 0.000)²
= 1.0000

Basic Wind Pressure, Imperial Units [qz]:
= 0.00256 * Kz * Kzt * Kd * I * Vr(mph)²
= 0.00256 * 0.849 * 1.000 * 0.950 * 1.150 * (76.000)²
= 13.713 psf [66.920] KG/SQ.M.

Force on the first element [F]:
= qz * Gh * Cf * WindArea
= 66.920 * 0.932 * 0.613 * 5330713
= 203.789 KG

Element	Hgt (z) mm.	K1	K2	K3	Kz	Kzt	qz KG/SQ.M.
BTM SKRT	904.8	0.000	0.000	0.000	0.849	1.000	66.920
INTER SKRT2	3004.8	0.000	0.000	0.000	0.849	1.000	66.920
INTER SKRT1	6004.8	0.000	0.000	0.000	0.899	1.000	70.873
TOP SKRT	7805.3	0.000	0.000	0.000	0.950	1.000	74.896
BTM HD	8129.2	0.000	0.000	0.000	0.958	1.000	75.540
Shell1	9677.6	0.000	0.000	0.000	0.994	1.000	78.364
Shell2	12725.6	0.000	0.000	0.000	1.053	1.000	83.014
SHELL3	15773.6	0.000	0.000	0.000	1.102	1.000	86.853
SHELL4	18821.6	0.000	0.000	0.000	1.143	1.000	90.144
SHELL5	21869.6	0.000	0.000	0.000	1.180	1.000	93.038
SHELL6	24917.6	0.000	0.000	0.000	1.213	1.000	95.629
SHELL7	27965.6	0.000	0.000	0.000	1.243	1.000	97.980
SHELL8	30387.2	0.000	0.000	0.000	1.265	1.000	99.709
SHELL9	31946.3	0.000	0.000	0.000	1.278	1.000	100.764
TOP HD	33018.3	0.000	0.000	0.000	1.287	1.000	101.467

Wind Vibration Calculations

This evaluation is based on work by Kanti Mahajan and Ed Zorilla

Nomenclature

Cf - Correction factor for natural frequency
D - Average internal diameter of vessel mm.
Df - Damping Factor < 0.75 Unstable, > 0.95 Stable
Dr - Average internal diameter of top half of vessel mm.
f - Natural frequency of vibration (Hertz)
f1 - Natural frequency of bare vessel based on a unit value of (D/L²)(10^(4))
L - Total height of structure mm.
Lc - Total length of conical section(s) of vessel mm.
tb - Uncorroded plate thickness at bottom of vessel mm.
V30 - Design Wind Speed provided by user m/sec
Vc - Critical wind velocity m/sec
Vw - Maximum wind speed at top of structure m/sec
W - Total corroded weight of structure KG
Ws - Cor. vessel weight excl. weight of parts which do not effect stiff. KG
Z - Maximum amplitude of vibration at top of vessel mm.
Dl - Logarithmic decrement (taken as 0.03 for Welded Structures)
Vp - Vib. Chance, <= 0.320E-06 (High); 0.320E-06 < 0.400E-06 (Probable)
P30 - wind pressure 30 feet above the base

Check other Conditions and Basic Assumptions:
#1 - Total Cone Length / Total Length < 0.5
0.000 / 32351.639 = 0.000

#2 - (D / L²) * 10^(4) < 8.0 (English Units)
- (11.81 / 106.14²) * 10^(4) = 10.479 [Geometry Violation]

Compute the vibration possibility. If Vp > 0.400E-06 no chance. [Vp]:

= W / (L * Dr²)
= 139934 / (32351.64 * 3512.088²)
= 0.000

Compute the damping factor Df which is a measure of instability [Df]:
= W * Dl/ (L * Dr²)
= 139934 * 0.03 / (32351.64 * 3512.088²)
= 0.657

Compute the critical wind velocity [Vc]:
= 3.4 * f * Dr
= 3.4 * 1.374 * 3512.088
= 24.059 m/sec

Compute the velocity at the top of the tower [Vw]:
= V30 * (L / (30 + BaseHeight))^(0.143)
= 33.97 * (32351.64 / (30 + 304.8))^0.143
= 40.512 m/sec

Compute the maximum gust velocity using the gust response factor Gh [Vg]:
= Vw * Gh
= 40.512 * 0.932
= 37.754 m/sec

Compute the maximum dynamic deflection [Z]:
= L^(5) * Vc² * 0.00243 / (W * Dl * Dr) * (1E-6)
= 32351^(5)*24.1²*0.00243/(139934*0.030*3512.088)*(1E-6)
= 22.580 mm.

Allowable Deflection at the Tower Top (Ope)(6.000"/100ft. Criteria)
Allowable Deflection : 161.758 Actual Deflection : 22.580 mm.

Platform Load Calculations

ID	Wind Area sq.mm.	Elevation mm.	Pressure KG/SQ.M.	Force KG	Cf
PLTFM1	2477570.00	7504.80	74.22	183.94	1.00
PLT2	2000120.00	13213.25	83.63	167.30	1.00
PLT3	0.00	18211.97	89.49	0.00	0.00
PLAT4	2000120.00	23345.57	94.29	188.64	1.00
PLTA5	2000120.00	28441.56	98.32	196.70	1.00
PLAT6	2000120.00	31784.84	100.66	201.37	1.00
TOP PLT	3561300.00	33483.97	101.77	362.50	1.00

Wind Loads on Masses/Equipment/Piping

ID	Wind Area sq.mm.	Elevation mm.	Pressure KG/SQ.M.	Force KG
TAILING LUG	0.00	504.80	66.92	0.00
CHMNY TRY1	0.00	18087.57	89.35	0.00
PLT + INSUL C	0.00	21869.57	93.04	0.00
ANNULAR RING	0.00	20845.57	92.07	0.00
CHMNY TRY2	0.00	26441.57	96.80	0.00
DISTRIBUTOR W	0.00	32351.64	101.03	0.00
LIFTING LUG1	0.00	32351.64	101.03	0.00
LIFTING LUG2	0.00	32351.64	101.03	0.00
PIPE DAVIT	0.00	32351.64	101.03	0.00
OVRHD	0.00	31284.84	100.32	0.00

The Natural Frequency for the Vessel (Ope...) is 1.37378 Hz.

Wind Load Calculation

From	To	Wind Height mm.	Wind Diameter mm.	Wind Area sq.mm.	Height Factor KG/SQ.M.	Element Wind Load KG
10	20	904.800	4441.98	5.331E+06	66.9201	203.789
20	30	3004.80	4440.05	13.32E+06	66.9201	509.250
30	40	6004.80	4441.98	13.33E+06	70.8731	539.566
40	50	7805.26	4422.32	2.654E+06	74.8959	290.392
50	60	8129.18	4326.58	211012.	75.5398	9.10584
60	70	9677.57	4326.58	13.19E+06	78.3640	590.393
70	80	12725.6	4326.58	13.19E+06	83.0139	799.141
80	90	15773.6	4326.58	13.19E+06	86.8526	654.346
90	100	18821.6	4326.58	13.19E+06	90.1438	679.141
100	110	21869.6	4326.58	13.19E+06	93.0376	902.315
110	120	24917.6	4326.58	13.19E+06	95.6287	720.464
120	130	27965.6	4326.58	13.19E+06	97.9805	938.228
130	140	30387.2	4326.58	7.768E+06	99.7086	442.458
140	150	31946.3	4328.57	5.726E+06	100.764	529.977
150	160	33018.3	4333.41	3.324E+06	101.467	560.265

The following table is for the Operating Case + Vortex Shedding.

Wind/Earthquake Shear, Bending

From	To	Distance to Support mm.	Cummulative Wind Shear KG	Earthquake Shear KG	Wind Bending KG-M	Earthquake Bending KG-M
10	20	600.000	8368.83	0.00000	300658.	0.00000
20	30	2700.00	8165.04	0.00000	287923.	0.00000
30	40	5700.00	7655.79	0.00000	256087.	0.00000
40	50	7500.00	7116.23	0.00000	224250.	0.00000
50	60	7824.38	6825.83	0.00000	217883.	0.00000
60	70	9372.77	6816.73	0.00000	217366.	0.00000
70	80	12420.8	6226.34	0.00000	185020.	0.00000
80	90	15468.8	5427.19	0.00000	152674.	0.00000
90	100	18516.8	4772.85	0.00000	120328.	0.00000
100	110	21564.8	4093.71	0.00000	87982.3	0.00000
110	120	24612.8	3191.39	0.00000	56589.3	0.00000
120	130	27660.8	2470.93	0.00000	29755.7	0.00000
130	140	30082.4	1532.70	0.00000	11043.3	0.00000
140	150	31641.5	1090.24	0.00000	3931.99	0.00000
150	160	32327.3	560.265	0.00000	679.105	0.00000

The following table is for the Operating Case.

Wind/Earthquake Shear, Bending

From	To	Distance to Support mm.	Cummulative Wind Shear KG	Earthquake Shear KG	Wind Bending KG-M	Earthquake Bending KG-M
10	20	600.000	8368.83	0.00000	156499.	0.00000
20	30	2700.00	8165.04	0.00000	146581.	0.00000
30	40	5700.00	7655.79	0.00000	122854.	0.00000
40	50	7500.00	7116.23	0.00000	100700.	0.00000
50	60	7824.38	6825.83	0.00000	96518.6	0.00000
60	70	9372.77	6816.73	0.00000	96186.0	0.00000
70	80	12420.8	6226.34	0.00000	76312.2	0.00000
80	90	15468.8	5427.19	0.00000	58555.7	0.00000
90	100	18516.8	4772.85	0.00000	43013.9	0.00000
100	110	21564.8	4093.71	0.00000	29503.8	0.00000
110	120	24612.8	3191.39	0.00000	18403.5	0.00000
120	130	27660.8	2470.93	0.00000	9775.80	0.00000
130	140	30082.4	1532.70	0.00000	3675.46	0.00000
140	150	31641.5	1090.24	0.00000	1321.46	0.00000
150	160	32327.3	560.265	0.00000	230.006	0.00000

1) The wind shear for operating + vortex case is same as those of operating case. It does not take effect of vortex shedding as is tabulated on page 48.

2) The moment as calculated for operating + vortex case are difficult to evaluate. Please provide us the basis (or the basic calculation) that PV-Elite follows to arrive at these values. Also note that the calculation by Kanti K. Mahajan doesnot show how to calculate the moment.

Wind Deflection Calculations:

The following table is for the Operating Case + Vortex Shedding.

Wind Deflection

From	To	Cumulative Wind Shear KG	Centroid Deflection mm.	Elem. End Deflection mm.	Elem. Ang. Rotation
10	20	10614.2	0.0080327	0.031903	0.00005
20	30	10614.2	0.17152	0.42748	0.00020790
30	40	10614.2	0.80143	1.29433	0.00036650
40	50	10614.2	1.40652	1.52316	0.00039610
50	60	10614.2	1.53283	1.54253	0.00039861
60	70	10614.2	2.20807	2.98383	0.00054325
70	80	10614.2	3.86096	4.83058	0.00066465
80	90	10614.2	5.88385	7.01190	0.00076279
90	100	10614.2	8.20587	9.45690	0.00083767
100	110	10614.2	10.7561	12.0949	0.00088952
110	120	9988.91	13.4647	14.8577	0.00092013
120	130	7621.83	16.2671	17.6872	0.00093426
130	140	4659.02	18.5267	19.3677	0.00093734
140	150	3264.81	19.9878	20.6083	0.00093816
150	160	1654.21	20.6312	20.6540	0.00093816

Allowable deflection at the Tower Top (Emp)(6.000"/100ft. Criteria)
Allowable deflection : 161.758 Actual Deflection : 20.654 mm.

The following table is for the Operating Case.

Wind Deflection

From	To	Cumulative Wind Shear KG	Centroid Deflection mm.	Elem. End Deflection mm.	Elem. Ang. Rotation
10	20	8368.83	0.0041661	0.016486	0.00003
20	30	8165.04	0.087735	0.21653	0.00010393
30	40	7655.79	0.40191	0.64257	0.00017765
40	50	7116.23	0.69687	0.75315	0.00019086
50	60	6825.83	0.75781	0.76248	0.00019197
60	70	6816.73	1.08045	1.44556	0.00025387
70	80	6226.34	1.85250	2.29625	0.00030220
80	90	5427.19	2.77210	3.27567	0.00033860
90	100	4772.85	3.80282	4.34971	0.00036454
100	110	4093.71	4.91280	5.48885	0.00038160
110	120	3191.39	6.07501	6.66877	0.00039160
120	130	2470.93	7.26791	7.87057	0.00039626
130	140	1532.70	8.22658	8.58304	0.00039729
140	150	1090.24	8.84588	9.10882	0.00039757
150	160	560.265	9.11851	9.12821	0.00039757

Critical Wind Velocity for Tower Vibration

From	To	1st Crit. Wind Speed m/sec	2nd Crit. Wind Speed m/sec
10	20	30.4296	190.185
20	30	30.4163	190.102
30	40	30.4296	190.185
40	50	30.2948	189.343

50	60	29.6390	185.243
60	70	29.6390	185.243
70	80	29.6390	185.243
80	90	29.6390	185.243
90	100	29.6390	185.243
100	110	29.6390	185.243
110	120	29.6390	185.243
120	130	29.6390	185.243
130	140	29.6390	185.243
140	150	29.6526	185.329
150	160	29.6858	185.536

Allowable deflection at the Tower Top (Ope)(6.000"/100ft. Criteria)
Allowable deflection : 161.758 Actual Deflection : 9.128 mm.

Longitudinal Stress Constants

From	To	Metal Area New & Cold sq.mm.	Metal Area Corroded sq.mm.	New & Cold Sect. Mod. $mm.^3$	Corroded Sect. Mod. $mm.^3$
10	20	223032.	189738.	196.8E+06	167.7E+06
20	30	178627.	145257.	158.0E+06	128.7E+06
30	40	156386.	122978.	138.5E+06	109.1E+06
40	50	154956.	121855.	135.9E+06	107.1E+06
50	60	132843.	132843.	116.6E+06	116.6E+06
60	70	132843.	132843.	116.6E+06	116.6E+06
70	80	132843.	132843.	116.6E+06	116.6E+06
80	90	132843.	132843.	116.6E+06	116.6E+06
90	100	132843.	132843.	116.6E+06	116.6E+06
100	110	132843.	132843.	116.6E+06	116.6E+06
110	120	132843.	132843.	116.6E+06	116.6E+06
120	130	132843.	132843.	116.6E+06	116.6E+06
130	140	132843.	132843.	116.6E+06	116.6E+06
140	150	177006.	106949.	155.1E+06	94.05E+06
150	160	199245.	129189.	174.6E+06	113.6E+06

Longitudinal Allowable Stresses

From	To	All. Str. Long. Ten. KG/CM2	All. Str. Hydr. Ten. KG/CM2	All. Str. Long. Com. KG/CM2	All. Str. Hyr. Comp. KG/CM2
10	20	927.209	1594.56	-652.788	-1383.97
20	30	927.209	1594.56	-610.889	-1259.79
30	40	728.774	1700.87	-584.417	-1175.85
40	50	728.774	1700.87	-585.874	-1180.58
50	60	1041.11	2429.81	-599.753	-1224.99
60	70	884.940	2065.34	-599.753	-1224.99
70	80	884.940	2065.34	-599.753	-1224.99
80	90	884.940	2065.34	-599.753	-1224.99
90	100	884.940	2065.34	-599.753	-1224.99
100	110	884.940	2065.34	-599.753	-1224.99
110	120	884.940	2065.34	-599.753	-1224.99
120	130	884.940	2065.34	-599.753	-1224.99
130	140	884.940	2065.34	-599.753	-1224.99
140	150	884.940	2065.34	-564.922	-1042.95
150	160	1041.11	2429.81	-594.809	-1209.30

Longitudinal Stress Report

Note: Longitudinal Operating and Empty Stresses are computed in the corroded condition. Stresses due to loads in the hydrostatic test cases have also been computed in the corroded condition.

Longitudinal Stresses Due to . . .

From	To	Long. Str. Int. Pres. KG/CM2	Long. Str. Ext. Pres. KG/CM2	Long. Str. Hyd. Pres. KG/CM2
10	20	0.00000	0.00000	0.00000
20	30	0.00000	0.00000	0.00000
30	40	0.00000	0.00000	0.00000
40	50	0.00000	0.00000	0.00000
50	60	256.470	-77.9436	605.545
60	70	256.470	-77.9436	605.545
70	80	256.470	-77.9436	605.545
80	90	256.470	-77.9436	605.545
90	100	256.470	-77.9436	605.545
100	110	256.470	-77.9436	605.545
110	120	256.470	-77.9436	605.545
120	130	256.470	-77.9436	605.545
130	140	256.470	-77.9436	605.545
140	150	319.676	-96.9056	754.780
150	160	264.676	-80.4050	624.919

Longitudinal Stresses Due to . . .

From	To	Wght. Str. Empty KG/CM2	Wght. Str. Operating KG/CM2	Wght. Str. Hydrotest KG/CM2	Wght. Str. Emp. Mom. KG/CM2	Wght. Str. Opr. Mom. KG/CM2
10	20	-74.7765	-74.7765	-204.006	7.47464	7.47464
20	30	-92.5451	-92.5451	-261.584	9.74166	9.74166
30	40	-102.385	-102.385	-302.749	11.4936	11.4936
40	50	-93.8646	-93.8646	-296.784	11.7068	11.7068
50	60	-77.2399	-77.2399	-77.2399	10.7488	10.7488
60	70	-75.1041	-75.1041	-75.1041	10.7488	10.7488
70	80	-70.5776	-70.5776	-70.5776	9.96278	9.96278
80	90	-63.1586	-63.1586	-63.1586	8.72360	8.72360
90	100	-55.2925	-55.2925	-55.2925	8.72360	8.72360
100	110	-46.1865	-46.1865	-46.1865	6.69841	6.69841
110	120	-35.9218	-35.9218	-35.9218	5.46129	5.46129
120	130	-28.1069	-28.1069	-28.1069	5.46129	5.46129
130	140	-18.2270	-18.2270	-18.2270	3.43815	3.43815
140	150	-16.0303	-16.0303	-16.0303	4.26293	4.26293
150	160	-6.91878	-6.91878	-6.91878	0.00000	0.00000

Longitudinal Stresses Due to . . .

From	To	Wght. Str. Hyd. Mom. KG/CM2	Bend. Str. Oper. Wind KG/CM2	Bend. Str. Oper. Equ. KG/CM2	Bend. Str. Hyd. Wind KG/CM2	Bend. Str. Hyd. Equ. KG/CM2
10	20	7.47464	93.3583	0.00000	30.8082	0.00000
20	30	9.74166	113.962	0.00000	37.6075	0.00000
30	40	11.4936	112.693	0.00000	37.1886	0.00000
40	50	11.7068	94.0852	0.00000	31.0481	0.00000
50	60	10.7488	82.7983	0.00000	27.3234	0.00000
60	70	10.7488	82.5129	0.00000	27.2293	0.00000
70	80	9.96278	65.4643	0.00000	21.6032	0.00000
80	90	8.72360	50.2319	0.00000	16.5765	0.00000
90	100	8.72360	36.8993	0.00000	12.1768	0.00000

100	110	6.69841	25.3098	0.00000	8.35224	0.00000
110	120	5.46129	15.7874	0.00000	5.20984	0.00000
120	130	5.46129	8.38615	0.00000	2.76743	0.00000
130	140	3.43815	3.15298	0.00000	1.04048	0.00000
140	150	4.26293	1.40556	0.00000	0.46383	0.00000
150	160	0.00000	0.20253	0.00000	0.066834	0.00000

Longitudinal Stresses Due to . . .

From	To	Long. Str. Vortex Ope. KG/CM2	Long. Str. Vortex Emp. KG/CM2	Long. Str. Vortex Tst. KG/CM2	EarthQuake Empty KG/CM2
10	20	179.355	0.00000	0.00000	0.00000
20	30	223.852	0.00000	0.00000	0.00000
30	40	234.906	0.00000	0.00000	0.00000
40	50	209.519	0.00000	0.00000	0.00000
50	60	186.911	0.00000	0.00000	0.00000
60	70	186.467	0.00000	0.00000	0.00000
70	80	158.719	0.00000	0.00000	0.00000
80	90	130.971	0.00000	0.00000	0.00000
90	100	103.223	0.00000	0.00000	0.00000
100	110	75.4754	0.00000	0.00000	0.00000
110	120	48.5450	0.00000	0.00000	0.00000
120	130	25.5259	0.00000	0.00000	0.00000
130	140	9.47348	0.00000	0.00000	0.00000
140	150	4.18221	0.00000	0.00000	0.00000
150	160	0.59797	0.00000	0.00000	0.00000

Longitudinal Stresses Due to . . .

From	To	Long. Str. Y Forces W KG/CM2	Long. Str. Y ForceS S KG/CM2
10	20	0.00000	0.00000
20	30	0.00000	0.00000
30	40	0.00000	0.00000
40	50	0.00000	0.00000
50	60	0.00000	0.00000
60	70	0.00000	0.00000
70	80	0.00000	0.00000
80	90	0.00000	0.00000
90	100	0.00000	0.00000
100	110	0.00000	0.00000
110	120	0.00000	0.00000
120	130	0.00000	0.00000
130	140	0.00000	0.00000
140	150	0.00000	0.00000
150	160	0.00000	0.00000

Long. Stresses due to User Forces and Moments

From	To	Wind For/Mom Corroded KG/CM2	Eqk For/Mom Corroded KG/CM2	Wnd For/Mom No Corr. KG/CM2	Eqk For/Mom No Corr. KG/CM2
10	20	0.00000	0.00000	0.00000	0.00000
20	30	0.00000	0.00000	0.00000	0.00000
30	40	0.00000	0.00000	0.00000	0.00000
40	50	0.00000	0.00000	0.00000	0.00000
50	60	0.00000	0.00000	0.00000	0.00000
60	70	0.00000	0.00000	0.00000	0.00000
70	80	0.00000	0.00000	0.00000	0.00000
80	90	0.00000	0.00000	0.00000	0.00000
90	100	0.00000	0.00000	0.00000	0.00000

100	110	0.00000	0.00000	0.00000	0.00000
110	120	0.00000	0.00000	0.00000	0.00000
120	130	0.00000	0.00000	0.00000	0.00000
130	140	0.00000	0.00000	0.00000	0.00000
140	150	0.00000	0.00000	0.00000	0.00000
150	160	0.00000	0.00000	0.00000	0.00000

Stress Combination Load Cases for Vertical Vessels:

Load Case Definition Key

IP = Longitudinal Stress due to Internal Pressure
EP = Longitudinal Stress due to External Pressure
HP = Longitudinal Stress due to Hydrotest Pressure
NP = No Pressure
EW = Longitudinal Stress due to Weight (No Liquid)
OW = Longitudinal Stress due to Weight (Operating)
HW = Longitudinal Stress due to Weight (Hydrotest)
WI = Bending Stress due to Wind Moment (Operating)
EQ = Bending Stress due to Earthquake Moment (Operating)
EE = Bending Stress due to Earthquake Moment (Empty)
HI = Bending Stress due to Wind Moment (Hydrotest)
HE = Bending Stress due to Earthquake Moment (Hydrotest)
WE = Bending Stress due to Wind Moment (Empty) (no CA)
WF = Bending Stress due to Wind Moment (Filled) (no CA)
CW = Longitudinal Stress due to Weight (Empty) (no CA)
VO = Bending Stress due to Vortex Shedding Loads (Ope)
VE = Bending Stress due to Vortex Shedding Loads (Emp)
VF = Bending Stress due to Vortex Shedding Loads (Test No CA.)
FW = Axial Stress due to Vertical Forces for the Wind Case
FS = Axial Stress due to Vertical Forces for the Seismic Case
BW = Bending Stress due to Lat. Forces for the Wind Case, Corroded
BS = Bending Stress due to Lat. Forces for the Seismic Case, Corroded
BN = Bending Stress due to Lat. Forces for the Wind Case, UnCorroded
BU = Bending Stress due to Lat. Forces for the Seismic Case, UnCorroded

General Notes:

Case types HI and HE are in the Corroded condition.

Case types WE, WF, and CW are in the Un-Corroded condition.

A blank stress and stress ratio indicates that the corresponding stress comprising those components that did not contribute to that type of stress.

An asterisk (*) in the final column denotes overstress.

Analysis of Load Case 1 : NP+EW+WI+FW+BW

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10	26.06	927.21	-175.61	652.79	0.0281	0.2690
20	31.16	927.21	-216.25	610.89	0.0336	0.3540
30	21.80	728.77	-226.57	584.42	0.0299	0.3877
40	11.93	728.77	-199.66	585.87	0.0164	0.3408
50	16.31	1041.11	-170.79	599.75	0.0157	0.2848
60	18.16	884.94	-168.37	599.75	0.0205	0.2807
70	4.85	884.94	-146.00	599.75	0.0055	0.2434
80		884.94	-122.11	599.75		0.2036
90		884.94	-100.92	599.75		0.1683
100		884.94	-78.19	599.75		0.1304
110		884.94	-57.17	599.75		0.0953
120		884.94	-41.95	599.75		0.0700
130		884.94	-24.82	599.75		0.0414
140		884.94	-21.70	564.92		0.0384
150		1041.11	-7.12	594.81		0.0120

Analysis of Load Case 2 : NP+EW+EE+FS+BS

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10		927.21	-82.25	652.79		0.1260
20		927.21	-102.29	610.89		0.1674
30		728.77	-113.88	584.42		0.1949
40		728.77	-105.57	585.87		0.1802
50		1041.11	-87.99	599.75		0.1467
60		884.94	-85.85	599.75		0.1431
70		884.94	-80.54	599.75		0.1343
80		884.94	-71.88	599.75		0.1199
90		884.94	-64.02	599.75		0.1067
100		884.94	-52.88	599.75		0.0882
110		884.94	-41.38	599.75		0.0690
120		884.94	-33.57	599.75		0.0560
130		884.94	-21.67	599.75		0.0361
140		884.94	-20.29	564.92		0.0359
150		1041.11	-6.92	594.81		0.0116

Analysis of Load Case 3 : NP+OW+WI+FW+BW

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10	26.06	927.21	-175.61	652.79	0.0281	0.2690
20	31.16	927.21	-216.25	610.89	0.0336	0.3540
30	21.80	728.77	-226.57	584.42	0.0299	0.3877
40	11.93	728.77	-199.66	585.87	0.0164	0.3408
50	16.31	1041.11	-170.79	599.75	0.0157	0.2848
60	18.16	884.94	-168.37	599.75	0.0205	0.2807
70	4.85	884.94	-146.00	599.75	0.0055	0.2434
80		884.94	-122.11	599.75		0.2036
90		884.94	-100.92	599.75		0.1683
100		884.94	-78.19	599.75		0.1304
110		884.94	-57.17	599.75		0.0953
120		884.94	-41.95	599.75		0.0700
130		884.94	-24.82	599.75		0.0414
140		884.94	-21.70	564.92		0.0384
150		1041.11	-7.12	594.81		0.0120

Analysis of Load Case 4 : NP+OW+EQ+FS+BS

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10		927.21	-82.25	652.79		0.1260
20		927.21	-102.29	610.89		0.1674
30		728.77	-113.88	584.42		0.1949
40		728.77	-105.57	585.87		0.1802
50		1041.11	-87.99	599.75		0.1467
60		884.94	-85.85	599.75		0.1431
70		884.94	-80.54	599.75		0.1343
80		884.94	-71.88	599.75		0.1199
90		884.94	-64.02	599.75		0.1067
100		884.94	-52.88	599.75		0.0882
110		884.94	-41.38	599.75		0.0690
120		884.94	-33.57	599.75		0.0560
130		884.94	-21.67	599.75		0.0361
140		884.94	-20.29	564.92		0.0359
150		1041.11	-6.92	594.81		0.0116

Analysis of Load Case 5 : NP+HW+HI

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10		927.21	-242.29	652.79		0.3712
20		927.21	-308.93	610.89		0.5057
30		728.77	-351.43	584.42		0.6013
40		728.77	-339.54	585.87		0.5795

50	1041.11	-115.31	599.75	0.1923
60	884.94	-113.08	599.75	0.1885
70	884.94	-102.14	599.75	0.1703
80	884.94	-88.46	599.75	0.1475
90	884.94	-76.19	599.75	0.1270
100	884.94	-61.24	599.75	0.1021
110	884.94	-46.59	599.75	0.0777
120	884.94	-36.34	599.75	0.0606
130	884.94	-22.71	599.75	0.0379
140	884.94	-20.76	564.92	0.0367
150	1041.11	-6.99	594.81	0.0117

Analysis of Load Case 6 : NP+HW+HE

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10		927.21	-211.48	652.79		0.3240
20		927.21	-271.33	610.89		0.4441
30		728.77	-314.24	584.42		0.5377
40		728.77	-308.49	585.87		0.5265
50		1041.11	-87.99	599.75		0.1467
60		884.94	-85.85	599.75		0.1431
70		884.94	-80.54	599.75		0.1343
80		884.94	-71.88	599.75		0.1199
90		884.94	-64.02	599.75		0.1067
100		884.94	-52.88	599.75		0.0882
110		884.94	-41.38	599.75		0.0690
120		884.94	-33.57	599.75		0.0560
130		884.94	-21.67	599.75		0.0361
140		884.94	-20.29	564.92		0.0359
150		1041.11	-6.92	594.81		0.0116

Analysis of Load Case 7 : IP+OW+WI+FW+BW

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10	26.06	927.21	-175.61	652.79	0.0281	0.2690
20	31.16	927.21	-216.25	610.89	0.0336	0.3540
30	21.80	728.77	-226.57	584.42	0.0299	0.3877
40	11.93	728.77	-199.66	585.87	0.0164	0.3408
50	272.78	1041.11		599.75	0.2620	
60	274.63	884.94		599.75	0.3103	
70	261.32	884.94		599.75	0.2953	
80	252.27	884.94		599.75	0.2851	
90	246.80	884.94		599.75	0.2789	
100	242.29	884.94		599.75	0.2738	
110	241.80	884.94		599.75	0.2732	
120	242.21	884.94		599.75	0.2737	
130	244.83	884.94		599.75	0.2767	
140	309.31	884.94		564.92	0.3495	
150	257.96	1041.11		594.81	0.2478	

Analysis of Load Case 8 : IP+OW+EQ+FS+BS

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10		927.21	-82.25	652.79		0.1260
20		927.21	-102.29	610.89		0.1674
30		728.77	-113.88	584.42		0.1949
40		728.77	-105.57	585.87		0.1802
50	189.98	1041.11		599.75	0.1825	
60	192.12	884.94		599.75	0.2171	
70	195.86	884.94		599.75	0.2213	
80	202.04	884.94		599.75	0.2283	
90	209.90	884.94		599.75	0.2372	
100	216.98	884.94		599.75	0.2452	

110	226.01	884.94		599.75	0.2554
120	233.82	884.94		599.75	0.2642
130	241.68	884.94		599.75	0.2731
140	307.91	884.94		564.92	0.3479
150	257.76	1041.11		594.81	0.2476

Analysis of Load Case 9 : EP+OW+WI+FW+BW

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10	26.06	927.21	-175.61	652.79	0.0281	0.2690
20	31.16	927.21	-216.25	610.89	0.0336	0.3540
30	21.80	728.77	-226.57	584.42	0.0299	0.3877
40	11.93	728.77	-199.66	585.87	0.0164	0.3408
50		1041.11	-248.73	599.75		0.4147
60		884.94	-246.31	599.75		0.4107
70		884.94	-223.95	599.75		0.3734
80		884.94	-200.06	599.75		0.3336
90		884.94	-178.86	599.75		0.2982
100		884.94	-156.14	599.75		0.2603
110		884.94	-135.11	599.75		0.2253
120		884.94	-119.90	599.75		0.1999
130		884.94	-102.76	599.75		0.1713
140		884.94	-118.60	564.92		0.2099
150		1041.11	-87.53	594.81		0.1472

Analysis of Load Case 10 : EP+OW+EQ+FS+BS

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10		927.21	-82.25	652.79		0.1260
20		927.21	-102.29	610.89		0.1674
30		728.77	-113.88	584.42		0.1949
40		728.77	-105.57	585.87		0.1802
50		1041.11	-165.93	599.75		0.2767
60		884.94	-163.80	599.75		0.2731
70		884.94	-158.48	599.75		0.2642
80		884.94	-149.83	599.75		0.2498
90		884.94	-141.96	599.75		0.2367
100		884.94	-130.83	599.75		0.2181
110		884.94	-119.33	599.75		0.1990
120		884.94	-111.51	599.75		0.1859
130		884.94	-99.61	599.75		0.1661
140		884.94	-117.20	564.92		0.2075
150		1041.11	-87.32	594.81		0.1468

Analysis of Load Case 11 : HP+HW+HI

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10		1594.56	-242.29	1383.97		0.1751
20		1594.56	-308.93	1259.79		0.2452
30		1700.87	-351.43	1175.85		0.2989
40		1700.87	-339.54	1180.58		0.2876
50	566.38	2429.81		1224.99	0.2331	
60	568.42	2065.34		1224.99	0.2752	
70	566.53	2065.34		1224.99	0.2743	
80	567.69	2065.34		1224.99	0.2749	
90	571.15	2065.34		1224.99	0.2765	
100	574.41	2065.34		1224.99	0.2781	
110	580.29	2065.34		1224.99	0.2810	
120	585.67	2065.34		1224.99	0.2836	
130	591.80	2065.34		1224.99	0.2865	
140	743.48	2065.34		1042.95	0.3600	
150	618.07	2429.81		1209.30	0.2544	

Analysis of Load Case 12 : HP+HW+HE

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10		1594.56	-211.48	1383.97		0.1528
20		1594.56	-271.33	1259.79		0.2154
30		1700.87	-314.24	1175.85		0.2672
40		1700.87	-308.49	1180.58		0.2613
50	539.05	2429.81		1224.99	0.2219	
60	541.19	2065.34		1224.99	0.2620	
70	544.93	2065.34		1224.99	0.2638	
80	551.11	2065.34		1224.99	0.2668	
90	558.98	2065.34		1224.99	0.2706	
100	566.06	2065.34		1224.99	0.2741	
110	575.09	2065.34		1224.99	0.2784	
120	582.90	2065.34		1224.99	0.2822	
130	590.76	2065.34		1224.99	0.2860	
140	743.01	2065.34		1042.95	0.3598	
150	618.00	2429.81		1209.30	0.2543	

Analysis of Load Case 13 : IP+WE+EW

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10		927.21	-82.25	652.79		0.1260
20		927.21	-102.29	610.89		0.1674
30		728.77	-113.88	584.42		0.1949
40		728.77	-105.57	585.87		0.1802
50	189.98	1041.11		599.75	0.1825	
60	192.12	884.94		599.75	0.2171	
70	195.86	884.94		599.75	0.2213	
80	202.04	884.94		599.75	0.2283	
90	209.90	884.94		599.75	0.2372	
100	216.98	884.94		599.75	0.2452	
110	226.01	884.94		599.75	0.2554	
120	233.82	884.94		599.75	0.2642	
130	241.68	884.94		599.75	0.2731	
140	307.91	884.94		564.92	0.3479	
150	257.76	1041.11		594.81	0.2476	

Analysis of Load Case 14 : IP+WF+CW

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10		927.21	-63.61	652.79		0.0974
20		927.21	-75.26	610.89		0.1232
30		728.77	-80.51	584.42		0.1378
40		728.77	-73.81	585.87		0.1260
50	179.23	1041.11		599.75	0.1722	
60	181.37	884.94		599.75	0.2049	
70	185.89	884.94		599.75	0.2101	
80	193.31	884.94		599.75	0.2184	
90	201.18	884.94		599.75	0.2273	
100	210.28	884.94		599.75	0.2376	
110	220.55	884.94		599.75	0.2492	
120	228.36	884.94		599.75	0.2581	
130	238.24	884.94		599.75	0.2692	
140	309.99	884.94		564.92	0.3503	
150	260.19	1041.11		594.81	0.2499	

Analysis of Load Case 15 : IP+VO+OW

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10	112.05	927.21	-261.61	652.79	0.1209	0.4008
20	141.05	927.21	-326.14	610.89	0.1521	0.5339
30	144.01	728.77	-348.78	584.42	0.1976	0.5968

40	127.36	728.77	-315.09	585.87	0.1748	0.5378
50	376.89	1041.11	-18.43	599.75	0.3620	0.0307
60	378.58	884.94	-15.85	599.75	0.4278	0.0264
70	354.57	884.94		599.75	0.4007	
80	333.01	884.94		599.75	0.3763	
90	313.12	884.94		599.75	0.3538	
100	292.46	884.94		599.75	0.3305	
110	274.55	884.94		599.75	0.3103	
120	259.35	884.94		599.75	0.2931	
130	251.16	884.94		599.75	0.2838	
140	312.09	884.94		564.92	0.3527	
150	258.35	1041.11		594.81	0.2482	

Analysis of Load Case 16 : IP+VE+EW

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10		927.21	-82.25	652.79		0.1260
20		927.21	-102.29	610.89		0.1674
30		728.77	-113.88	584.42		0.1949
40		728.77	-105.57	585.87		0.1802
50	189.98	1041.11		599.75	0.1825	
60	192.12	884.94		599.75	0.2171	
70	195.86	884.94		599.75	0.2213	
80	202.04	884.94		599.75	0.2283	
90	209.90	884.94		599.75	0.2372	
100	216.98	884.94		599.75	0.2452	
110	226.01	884.94		599.75	0.2554	
120	233.82	884.94		599.75	0.2642	
130	241.68	884.94		599.75	0.2731	
140	307.91	884.94		564.92	0.3479	
150	257.76	1041.11		594.81	0.2476	

Analysis of Load Case 17 : NP+VO+OW

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10	112.05	927.21	-261.61	652.79	0.1209	0.4008
20	141.05	927.21	-326.14	610.89	0.1521	0.5339
30	144.01	728.77	-348.78	584.42	0.1976	0.5968
40	127.36	728.77	-315.09	585.87	0.1748	0.5378
50	120.42	1041.11	-274.90	599.75	0.1157	0.4584
60	122.11	884.94	-272.32	599.75	0.1380	0.4541
70	98.10	884.94	-239.26	599.75	0.1109	0.3989
80	76.54	884.94	-202.85	599.75	0.0865	0.3382
90	56.65	884.94	-167.24	599.75	0.0640	0.2788
100	35.99	884.94	-128.36	599.75	0.0407	0.2140
110	18.08	884.94	-89.93	599.75	0.0204	0.1499
120	2.88	884.94	-59.09	599.75	0.0033	0.0985
130		884.94	-31.14	599.75		0.0519
140		884.94	-24.48	564.92		0.0433
150		1041.11	-7.52	594.81		0.0126

Analysis of Load Case 18 : FS+BS+IP+OW

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10		927.21	-82.25	652.79		0.1260
20		927.21	-102.29	610.89		0.1674
30		728.77	-113.88	584.42		0.1949
40		728.77	-105.57	585.87		0.1802
50	189.98	1041.11		599.75	0.1825	
60	192.12	884.94		599.75	0.2171	
70	195.86	884.94		599.75	0.2213	
80	202.04	884.94		599.75	0.2283	
90	209.90	884.94		599.75	0.2372	

100	216.98	884.94		599.75	0.2452
110	226.01	884.94		599.75	0.2554
120	233.82	884.94		599.75	0.2642
130	241.68	884.94		599.75	0.2731
140	307.91	884.94		564.92	0.3479
150	257.76	1041.11		594.81	0.2476

Analysis of Load Case 19 : FS+BS+EP+OW

From Node	Tensile Stress	All. Tens. Stress	Comp. Stress	All. Comp. Stress	Tens. Ratio	Comp. Ratio
10		927.21	-82.25	652.79		0.1260
20		927.21	-102.29	610.89		0.1674
30		728.77	-113.88	584.42		0.1949
40		728.77	-105.57	585.87		0.1802
50		1041.11	-165.93	599.75		0.2767
60		884.94	-163.80	599.75		0.2731
70		884.94	-158.48	599.75		0.2642
80		884.94	-149.83	599.75		0.2498
90		884.94	-141.96	599.75		0.2367
100		884.94	-130.83	599.75		0.2181
110		884.94	-119.33	599.75		0.1990
120		884.94	-111.51	599.75		0.1859
130		884.94	-99.61	599.75		0.1661
140		884.94	-117.20	564.92		0.2075
150		1041.11	-87.32	594.81		0.1468

Absolute Maximum of the all of the Stress Ratio's 0.6013

Governing Element: INTER SKRT1
Governing Load Case 5 : NP+HW+HI

Fatigue Stress Calculations due to Wind Induced Vortex Shedding Loads

From	Elevation	Alternating Stress	Sif	Number of Cycles	Hours of Total Vibration
10	1200.00	436.48	2.0	1000000	202.20
20	4200.00	544.76	2.0	1000000	202.20
30	7200.00	571.66	2.0	1000000	202.20
40	7800.00	764.82	3.0	1000000	202.20
50	7848.77	454.86	2.0	1000000	202.20
60	10896.77	453.78	2.0	1000000	202.20
70	13944.77	386.26	2.0	1000000	202.20
80	16992.77	318.73	2.0	1000000	202.20
90	20040.77	251.20	2.0	1000000	202.20
100	23088.77	183.68	2.0	1000000	202.20
110	26136.77	118.14	2.0	1000000	202.20
120	29184.77	62.12	2.0	1000000	202.20
130	30980.04	23.05	2.0	1000000	202.20
140	32302.87	10.18	2.0	1000000	202.20
150	32351.64	1.46	2.0	1000000	202.20

Cycle Life Determination based on ASME Div. II, Table 5-110.1

Shop/Field Installation Options :

Platform(s) installed in the Shop.
Trays are installed in the Shop.
Insulation is installed in the Shop.
Lining is installed in the Shop.

Note : The CG is computed from the first Element From Node

Center of Gravity of Platforms	20572.6 mm.
Center of Gravity of Insulation	5587.9 mm.
Center of Gravity of Lining	13971.2 mm.
Center of Gravity of Stiffening Rings	20750.3 mm.
Center of Gravity of Nozzles	22620.7 mm.
Center of Gravity of Trays	23060.0 mm.
Center of Gravity of Added Weights (Empty)	24491.1 mm.
Center of Gravity of Added Weights (Operating)	22142.4 mm.
Center of Gravity of Bare Shell New and Cold	15468.1 mm.
Center of Gravity of Bare Shell Corroded	15414.1 mm.
Vessel CG in the Operating Condition	17312.6 mm.
Vessel CG in the Fabricated (Shop/Empty) Condition	17449.5 mm.

Skirt Data :

Skirt Outside Diameter at Base	SOD	3569.4619	mm.
Skirt Thickness	STHK	20.0000	mm.
Skirt Internal Corrosion Allowance	SCA	3.0000	mm.
Skirt External Corrosion Allowance		0.0000	mm.
Skirt Material		SA-283 C	

Basering Input: Type of Geometry: Continuous Top Ring W/Gussets

Thickness of Basering	TBA	38.0000	mm.
Design Temperature of the Basering		40.00	C
Basering Matl		SA-283 C	
Basering Operating All. Stress	BASOPE	1103.82	KG/CM2
Basering Yield Stress		2099.11	KG/CM2
Inside Diameter of Basering	DI	3289.4600	mm.
Outside Diameter of Basering	DOU	3889.4597	mm.
Nominal Diameter of Bolts	BND	48.0000	mm.
Bolt Corrosion Allowance	BCA	0.0000	mm.
Root Area of a Single Bolt	Area	1424.0000	sq.mm.
Bolt Material		SA-193 B7	
Bolt Operating Allowable Stress	SA	1335.79	KG/CM2
Number of Bolts	RN	20	
Diameter of Bolt Circle	DC	3739.4600	mm.
Ultimate Comp. Strength of Concrete	FPC	249.3	KG/CM2
Allowable Comp. Strength of Concrete	FC	112.2	KG/CM2
Modular ratio Steel/Concrete		8.840	
Thickness of Gusset Plates	TGA	16.0000	mm.
Width of Gussets at Top Plate	TWDT	150.0000	mm.
Width of Gussets at Base Plate	BWDT	150.0000	mm.
Gusset Plate Elastic Modulus	E	2038900.0	KG/CM2
Gusset Plate Yield Stress	SY	2099.1	KG/CM2
Height of Gussets	HG	280.0000	mm.
Distance between Gussets	RG	110.0000	mm.
Dist. from Bolt Center to Gusset (Rg/2)	CG	55.0000	mm.
Number of Gussets per bolt	NG	2	
Thickness of Top Plate or Ring	TTA	38.0000	mm.
Radial Width of the Top Plate	TOPWTH	160.0000	mm.
Anchor Bolt Hole Dia. in Top Plate	BHOLE	51.0000	mm.
External Corrosion Allowance	CA	0.0000	mm.
Dead Weight of Vessel	DW	143631.3	KG
Operating Weight of Vessel	ROW	141841.3	KG
Test Weight of Vessel	TW	386972.7	KG
Earthquake Moment on Basering	EQMOM	5133.0	KG-M
Wind Moment on Basering	WIMOM	161632.2	KG-M
Vortex Shedding Moment on Basering	Vormom	300658.0	KG-M
Test Moment on Basering	TM	56777.7	KG-M
Percent Bolt Preload	ppl	100.0	
Use AISC A5.2 Increase in Fc and Bolt Stress		No	
Use Allowable Weld Stress per AISC J2.5		No	
Factor for Increase of Allowables	Fact	1.0000	

Results for Brownell and Young Basering Analysis : Analyze Option

Note: This analysis is based on Neutral Axis shift method for Steel on

Concrete (or a material with significantly different Young's modulus).

Governing Bolt Load Condition, Vortex Shedding Condition:
Area Available in one Bolt Abss : 1424.0000 sq.mm.
Area Available in all the Bolts Abss * RN : 28480.0000 sq.mm.

Trial#	k	knew	Cc	Ct	z	j	Ft	Fc
1	0.394	0.197	1.749	2.238	0.417	0.784	27118.9	26194.2
2	0.197	0.295	1.208	2.668	0.460	0.775	19631.0	25033.4
3	0.295	0.344	1.497	2.452	0.439	0.781	23298.6	25602.0
4	0.344	0.369	1.626	2.345	0.428	0.783	25187.3	25894.8
5	0.369	0.381	1.688	2.292	0.422	0.784	26147.4	26043.6
6	0.381	0.375	1.719	2.265	0.420	0.784	26631.7	26118.7
7	0.375	0.372	1.704	2.278	0.421	0.784	26389.2	26081.1
8	0.372	0.371	1.696	2.285	0.422	0.784	26268.2	26062.4
9	0.371	0.370	1.692	2.288	0.422	0.784	26207.8	26053.0
10	0.370	0.369	1.690	2.290	0.422	0.784	26177.6	26048.3
11	0.369	0.369	1.689	2.291	0.422	0.784	26162.5	26046.0
12	0.369	0.369	1.689	2.291	0.422	0.784	26155.0	26044.8

The Actual Stress in a Single Bolt [Sbolt]:
= 2 * Ft / (T1 * Dc * Ct)
= 2 * 26155.0 / (2.424 * 3739.460 * 2.291)
= 251.917 KG/CM2 , Should be less than 1335.8

Thickness of the Band of Bolting Steel [T1]
= RN * Bolt Area / (3.14159 * Dc)
= 20 * 1424.000 / (3.14159 * 3739.460)
= 2.424 mm.

Check the Bearing Stress in the Concrete [fc(max)]
= fc`[(2kd + t3) / (2kd)]
= 107.592[(2*0.369*3739.460+300.000)/(2*0.369*3739.460)]
= 18.492 KG/CM2 , Should be less than 112.2

Values for table 10.3, l = 159.999 , b = 293.697 , l/b = 0.544776

Maximum Moment per unit width [Mmax]:
= Max(Mx, My) = Max(580.809 , 1392.827) = 1392.827 KG

Reqd Thickness of Basering, Brownell & Young Method [T]:
= (6 * Mmax / fallow)½ + Ca
= (6 * 1392.827 / 1385.4)½ + 0.000
= 24.563 mm.

Nomenclature:

a	= (Dc-Ds)/2	Skirt Distance to Bolt Circle
P	= Sa * Abss	Maximum Load on one Bolt
l	= Avgwdt	Average Gusset Width
g1	= Gamma 1	Constant Term f(b/l)
g2	= Gamma 2	Constant Term f(b/l)
g	= Flat distance / 2	Nut 1/2 Dimension (from Tema)
Fb		Allowable Bending Stress

Values for table 10.6, l = 150.000 , b = 110.000 , b/l = 0.733333
As b/l (0.733) is less than 1, inverting b/l = 1.364 .

Moment Term, based on geometry [Mo]:
= P/(4pi) [1.3(ln((2lsin(pi*a/l)/(pi*g))) + 1] - [(0.7-g2)P/(4pi)]
= 19016.59 /(4*3.14) [1.3(ln((2*150.000 *SIN(3.14* 84.999 / 150.000))
(3.14 * 39.688))) + 1] - [(0.7 - 0.087)* 19016.59 / (4 * 3.14)]
= 2269.3745 KG

Required Thickness of Continuous Top Ring [Tc]:
= (6 * Abs(Mo) / Fb)½ + Ca
= (6 * Abs(2269.37) / 1399.41)½ + 0.0000
= 31.1962 mm.

Required Gusset Plate Thickness [tg]:
= P / (Stress Term * l) + Ca
= 19016.59 / (1265.5260 * 159.999) + 0.000
= 9.525 (not less than 9.525 + 0.000) mm.

Bolt spacing [m]:
= pi * Bolt Circle Diameter / number of Bolts
= 3.142 * 3739.46 / 20 = 587.393 mm.

Req. Skirt Thk. to withstand Local Bending, (Brownell and Young) [t]:
= 1.76 * (P*a/(m * (h + tba) * 1.5 * Sktope))^(2/3) * r^(1/3) + Ca
= 1.76*(19016*84.999/(587.39*318.00*1655))^(2/3)*1784.73^(1/3)+Ca
= 13.854 + 3.000 = 16.854 mm.

Summary of Basering Thickness Calculations

Required Basering Thickness (tension)	24.5629	mm.
Actual Basering Thickness as entered by user	38.0000	mm.
Required Thickness of Chair Cap	31.1962	mm.
Actual Top Ring Thickness as entered by user	38.0000	mm.
Required Gusset thickness, + CA	9.5250	mm.
Actual Gusset Thickness as entered by user	16.0000	mm.
Required Thickness of Skirt for Local Stress	16.8536	mm.
Given Thickness of Skirt	20.0000	mm.
Required Gusset Height to meet local stress	145.3275	mm.

Weld Size Calculations per Steel Plate Engineering Data - Vol. 2

Compute the Weld load at the Skirt/Base Junction [W]
= SkirtStress * (SkirtThickness - CA)
= 261.606 * (20.000 - 3.000)
= 44.46 KG /mm.

Results for Computed Minimum Basering Weld Size [BWeld]
= W / [(0.4 * Yield) * 2 * 0.707]
= 44 / [(0.4 * 1447) * 2 * 0.707]
= 5.432 mm.

Results for Computed Minimum Gusset and Top Plate to Skirt Weld Size

Vertical Plate Load [Wv]
= Bolt Load / (Cmwth + 2 * (Hg + Tta))
= 19016.6 / (175.260 + 2 * (280.000 + 38.000))
= 23.441 KG /mm.

Horizontal Plate Load [Wh]
= Bolt Load * e / (Cmwth * (Hg+Tta) + 0.6667 * (Hg+Tta)²)
= 19016.6 * 84.999 /(175.260 * (318.000) + 0.6667 * (318.000)²)
= 13.125 KG /mm.

Resultant Weld Load [Wr]
= (Wv² + Wh²)½
= (23.44² + 13.13²)½
= 26.865 KG /mm.

Results for Computed Min Gusset and Top Plate to Skirt Weld Size [GsWeld]
= Wr / [(0.4 * Yield) * 2 * 0.707]
= 26.87 / [(0.4 * 1447) * 2 * 0.707]
= 3.282 mm.

Results for Computed Minimum Gusset to Top Plate Weld Size

Weld Load [Wv]
= Bolt Load / (2 * TopWth)
= 19016.6 / (2 * 150.000)
= 63.389 KG /mm.

Weld Load [Wh]
= Bolt Load * e / (2 * Hgt * TopWth)
= 19016.6 * 85.00 / (2 * 318.000 * 150.000)
= 16.943 KG /mm.

Resultant Weld Load [Wr]
= (Wv² + Wh²)½
= (63.39² + 16.94²)½
= 65.614 KG /mm.

Results for Computed Min Gusset to Top Plate Weld Size [GtpWeld]
= Wr / [(0.4 * Yield) * 2 * 0.707]
= 65.61 / [(0.4 * 1447) * 2 * 0.707]
= 8.015 mm.

Note: The calculated weld sizes need not exceed the component thickness framing into the weld. At the same time, the weld must meet a minimum size specification which is 3/16 in. (4.76 mm) or 1/4 in. (6.35 mm), depending on the component thickness.

Summary of Required Weld Sizes:

Required Basering to Skirt Double Fillet Weld Size	6.3500	mm.
Required Gusset to Skirt Double Fillet Weld Size	6.3500	mm.
Required Top Plate to Skirt Weld Size	8.0153	mm.
Required Gusset to Top Plate Double Fillet Weld Size	8.0153	mm.

INPUT VALUES, Nozzle Description: 1M From : 60

Pressure for Reinforcement Calculations	P	3.515	KG/CM2
Temperature for Internal Pressure	Temp	407	C
Design External Pressure	Pext	1.05	KG/CM2
Temperature for External Pressure	Tempex	407	C
Shell Material		SA-516 60	
Shell Allowable Stress at Temperature	S	867.59	KG/CM2
Shell Allowable Stress At Ambient	Sa	1202.25	KG/CM2
Inside Diameter of Cylindrical Shell	D	3511.55	mm.
Design Length of Section	L	2779.7971	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	0.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		658.3679	mm.
User Entered Minimum Design Metal Temperature		19.40	C

Type of Element Connected to the Shell : Nozzle

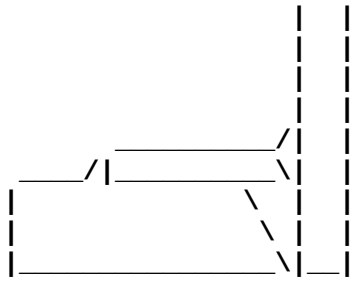
Material		SA-516 60	
Material UNS Number		K02100	
Material Specification/Type		Plate	
Allowable Stress at Temperature	Sn	867.59	KG/CM2
Allowable Stress At Ambient	Sna	1202.25	KG/CM2
Diameter Basis (for tr calc only)		ID	
Layout Angle		0.00	deg
Diameter		609.6000	mm.
Size and Thickness Basis		Actual	
Actual Thickness	tn	12.0000	mm.
Flange Material		SA-105	
Flange Type		Weld Neck Flange	
Corrosion Allowance	can	0.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	250.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	12.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Pad Material		SA-516 60	
Pad Allowable Stress at Temperature	Sp	867.59	KG/CM2
Pad Allowable Stress At Ambient	Spa	1202.25	KG/CM2
Diameter of Pad along vessel surface	Dp	1220.0000	mm.
Thickness of Pad	te	12.0000	mm.
Weld leg size between Pad and Shell	Wp	9.0000	mm.
Groove weld depth between Pad and Nozzle	Wgpn	9.0000	mm.
Reinforcing Pad Width		293.2000	mm.
ASME Code Weld Type per UW-16		None	

This is a Manway or Access Opening.

Class of attached Flange		150	
Grade of attached Flange		GR 1.1	

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch



Insert Nozzle With Pad, no Inside projection

Reinforcement CALCULATION, Description: 1M

ASME Code, Section VIII, Division 1, 2007, A-08 UG-37 to UG-45

```
Actual Inside Diameter Used in Calculation          609.600  mm.
Actual Thickness Used in Calculation                 12.000  mm.
```

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)
 = (3.52*1755.7750)/(867*1.00-0.6*3.52)
 = 7.1315 mm.
```

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]
```
 = (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
 = (3.52*304.80)/(867*1.00-0.6*3.52)
 = 1.2380 mm.
```

Required Nozzle thickness under External Pressure per UG-28 : 1.5065 mm.

UG-40, Limits of Reinforcement : [Int. Press]
```
Parallel to Vessel Wall (Diameter Limit)           Dl  1219.2000  mm.
Parallel to Vessel Wall                             d   609.6000  mm.
Normal to Vessel Wall (Thickness Limit), pad side Tlwp   30.0000  mm.
```

Note : The Pad diameter is greater than the Diameter Limit, the excess will not be considered .

Weld Strength Reduction Factor [fr1]:
```
 = min( 1, Sn/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr2]:
```
 = min( 1, Sn/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr4]:
```
 = min( 1, Sp/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr3]:
```
 = min( fr2, fr4 )
 = min( 1.0 , 1.0 )
```

= 1.000

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc	
Area Required	Ar	4347.631	3409.524	NA	sq.mm.
Area in Shell	A1	2968.022	496.606	NA	sq.mm.
Area in Nozzle Wall	A2	645.759	629.647	NA	sq.mm.
Area in Inward Nozzle	A3	0.000	0.000	NA	sq.mm.
Area in Welds	A41+A42+A43	144.009	144.009	NA	sq.mm.
Area in Element	A5	7027.636	7027.636	NA	sq.mm.
TOTAL AREA AVAILABLE	Atot	10785.427	8297.897	NA	sq.mm.

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Insufficient.
The area available with the given pad is Sufficient.

SELECTION OF POSSIBLE REINFORCING PADS:	Diameter	Thickness	
Based on given Pad Thickness:	811.8608	12.0000	mm.
Based on given Pad Diameter:	1220.0000	3.6529	mm.
Based on Shell or Nozzle Thickness:	811.8608	12.0000	mm.

Area Required [A]:
= 0.5(d * tr*F + 2 * tn * tr*F * (1-fr1)) per UG-37(d) or UG-39
= 0.5(609.6000*11.1854*1+2*12.0000*11.1854*1*(1-1.00))
= 3409.524 sq.mm.

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:
= d(E1*t - F*tr) - 2 * tn(E1*t - F*tr) * (1 - fr1)
= 609.600 (1.00 * 12.0000 - 1.0 * 11.185) - 2 * 12.000
(1.00 * 12.0000 - 1.0 * 11.1854) * (1 - 1.000)
= 496.606 sq.mm.

Area Available in Nozzle Wall Projecting Outward [A2]:
= (2 * Tlwp) * (tn - trn) * fr2
= (2 * 30.00) * (12.00 - 1.51) * 1.0000)
= 629.647 sq.mm.

Area Available in Welds [A41 + A42 + A43]:
= Wo²*fr3+(Wi-can/0.707)²*fr2+Wp²*fr4
= 12.0000² *1.00 + (0.0000)² *1.00 + 0.0000² * 1.00
= 144.009 sq.mm.

Area Available in Element [A5]:
= (min(Dp,DL)-(Nozzle OD))*(min(tp,Tlwp,te))*fr4
= (1219.2000 - 633.6000) * 12.0000 * 1.0000
= 7027.636 sq.mm.

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

MDMT of the Nozzle Neck to Flange Weld, Curve: C

Govrn. thk, tg = 12.000 , tr = 0.893 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.074 , Temp. Reduction = 78 C

Min Metal Temp. w/o impact per UCS-66	-39	C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit	-56	C
Min Metal Temp. at Required thickness (UCS 66.1)	-104	C

MDMT of Nozzle Neck to Pad Weld for the Nozzle, Curve: C

Govrn. thk, tg = 12.000 , tr = 0.893 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.074 , Temp. Reduction = 78 C

```
Min Metal Temp. w/o impact per UCS-66                    -39  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -56  C
Min Metal Temp. at Required thickness (UCS 66.1)        -104  C
```

MDMT of Nozzle Neck to Pad Weld for Reinforcement pad, Curve: C

Govrn. thk, tg = 12.000 , tr = 0.893 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.074 , Temp. Reduction = 78 C

```
Min Metal Temp. w/o impact per UCS-66                    -39  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -56  C
Min Metal Temp. at Required thickness (UCS 66.1)        -104  C
```

MDMT of Shell to Pad Weld at Pad OD for pad, Curve: C

Govrn. thk, tg = 12.000 , tr = 5.143 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.429 , Temp. Reduction = 49 C

```
Min Metal Temp. w/o impact per UCS-66                    -39  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -56  C
Min Metal Temp. at Required thickness (UCS 66.1)         -65  C
```

MDMT of Nozzle-Shell/Head Weld for the Nozzle (UCS-66(a)1(b)), Curve: C

Govrn. thk, tg = 12.000 , tr = 5.143 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.429 , Temp. Reduction = 49 C

```
Min Metal Temp. w/o impact per UCS-66                    -39  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -56  C
Min Metal Temp. at Required thickness (UCS 66.1)         -65  C

Governing MDMT of the Nozzle                          :   -65 C
Governing MDMT of the Reinforcement Pad               :   -65 C
Governing MDMT of all the sub-joints of this Junction :   -65 C
```

Weld Size Calculations, Description: 1M

```
Intermediate Calc. for nozzle/shell Welds   Tmin     12.0000  mm.
Intermediate Calc. for pad/shell Welds   TminPad     12.0000  mm.
```

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	8.4000 = 0.7 * tmin.	8.4840 = 0.7 * Wo mm.
Pad Weld	6.0000 = 0.5*TminPad	6.3630 = 0.7 * Wp mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)
Weld Load [W]:

```
 = (A-A1+2*tn*fr1*(E1*t-tr))*Sv
 = (3409.5242 - 496.6056 + 2 * 12.0000 * 1.0000 *
   (1.00 * 12.0000 - 11.1854 ) ) * 867
 = 25435.00 KG
```

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

```
 = (A2+A5+A4-(Wi-Can/.707)²*fr2)*Sv
 = ( 629.6472 + 7027.6362 + 144.0089 - 0.0000 * 1.00 ) * 867
 = 67665.09 KG
```

Weld Load [W2]:
= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv
= (629.6472 + 0.0000 + 144.0089 + (288.0179)) * 867
= 9208.51 KG

Weld Load [W3]:
= (A2+A3+A4+A5+(2*tn*t*fr1))*S
= (629.6472 + 0.0000 + 144.0089 + 7027.6362 + (288.0179)) * 867
= 70163.23 KG

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:
= (pi/2) * Dlo * Wo * 0.49 * Snw
= (3.1416 / 2.0) * 633.6000 * 12.0000 * 0.49 * 867
= 50762. KG

Shear, Pad Element Weld [Spew]:
= (pi/2) * DP * WP * 0.49 * SEW
= (3.1416 / 2.0) * 1220.0000 * 9.0000 * 0.49 * 867
= 73307. KG

Shear, Nozzle Wall [Snw]:
= (pi *(Dlr + Dlo)/4) * (Thk - Can) * 0.7 * Sn
= (3.1416 * 310.8000) * (12.0000 - 0.0000) * 0.7 * 867
= 71143. KG

Tension, Pad Groove Weld [Tpgw]:
= (pi/2) * Dlo * Wgpn * 0.74 * Seg
= (3.1416 / 2) * 633.6000 * 9.0000 * 0.74 * 867
= 57496. KG

Tension, Shell Groove Weld [Tngw]:
= (pi/2) * Dlo * (Wgnvi-Cas) * 0.74 * Sng
= (3.1416 / 2.0) * 633.6000 * (12.0000 - 0.0000) * 0.74 * 867
= 76661. KG

Strength of Failure Paths:

PATH11 = (SPEW + SNW) = (73306 + 71143) = 144450 KG
PATH22 = (Sonw + Tpgw + Tngw + Sinw)
= (50761 + 57495 + 76660 + 0) = 184918 KG
PATH33 = (Spew + Tngw + Sinw)
= (73306 + 76660 + 0) = 149967 KG

Summary of Failure Path Calculations:
Path 1-1 = 144450 KG , must exceed W = 25434 KG or W1 = 67665 KG
Path 2-2 = 184918 KG , must exceed W = 25434 KG or W2 = 9208 KG
Path 3-3 = 149967 KG , must exceed W = 25434 KG or W3 = 70163 KG

Maximum Allowable Pressure for this Nozzle at this Location:
Converged Max. Allow. Pressure in Operating case 5.020 KG/CM2

Note: The MAWP of this junction was limited by the shell.

Nozzle is O.K. for the External Pressure 1.055 KG/CM2

The Drop for this Nozzle is : 28.8170 mm.
The Cut Length for this Nozzle is, Drop + Ho + H + T : 290.8171 mm.

INPUT VALUES, Nozzle Description: 1M2 From : 90

Pressure for Reinforcement Calculations	P	3.515	KG/CM2
Temperature for Internal Pressure	Temp	407	C
Design External Pressure	Pext	1.05	KG/CM2
Temperature for External Pressure	Tempex	407	C
Shell Material		SA-516 60	
Shell Allowable Stress at Temperature	S	867.59	KG/CM2
Shell Allowable Stress At Ambient	Sa	1202.25	KG/CM2
Inside Diameter of Cylindrical Shell	D	3511.55	mm.
Design Length of Section	L	3048.0000	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	0.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		10411.9688	mm.
User Entered Minimum Design Metal Temperature		19.40	C

Type of Element Connected to the Shell : Nozzle

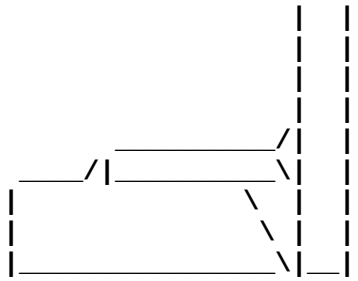
Material		SA-516 60	
Material UNS Number		K02100	
Material Specification/Type		Plate	
Allowable Stress at Temperature	Sn	867.59	KG/CM2
Allowable Stress At Ambient	Sna	1202.25	KG/CM2
Diameter Basis (for tr calc only)		ID	
Layout Angle		0.00	deg
Diameter		609.6000	mm.
Size and Thickness Basis		Actual	
Actual Thickness	tn	12.0000	mm.
Flange Material		SA-105	
Flange Type		Weld Neck Flange	
Corrosion Allowance	can	0.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	250.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	12.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	12.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Pad Material		SA-516 60	
Pad Allowable Stress at Temperature	Sp	867.59	KG/CM2
Pad Allowable Stress At Ambient	Spa	1202.25	KG/CM2
Diameter of Pad along vessel surface	Dp	1220.0000	mm.
Thickness of Pad	te	12.0000	mm.
Weld leg size between Pad and Shell	Wp	9.0000	mm.
Groove weld depth between Pad and Nozzle	Wgpn	9.0000	mm.
Reinforcing Pad Width		293.2000	mm.
ASME Code Weld Type per UW-16		None	

This is a Manway or Access Opening.

Class of attached Flange		150
Grade of attached Flange		GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch



Insert Nozzle With Pad, no Inside projection

Reinforcement CALCULATION, Description: 1M2

ASME Code, Section VIII, Division 1, 2007, A-08 UG-37 to UG-45

```
Actual Inside Diameter Used in Calculation          609.600  mm.
Actual Thickness Used in Calculation                 12.000  mm.
```

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)
 = (3.52*1755.7750)/(867*1.00-0.6*3.52)
 = 7.1315 mm.
```

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]
```
 = (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
 = (3.52*304.80)/(867*1.00-0.6*3.52)
 = 1.2380 mm.
```

Required Nozzle thickness under External Pressure per UG-28 : 1.5065 mm.

UG-40, Limits of Reinforcement : [Int. Press]
```
Parallel to Vessel Wall (Diameter Limit)           Dl  1219.2000  mm.
Parallel to Vessel Wall                             d   609.6000  mm.
Normal to Vessel Wall (Thickness Limit), pad side Tlwp   30.0000  mm.
```

Note : The Pad diameter is greater than the Diameter Limit, the excess will not be considered .

Weld Strength Reduction Factor [fr1]:
```
 = min( 1, Sn/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr2]:
```
 = min( 1, Sn/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr4]:
```
 = min( 1, Sp/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr3]:
```
 = min( fr2, fr4 )
 = min( 1.0 , 1.0 )
```

= 1.000

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc	
Area Required	Ar	4347.631	3540.761	NA	sq.mm.
Area in Shell	A1	2968.022	234.132	NA	sq.mm.
Area in Nozzle Wall	A2	645.759	629.647	NA	sq.mm.
Area in Inward Nozzle	A3	0.000	0.000	NA	sq.mm.
Area in Welds	A41+A42+A43	144.009	144.009	NA	sq.mm.
Area in Element	A5	7027.636	7027.636	NA	sq.mm.
TOTAL AREA AVAILABLE	Atot	10785.427	8035.424	NA	sq.mm.

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Insufficient.
The area available with the given pad is Sufficient.

SELECTION OF POSSIBLE REINFORCING PADS:	Diameter	Thickness	
Based on given Pad Thickness:	844.6680	12.0000	mm.
Based on given Pad Diameter:	1220.0000	4.3252	mm.
Based on Shell or Nozzle Thickness:	844.6680	12.0000	mm.

Area Required [A]:
= 0.5(d * tr*F + 2 * tn * tr*F * (1-fr1)) per UG-37(d) or UG-39
= 0.5(609.6000*11.6159*1+2*12.0000*11.6159*1*(1-1.00))
= 3540.761 sq.mm.

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:
= d(E1*t - F*tr) - 2 * tn(E1*t - F*tr) * (1 - fr1)
= 609.600 (1.00 * 12.0000 - 1.0 * 11.616) - 2 * 12.000
(1.00 * 12.0000 - 1.0 * 11.6159) * (1 - 1.000)
= 234.132 sq.mm.

Area Available in Nozzle Wall Projecting Outward [A2]:
= (2 * Tlwp) * (tn - trn) * fr2
= (2 * 30.00) * (12.00 - 1.51) * 1.0000)
= 629.647 sq.mm.

Area Available in Welds [A41 + A42 + A43]:
= Wo²*fr3+(Wi-can/0.707)²*fr2+Wp²*fr4
= 12.0000² *1.00 + (0.0000)² *1.00 + 0.0000² * 1.00
= 144.009 sq.mm.

Area Available in Element [A5]:
= (min(Dp,DL)-(Nozzle OD))*(min(tp,Tlwp,te))*fr4
= (1219.2000 - 633.6000) * 12.0000 * 1.0000
= 7027.636 sq.mm.

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

MDMT of the Nozzle Neck to Flange Weld, Curve: C

Govrn. thk, tg = 12.000 , tr = 0.893 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.074 , Temp. Reduction = 78 C

Min Metal Temp. w/o impact per UCS-66	-39	C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit	-56	C
Min Metal Temp. at Required thickness (UCS 66.1)	-104	C

MDMT of Nozzle Neck to Pad Weld for the Nozzle, Curve: C

Govrn. thk, tg = 12.000 , tr = 0.893 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.074 , Temp. Reduction = 78 C

```
Min Metal Temp. w/o impact per UCS-66                    -39  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -56  C
Min Metal Temp. at Required thickness (UCS 66.1)        -104  C
```

MDMT of Nozzle Neck to Pad Weld for Reinforcement pad, Curve: C

Govrn. thk, tg = 12.000 , tr = 0.893 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.074 , Temp. Reduction = 78 C

```
Min Metal Temp. w/o impact per UCS-66                    -39  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -56  C
Min Metal Temp. at Required thickness (UCS 66.1)        -104  C
```

MDMT of Shell to Pad Weld at Pad OD for pad, Curve: C

Govrn. thk, tg = 12.000 , tr = 5.143 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.429 , Temp. Reduction = 49 C

```
Min Metal Temp. w/o impact per UCS-66                    -39  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -56  C
Min Metal Temp. at Required thickness (UCS 66.1)         -65  C
```

MDMT of Nozzle-Shell/Head Weld for the Nozzle (UCS-66(a)1(b)), Curve: C

Govrn. thk, tg = 12.000 , tr = 5.143 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.429 , Temp. Reduction = 49 C

```
Min Metal Temp. w/o impact per UCS-66                    -39  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -56  C
Min Metal Temp. at Required thickness (UCS 66.1)         -65  C

Governing MDMT of the Nozzle                          :   -65 C
Governing MDMT of the Reinforcement Pad               :   -65 C
Governing MDMT of all the sub-joints of this Junction :   -65 C
```

Weld Size Calculations, Description: 1M2

```
Intermediate Calc. for nozzle/shell Welds   Tmin     12.0000  mm.
Intermediate Calc. for pad/shell Welds   TminPad     12.0000  mm.
```

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	8.4000 = 0.7 * tmin.	8.4840 = 0.7 * Wo mm.
Pad Weld	6.0000 = 0.5*TminPad	6.3630 = 0.7 * Wp mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)
Weld Load [W]:

```
 = (A-A1+2*tn*fr1*(E1*t-tr))*Sv
 = (3540.7610 - 234.1316 + 2 * 12.0000 * 1.0000 *
   (1.00 * 12.0000 - 11.6159 ) ) * 867
 = 28760.25 KG
```

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

```
 = (A2+A5+A4-(Wi-Can/.707)²*fr2)*Sv
 = ( 629.6472 + 7027.6362 + 144.0089 - 0.0000 * 1.00 ) * 867
 = 67665.09 KG
```

Weld Load [W2]:
= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv
= (629.6472 + 0.0000 + 144.0089 + (288.0179)) * 867
= 9208.51 KG

Weld Load [W3]:
= (A2+A3+A4+A5+(2*tn*t*fr1))*S
= (629.6472 + 0.0000 + 144.0089 + 7027.6362 + (288.0179)) * 867
= 70163.23 KG

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:
= (pi/2) * Dlo * Wo * 0.49 * Snw
= (3.1416 / 2.0) * 633.6000 * 12.0000 * 0.49 * 867
= 50762. KG

Shear, Pad Element Weld [Spew]:
= (pi/2) * DP * WP * 0.49 * SEW
= (3.1416 / 2.0) * 1220.0000 * 9.0000 * 0.49 * 867
= 73307. KG

Shear, Nozzle Wall [Snw]:
= (pi *(Dlr + Dlo)/4) * (Thk - Can) * 0.7 * Sn
= (3.1416 * 310.8000) * (12.0000 - 0.0000) * 0.7 * 867
= 71143. KG

Tension, Pad Groove Weld [Tpgw]:
= (pi/2) * Dlo * Wgpn * 0.74 * Seg
= (3.1416 / 2) * 633.6000 * 9.0000 * 0.74 * 867
= 57496. KG

Tension, Shell Groove Weld [Tngw]:
= (pi/2) * Dlo * (Wgnvi-Cas) * 0.74 * Sng
= (3.1416 / 2.0) * 633.6000 * (12.0000 - 0.0000) * 0.74 * 867
= 76661. KG

Strength of Failure Paths:

PATH11 = (SPEW + SNW) = (73306 + 71143) = 144450 KG
PATH22 = (Sonw + Tpgw + Tngw + Sinw)
= (50761 + 57495 + 76660 + 0) = 184918 KG
PATH33 = (Spew + Tngw + Sinw)
= (73306 + 76660 + 0) = 149967 KG

Summary of Failure Path Calculations:
Path 1-1 = 144450 KG , must exceed W = 28760 KG or W1 = 67665 KG
Path 2-2 = 184918 KG , must exceed W = 28760 KG or W2 = 9208 KG
Path 3-3 = 149967 KG , must exceed W = 28760 KG or W3 = 70163 KG

Maximum Allowable Pressure for this Nozzle at this Location:
Converged Max. Allow. Pressure in Operating case 5.020 KG/CM2

Note: The MAWP of this junction was limited by the shell.

Nozzle is O.K. for the External Pressure 1.055 KG/CM2

The Drop for this Nozzle is : 28.8170 mm.
The Cut Length for this Nozzle is, Drop + Ho + H + T : 290.8171 mm.

INPUT VALUES, Nozzle Description: 1M3 From : 120

Pressure for Reinforcement Calculations	P	3.515	KG/CM2
Temperature for Internal Pressure	Temp	407	C
Design External Pressure	Pext	1.05	KG/CM2
Temperature for External Pressure	Tempex	407	C
Shell Material		SA-516 60	
Shell Allowable Stress at Temperature	S	867.59	KG/CM2
Shell Allowable Stress At Ambient	Sa	1202.25	KG/CM2
Inside Diameter of Cylindrical Shell	D	3511.55	mm.
Design Length of Section	L	3048.0000	mm.
Shell Finished (Minimum) Thickness	t	12.0000	mm.
Shell Internal Corrosion Allowance	c	0.0000	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		19555.9668	mm.
User Entered Minimum Design Metal Temperature		19.40	C

Type of Element Connected to the Shell : Nozzle

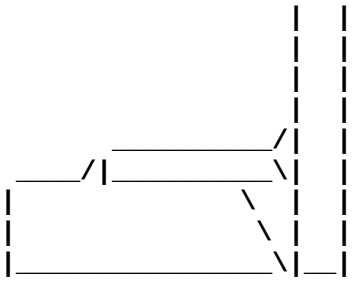
Material		SA-516 60	
Material UNS Number		K02100	
Material Specification/Type		Plate	
Allowable Stress at Temperature	Sn	867.59	KG/CM2
Allowable Stress At Ambient	Sna	1202.25	KG/CM2
Diameter Basis (for tr calc only)		ID	
Layout Angle		0.00	deg
Diameter		609.6000	mm.
Size and Thickness Basis		Actual	
Actual Thickness	tn	12.0000	mm.
Flange Material		SA-105	
Flange Type		Weld Neck Flange	
Corrosion Allowance	can	0.0000	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	250.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	12.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	9.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Pad Material		SA-516 60	
Pad Allowable Stress at Temperature	Sp	867.59	KG/CM2
Pad Allowable Stress At Ambient	Spa	1202.25	KG/CM2
Diameter of Pad along vessel surface	Dp	1220.0000	mm.
Thickness of Pad	te	12.0000	mm.
Weld leg size between Pad and Shell	Wp	9.0000	mm.
Groove weld depth between Pad and Nozzle	Wgpn	9.0000	mm.
Reinforcing Pad Width		293.2000	mm.
ASME Code Weld Type per UW-16		None	

This is a Manway or Access Opening.

Class of attached Flange		150
Grade of attached Flange		GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch



Insert Nozzle With Pad, no Inside projection

Reinforcement CALCULATION, Description: 1M3

ASME Code, Section VIII, Division 1, 2007, A-08 UG-37 to UG-45

```
Actual Inside Diameter Used in Calculation          609.600  mm.
Actual Thickness Used in Calculation                 12.000  mm.
```

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)
 = (3.52*1755.7750)/(867*1.00-0.6*3.52)
 = 7.1315 mm.
```

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]
```
 = (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
 = (3.52*304.80)/(867*1.00-0.6*3.52)
 = 1.2380 mm.
```

Required Nozzle thickness under External Pressure per UG-28 : 1.5065 mm.

UG-40, Limits of Reinforcement : [Int. Press]
```
Parallel to Vessel Wall (Diameter Limit)           Dl  1219.2000  mm.
Parallel to Vessel Wall                             d   609.6000  mm.
Normal to Vessel Wall (Thickness Limit), pad side Tlwp   30.0000  mm.
```

Note : The Pad diameter is greater than the Diameter Limit, the excess will not be considered .

Weld Strength Reduction Factor [fr1]:
```
 = min( 1, Sn/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr2]:
```
 = min( 1, Sn/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr4]:
```
 = min( 1, Sp/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr3]:
```
 = min( fr2, fr4 )
 = min( 1.0 , 1.0 )
```

= 1.000

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc	
Area Required	Ar	4347.631	3540.761	NA	sq.mm.
Area in Shell	A1	2968.022	234.132	NA	sq.mm.
Area in Nozzle Wall	A2	645.759	629.647	NA	sq.mm.
Area in Inward Nozzle	A3	0.000	0.000	NA	sq.mm.
Area in Welds	A41+A42+A43	144.009	144.009	NA	sq.mm.
Area in Element	A5	7027.636	7027.636	NA	sq.mm.
TOTAL AREA AVAILABLE	Atot	10785.427	8035.424	NA	sq.mm.

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Insufficient.
The area available with the given pad is Sufficient.

SELECTION OF POSSIBLE REINFORCING PADS:	Diameter	Thickness	
Based on given Pad Thickness:	844.6680	12.0000	mm.
Based on given Pad Diameter:	1220.0000	4.3252	mm.
Based on Shell or Nozzle Thickness:	844.6680	12.0000	mm.

Area Required [A]:
= 0.5(d * tr*F + 2 * tn * tr*F * (1-fr1)) per UG-37(d) or UG-39
= 0.5(609.6000*11.6159*1+2*12.0000*11.6159*1*(1-1.00))
= 3540.761 sq.mm.

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:
= d(E1*t - F*tr) - 2 * tn(E1*t - F*tr) * (1 - fr1)
= 609.600 (1.00 * 12.0000 - 1.0 * 11.616) - 2 * 12.000
(1.00 * 12.0000 - 1.0 * 11.6159) * (1 - 1.000)
= 234.132 sq.mm.

Area Available in Nozzle Wall Projecting Outward [A2]:
= (2 * Tlwp) * (tn - trn) * fr2
= (2 * 30.00) * (12.00 - 1.51) * 1.0000)
= 629.647 sq.mm.

Area Available in Welds [A41 + A42 + A43]:
= Wo²*fr3+(Wi-can/0.707)²*fr2+Wp²*fr4
= 12.0000² *1.00 + (0.0000)² *1.00 + 0.0000² * 1.00
= 144.009 sq.mm.

Area Available in Element [A5]:
= (min(Dp,DL)-(Nozzle OD))*(min(tp,Tlwp,te))*fr4
= (1219.2000 - 633.6000) * 12.0000 * 1.0000
= 7027.636 sq.mm.

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

MDMT of the Nozzle Neck to Flange Weld, Curve: C

Govrn. thk, tg = 12.000 , tr = 0.893 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.074 , Temp. Reduction = 78 C

Min Metal Temp. w/o impact per UCS-66	-39	C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit	-56	C
Min Metal Temp. at Required thickness (UCS 66.1)	-104	C

MDMT of Nozzle Neck to Pad Weld for the Nozzle, Curve: C

Govrn. thk, tg = 12.000 , tr = 0.893 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.074 , Temp. Reduction = 78 C

```
Min Metal Temp. w/o impact per UCS-66                    -39  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -56  C
Min Metal Temp. at Required thickness (UCS 66.1)        -104  C
```

MDMT of Nozzle Neck to Pad Weld for Reinforcement pad, Curve: C

Govrn. thk, tg = 12.000 , tr = 0.893 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.074 , Temp. Reduction = 78 C

```
Min Metal Temp. w/o impact per UCS-66                    -39  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -56  C
Min Metal Temp. at Required thickness (UCS 66.1)        -104  C
```

MDMT of Shell to Pad Weld at Pad OD for pad, Curve: C

Govrn. thk, tg = 12.000 , tr = 5.143 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.429 , Temp. Reduction = 49 C

```
Min Metal Temp. w/o impact per UCS-66                    -39  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -56  C
Min Metal Temp. at Required thickness (UCS 66.1)         -65  C
```

MDMT of Nozzle-Shell/Head Weld for the Nozzle (UCS-66(a)1(b)), Curve: C

Govrn. thk, tg = 12.000 , tr = 5.143 , c = 0.0000 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.429 , Temp. Reduction = 49 C

```
Min Metal Temp. w/o impact per UCS-66                    -39  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -56  C
Min Metal Temp. at Required thickness (UCS 66.1)         -65  C

Governing MDMT of the Nozzle                          :   -65 C
Governing MDMT of the Reinforcement Pad               :   -65 C
Governing MDMT of all the sub-joints of this Junction :   -65 C
```

Weld Size Calculations, Description: 1M3

```
Intermediate Calc. for nozzle/shell Welds   Tmin     12.0000  mm.
Intermediate Calc. for pad/shell Welds   TminPad     12.0000  mm.
```

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	8.4000 = 0.7 * tmin.	8.4840 = 0.7 * Wo mm.
Pad Weld	6.0000 = 0.5*TminPad	6.3630 = 0.7 * Wp mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

```
 = (A-A1+2*tn*fr1*(E1*t-tr))*Sv
 = (3540.7610 - 234.1316 + 2 * 12.0000 * 1.0000 *
   (1.00 * 12.0000 - 11.6159 ) ) * 867
 = 28760.25 KG
```

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

```
 = (A2+A5+A4-(Wi-Can/.707)²*fr2)*Sv
 = ( 629.6472 + 7027.6362 + 144.0089 - 0.0000 * 1.00 ) * 867
 = 67665.09 KG
```

Weld Load [W2]:
= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv
= (629.6472 + 0.0000 + 144.0089 + (288.0179)) * 867
= 9208.51 KG

Weld Load [W3]:
= (A2+A3+A4+A5+(2*tn*t*fr1))*S
= (629.6472 + 0.0000 + 144.0089 + 7027.6362 + (288.0179)) * 867
= 70163.23 KG

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:
= (pi/2) * Dlo * Wo * 0.49 * Snw
= (3.1416 / 2.0) * 633.6000 * 12.0000 * 0.49 * 867
= 50762. KG

Shear, Pad Element Weld [Spew]:
= (pi/2) * DP * WP * 0.49 * SEW
= (3.1416 / 2.0) * 1220.0000 * 9.0000 * 0.49 * 867
= 73307. KG

Shear, Nozzle Wall [Snw]:
= (pi *(Dlr + Dlo)/4) * (Thk - Can) * 0.7 * Sn
= (3.1416 * 310.8000) * (12.0000 - 0.0000) * 0.7 * 867
= 71143. KG

Tension, Pad Groove Weld [Tpgw]:
= (pi/2) * Dlo * Wgpn * 0.74 * Seg
= (3.1416 / 2) * 633.6000 * 9.0000 * 0.74 * 867
= 57496. KG

Tension, Shell Groove Weld [Tngw]:
= (pi/2) * Dlo * (Wgnvi-Cas) * 0.74 * Sng
= (3.1416 / 2.0) * 633.6000 * (9.0000 - 0.0000) * 0.74 * 867
= 57496. KG

Strength of Failure Paths:

PATH11 = (SPEW + SNW) = (73306 + 71143) = 144450 KG
PATH22 = (Sonw + Tpgw + Tngw + Sinw)
= (50761 + 57495 + 57495 + 0) = 165752 KG
PATH33 = (Spew + Tngw + Sinw)
= (73306 + 57495 + 0) = 130802 KG

Summary of Failure Path Calculations:
Path 1-1 = 144450 KG , must exceed W = 28760 KG or W1 = 67665 KG
Path 2-2 = 165752 KG , must exceed W = 28760 KG or W2 = 9208 KG
Path 3-3 = 130802 KG , must exceed W = 28760 KG or W3 = 70163 KG

Maximum Allowable Pressure for this Nozzle at this Location:
Converged Max. Allow. Pressure in Operating case 5.020 KG/CM2

Note: The MAWP of this junction was limited by the shell.

Nozzle is O.K. for the External Pressure 1.055 KG/CM2

The Drop for this Nozzle is : 28.8170 mm.
The Cut Length for this Nozzle is, Drop + Ho + H + T : 290.8171 mm.

INPUT VALUES, Nozzle Description: 1M4 From : 140

Pressure for Reinforcement Calculations	P	3.515	KG/CM2
Temperature for Internal Pressure	Temp	407	C
Design External Pressure	Pext	1.05	KG/CM2
Temperature for External Pressure	Tempex	407	C
Shell Material		SA-516 60	
Shell Allowable Stress at Temperature	S	867.59	KG/CM2
Shell Allowable Stress At Ambient	Sa	1202.25	KG/CM2
Inside Diameter of Cylindrical Shell	D	3505.20	mm.
Design Length of Section	L	1054.1000	mm.
Shell Finished (Minimum) Thickness	t	16.0000	mm.
Shell Internal Corrosion Allowance	c	6.3500	mm.
Shell External Corrosion Allowance	co	0.0000	mm.
Distance from Bottom/Left Tangent		23789.6406	mm.
User Entered Minimum Design Metal Temperature		19.40	C

Type of Element Connected to the Shell : Nozzle

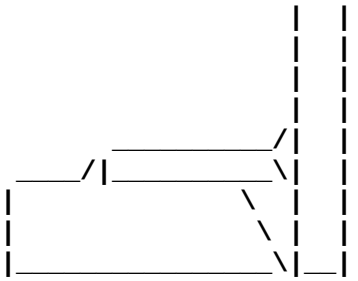
Material		SA-516 60	
Material UNS Number		K02100	
Material Specification/Type		Plate	
Allowable Stress at Temperature	Sn	867.59	KG/CM2
Allowable Stress At Ambient	Sna	1202.25	KG/CM2
Diameter Basis (for tr calc only)		ID	
Layout Angle		0.00	deg
Diameter		609.6000	mm.
Size and Thickness Basis		Actual	
Actual Thickness	tn	16.0000	mm.
Flange Material		SA-105	
Flange Type		Weld Neck Flange	
Corrosion Allowance	can	6.3500	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	250.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	16.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	16.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Pad Material		SA-516 60	
Pad Allowable Stress at Temperature	Sp	867.59	KG/CM2
Pad Allowable Stress At Ambient	Spa	1202.25	KG/CM2
Diameter of Pad along vessel surface	Dp	1400.0000	mm.
Thickness of Pad	te	16.0000	mm.
Weld leg size between Pad and Shell	Wp	8.0000	mm.
Groove weld depth between Pad and Nozzle	Wgpn	8.0000	mm.
Reinforcing Pad Width		379.2000	mm.
ASME Code Weld Type per UW-16		None	

This is a Manway or Access Opening.

Class of attached Flange		150
Grade of attached Flange		GR 1.1

The Pressure Design option was Design Pressure + static head.

Nozzle Sketch



Insert Nozzle With Pad, no Inside projection

Reinforcement CALCULATION, Description: 1M4

ASME Code, Section VIII, Division 1, 2007, A-08 UG-37 to UG-45

```
Actual Inside Diameter Used in Calculation          609.600  mm.
Actual Thickness Used in Calculation                 16.000  mm.
```

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)
 = (3.52*1758.9500)/(867*1.00-0.6*3.52)
 = 7.1444 mm.
```

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]
```
 = (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
 = (3.52*311.15)/(867*1.00-0.6*3.52)
 = 1.2638 mm.
```

Required Nozzle thickness under External Pressure per UG-28 : 1.5176 mm.

UG-40, Limits of Reinforcement : [Int. Press]
```
Parallel to Vessel Wall (Diameter Limit)           Dl  1244.6000  mm.
Parallel to Vessel Wall                             d   622.3000  mm.
Normal to Vessel Wall (Thickness Limit), pad side Tlwp   24.1250  mm.
```

Note : The Pad diameter is greater than the Diameter Limit, the excess will not be considered .

Weld Strength Reduction Factor [fr1]:
```
 = min( 1, Sn/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr2]:
```
 = min( 1, Sn/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr4]:
```
 = min( 1, Sp/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr3]:
```
 = min( fr2, fr4 )
 = min( 1.0 , 1.0 )
```

= 1.000

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc	
Area Required	Ar	4446.233	2325.426	NA	sq.mm.
Area in Shell	A1	1559.335	1354.716	NA	sq.mm.
Area in Nozzle Wall	A2	0.000	0.000	NA	sq.mm.
Area in Inward Nozzle	A3	0.000	0.000	NA	sq.mm.
Area in Welds	A41+A42+A43	193.996	193.996	NA	sq.mm.
Area in Element	A5	9648.599	9648.599	NA	sq.mm.
TOTAL AREA AVAILABLE	Atot	11401.930	11197.312	NA	sq.mm.

The Internal Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Insufficient.
The area available with the given pad is Sufficient.

SELECTION OF POSSIBLE REINFORCING PADS:	Diameter	Thickness	
Based on given Pad Thickness:	809.8959	16.0000	mm.
Based on given Pad Diameter:	1400.0000	4.4656	mm.
Based on Shell or Nozzle Thickness:	809.8959	16.0000	mm.

Area Required [A]:
= (d * tr*F + 2 * tn * tr*F * (1-fr1)) UG-37(c)
= (622.3000*7.1444*1.0+2*9.6500*7.1444*1.0*(1-1.00))
= 4446.233 sq.mm.

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:
= d(E1*t - F*tr) - 2 * tn(E1*t - F*tr) * (1 - fr1)
= 622.300 (1.00 * 9.6500 - 1.0 * 7.144) - 2 * 9.650
(1.00 * 9.6500 - 1.0 * 7.1444) * (1 - 1.000)
= 1559.335 sq.mm.

Area 2 has not been Calculated by User Request.

Area 2wp has not been Calculated by User Request.

Area Available in Welds [A41 + A42 + A43]:
= (Wo² - Ar Lost)*Fr3+((Wi-can/0.707)² - Ar Lost)*fr2 + Wp²*fr4
= (193.9964) * 1.00 + (0.0000) * 1.00 + 0.0000² * 1.00
= 193.996 sq.mm.

Area Available in Element [A5]:
= (min(Dp,DL)-(Nozzle OD))*(min(tp,Tlwp,te))*fr4
= (1244.6000 - 641.6000) * 16.0000 * 1.0000
= 9648.599 sq.mm.

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

MDMT of the Nozzle Neck to Flange Weld, Curve: C

Govrn. thk, tg = 16.000 , tr = 0.911 , c = 6.3500 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.094 , Temp. Reduction = 78 C

Min Metal Temp. w/o impact per UCS-66	-32	C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit	-49	C
Min Metal Temp. at Required thickness (UCS 66.1)	-104	C

MDMT of Nozzle Neck to Pad Weld for the Nozzle, Curve: C

Govrn. thk, tg = 16.000 , tr = 0.911 , c = 6.3500 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.094 , Temp. Reduction = 78 C

```
Min Metal Temp. w/o impact per UCS-66                    -32  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -49  C
Min Metal Temp. at Required thickness (UCS 66.1)        -104  C
```

MDMT of Nozzle Neck to Pad Weld for Reinforcement pad, Curve: C

Govrn. thk, tg = 16.000 , tr = 0.911 , c = 6.3500 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.094 , Temp. Reduction = 78 C

```
Min Metal Temp. w/o impact per UCS-66                    -32  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -49  C
Min Metal Temp. at Required thickness (UCS 66.1)        -104  C
```

MDMT of Shell to Pad Weld at Pad OD for pad, Curve: C

Govrn. thk, tg = 16.000 , tr = 5.152 , c = 6.3500 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.534 , Temp. Reduction = 30 C

```
Min Metal Temp. w/o impact per UCS-66                    -32  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -49  C
Min Metal Temp. at Required thickness (UCS 66.1)         -65  C
```

MDMT of Nozzle-Shell/Head Weld for the Nozzle (UCS-66(a)1(b)), Curve: C

Govrn. thk, tg = 16.000 , tr = 5.152 , c = 6.3500 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.534 , Temp. Reduction = 30 C

```
Min Metal Temp. w/o impact per UCS-66                    -32  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -49  C
Min Metal Temp. at Required thickness (UCS 66.1)         -65  C

Governing MDMT of the Nozzle                          :   -65 C
Governing MDMT of the Reinforcement Pad               :   -65 C
Governing MDMT of all the sub-joints of this Junction :   -65 C
```

Weld Size Calculations, Description: 1M4

```
Intermediate Calc. for nozzle/shell Welds   Tmin      9.6500  mm.
Intermediate Calc. for pad/shell Welds   TminPad      9.6500  mm.
```

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	6.7550 = 0.7 * tmin.	11.3120 = 0.7 * Wo mm.
Pad Weld	4.8250 = 0.5*TminPad	5.6560 = 0.7 * Wp mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

```
 = (A-A1+2*tn*fr1*(E1*t-tr))*Sv
 = (4446.2329 - 1559.3346 + 2 * 9.6500 * 1.0000 *
   (1.00 * 9.6500 - 7.1444 ) ) * 867
 = 25459.19 KG
```

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

```
 = (A2+A5+A4-(Wi-Can/.707)²*fr2)*Sv
 = ( 0.0000 + 9648.5986 + 193.9964 - 0.0000 * 1.00 ) * 867
 = 85370.48 KG
```

Weld Load [W2]:
= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv
= (0.0000 + 0.0000 + 256.0159 + (186.2565)) * 867
= 3836.08 KG

Weld Load [W3]:
= (A2+A3+A4+A5+(2*tn*t*fr1))*S
= (0.0000 + 0.0000 + 193.9964 + 9648.5986 + (186.2565)) * 867
= 86985.98 KG

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:
= (pi/2) * Dlo * Wo * 0.49 * Snw
= (3.1416 / 2.0) * 641.6000 * 16.0000 * 0.49 * 867
= 68537. KG

Shear, Pad Element Weld [Spew]:
= (pi/2) * DP * WP * 0.49 * SEW
= (3.1416 / 2.0) * 1400.0000 * 8.0000 * 0.49 * 867
= 74775. KG

Shear, Nozzle Wall [Snw]:
= (pi *(Dlr + Dlo)/4) * (Thk - Can) * 0.7 * Sn
= (3.1416 * 315.9750) * (16.0000 - 6.3500) * 0.7 * 867
= 58164. KG

Tension, Pad Groove Weld [Tpgw]:
= (pi/2) * Dlo * Wgpn * 0.74 * Seg
= (3.1416 / 2) * 641.6000 * 8.0000 * 0.74 * 867
= 51752. KG

Tension, Shell Groove Weld [Tngw]:
= (pi/2) * Dlo * (Wgnvi-Cas) * 0.74 * Sng
= (3.1416 / 2.0) * 641.6000 * (16.0000 - 6.3500) * 0.74 * 867
= 62426. KG

Strength of Failure Paths:

PATH11 = (SPEW + SNW) = (74775 + 58163) = 132939 KG
PATH22 = (Sonw + Tpgw + Tngw + Sinw)
= (68537 + 51752 + 62426 + 0) = 182715 KG
PATH33 = (Spew + Tngw + Sinw)
= (74775 + 62426 + 0) = 137201 KG

Summary of Failure Path Calculations:
Path 1-1 = 132939 KG , must exceed W = 25459 KG or W1 = 85370 KG
Path 2-2 = 182715 KG , must exceed W = 25459 KG or W2 = 3836 KG
Path 3-3 = 137201 KG , must exceed W = 25459 KG or W3 = 86985 KG

Maximum Allowable Pressure for this Nozzle at this Location:
Converged Max. Allow. Pressure in Operating case 4.032 KG/CM2

Note: The MAWP of this junction was limited by the shell.

Nozzle is O.K. for the External Pressure 1.055 KG/CM2

The Drop for this Nozzle is : 29.6102 mm.
The Cut Length for this Nozzle is, Drop + Ho + H + T : 295.6102 mm.

INPUT VALUES, Nozzle Description: VAPOR OL From : 150

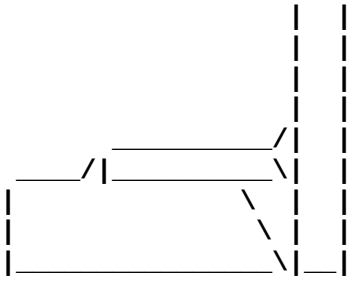
Pressure for Reinforcement Calculations	P	3.515	KG/CM2
Temperature for Internal Pressure	Temp	407	C
Design External Pressure	Pext	1.05	KG/CM2
Temperature for External Pressure	Tempex	407	C
Shell Material		SA-516 60	
Shell Allowable Stress at Temperature	S	867.59	KG/CM2
Shell Allowable Stress At Ambient	Sa	1202.25	KG/CM2
Inside Diameter of Elliptical Head	D	3505.20	mm.
Aspect Ratio of Elliptical Head	Ar	2.00	
Head Finished (Minimum) Thickness	t	18.0000	mm.
Head Internal Corrosion Allowance	c	6.3500	mm.
Head External Corrosion Allowance	co	0.0000	mm.
Distance from Head Centerline	L1	1436.8400	mm.
User Entered Minimum Design Metal Temperature		19.40	C

Type of Element Connected to the Shell : Nozzle

Material		SA-516 60	
Material UNS Number		K02100	
Material Specification/Type		Plate	
Allowable Stress at Temperature	Sn	867.59	KG/CM2
Allowable Stress At Ambient	Sna	1202.25	KG/CM2
Diameter Basis (for tr calc only)		ID	
Layout Angle		45.00	deg
Diameter		304.8000	mm.
Size and Thickness Basis		Actual	
Actual Thickness	tn	20.0000	mm.
Flange Material		SA-105	
Flange Type		Weld Neck Flange	
Corrosion Allowance	can	6.3500	mm.
Joint Efficiency of Shell Seam at Nozzle	E1	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Outside Projection	ho	300.0000	mm.
Weld leg size between Nozzle and Pad/Shell	Wo	15.0000	mm.
Groove weld depth between Nozzle and Vessel	Wgnv	15.0000	mm.
Inside Projection	h	0.0000	mm.
Weld leg size, Inside Element to Shell	Wi	0.0000	mm.
Pad Material		SA-516 60	
Pad Allowable Stress at Temperature	Sp	867.59	KG/CM2
Pad Allowable Stress At Ambient	Spa	1202.25	KG/CM2
Diameter of Pad along vessel surface	Dp	700.0000	mm.
Thickness of Pad	te	20.0000	mm.
Weld leg size between Pad and Shell	Wp	15.0000	mm.
Groove weld depth between Pad and Nozzle	Wgpn	15.0000	mm.
Reinforcing Pad Width		177.6000	mm.
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



Insert Nozzle With Pad, no Inside projection

Reinforcement CALCULATION, Description: VAPOR OL

ASME Code, Section VIII, Division 1, 2007, A-08 UG-37 to UG-45

```
Actual Inside Diameter Used in Calculation          304.800  mm.
Actual Thickness Used in Calculation                 20.000  mm.
```

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)
 = (3.52*3517.8999*1.000)/( 2*867.59*1.00-0.2*3.52)
 = 7.1299 mm.
```

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]
```
 = (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
 = (3.52*158.75)/(867*1.00-0.6*3.52)
 = 0.6448 mm.
```

Required Nozzle thickness under External Pressure per UG-28 : 1.1371 mm.

UG-40, Limits of Reinforcement : [Int. Press]
```
Parallel to Vessel Wall (Diameter Limit)           Dl   792.6113  mm.
Parallel to Vessel Wall                             d   396.3056  mm.
Normal to Vessel Wall (Thickness Limit), pad side Tlwp   29.1250  mm.
```

Weld Strength Reduction Factor [fr1]:
```
 = min( 1, Sn/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr2]:
```
 = min( 1, Sn/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr4]:
```
 = min( 1, Sp/S )
 = min( 1, 867.6 /867.6 )
 = 1.000
```

Weld Strength Reduction Factor [fr3]:
```
 = min( fr2, fr4 )
 = min( 1.0 , 1.0 )
 = 1.000
```

Results of Nozzle Reinforcement Area Calculations:
```
AREA AVAILABLE, A1 to A5          Design  External     Mapnc
```

Area Required	Ar	2825.801	2022.914	NA	sq.mm.
Area in Shell	A1	1791.447	571.419	NA	sq.mm.
Area in Nozzle Wall	A2	757.600	728.921	NA	sq.mm.
Area in Inward Nozzle	A3	0.000	0.000	NA	sq.mm.
Area in Welds	A41+A42+A43	283.593	283.593	NA	sq.mm.
Area in Element	A5	7104.440	7104.440	NA	sq.mm.
TOTAL AREA AVAILABLE	Atot	9937.079	8688.372	NA	sq.mm.

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 53.24 Degs.

The area available without a pad is Insufficient.
The area available with the given pad is Sufficient.

SELECTION OF POSSIBLE REINFORCING PADS:	Diameter	Thickness	
Based on given Pad Thickness:	366.7477	20.0000	mm.
Based on given Pad Diameter:	700.0000	1.2358	mm.
Based on Shell or Nozzle Thickness:	454.7681	18.0000	mm.

Area Required [A]:
= 0.5(d * tr*F + 2 * tn * tr*F * (1-fr1)) per UG-37(d) or UG-39
= 0.5(396.3056*10.2082*1+2*13.6500*10.2082*1*(1-1.00))
= 2022.914 sq.mm.

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:
= d(E1*t - F*tr) - 2 * tn(E1*t - F*tr) * (1 - fr1)
= 396.306 (1.00 * 11.6500 - 1.0 * 10.208) - 2 * 13.650
(1.00 * 11.6500 - 1.0 * 10.2082) * (1 - 1.000)
= 571.419 sq.mm.

Area Available in Nozzle Wall Projecting Outward [A2]:
= (2 * Tlwp) * (tn - trn) * fr2
= (2 * 29.13) * (13.65 - 1.14) * 1.0000)
= 728.921 sq.mm.

Area Available in Welds [A41 + A42 + A43]:
= (Wo² - Ar Lost)*Fr3+((Wi-can/0.707)² - Ar Lost)*fr2 + Trapfr4
= (190.4962) * 1.00 + (0.0000) * 1.00 + 93.0907² * 1.00
= 283.593 sq.mm.

Area Available in Element [A5]:
= (min(Dp,DL)-(Nozzle OD))*(min(tp,Tlwp,te))*fr4
= (785.5817 - 430.3817) * 20.0000 * 1.0000
= 7104.440 sq.mm.

Nozzle Junction Minimum Design Metal Temperature (MDMT) Calculations:

MDMT of the Nozzle Neck to Flange Weld, Curve: C

Govrn. thk, tg = 20.000 , tr = 0.465 , c = 6.3500 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.034 , Temp. Reduction = 78 C

Min Metal Temp. w/o impact per UCS-66	-27	C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit	-43	C
Min Metal Temp. at Required thickness (UCS 66.1)	-104	C

MDMT of Nozzle Neck to Pad Weld for the Nozzle, Curve: C

Govrn. thk, tg = 20.000 , tr = 0.465 , c = 6.3500 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.034 , Temp. Reduction = 78 C

```
Min Metal Temp. w/o impact per UCS-66                    -27  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -43  C
Min Metal Temp. at Required thickness (UCS 66.1)        -104  C
```

MDMT of Nozzle Neck to Pad Weld for Reinforcement pad, Curve: C

Govrn. thk, tg = 20.000 , tr = 0.465 , c = 6.3500 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.034 , Temp. Reduction = 78 C

```
Min Metal Temp. w/o impact per UCS-66                    -27  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -43  C
Min Metal Temp. at Required thickness (UCS 66.1)        -104  C
```

MDMT of Shell to Pad Weld at Pad OD for pad, Curve: C

Govrn. thk, tg = 18.000 , tr = 5.145 , c = 6.3500 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.442 , Temp. Reduction = 45 C

```
Min Metal Temp. w/o impact per UCS-66                    -29  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -46  C
Min Metal Temp. at Required thickness (UCS 66.1)         -65  C
```

MDMT of Nozzle-Shell/Head Weld for the Nozzle (UCS-66(a)1(b)), Curve: C

Govrn. thk, tg = 18.000 , tr = 5.145 , c = 6.3500 mm. , E* = 1.00
Stress Ratio = tr * (E*) / (tg - c) = 0.442 , Temp. Reduction = 45 C

```
Min Metal Temp. w/o impact per UCS-66                    -29  C
Min Metal Temp per UCS-66 and UCS-68(c),PWHT credit      -46  C
Min Metal Temp. at Required thickness (UCS 66.1)         -65  C

Governing MDMT of the Nozzle                          :   -65 C
Governing MDMT of the Reinforcement Pad               :   -65 C
Governing MDMT of all the sub-joints of this Junction :   -65 C
```

Weld Size Calculations, Description: VAPOR OL

```
Intermediate Calc. for nozzle/shell Welds   Tmin     13.6500  mm.
Intermediate Calc. for pad/shell Welds   TminPad     13.6500  mm.
```

Results Per UW-16.1:

```
                      Required Thickness    Actual Thickness
Nozzle Weld          9.5550 = 0.7 * tmin. 10.6050 = 0.7 * Wo mm.
Pad Weld             6.8250 = 0.5*TminPad 10.6050 = 0.7 * Wp mm.
```

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:

```
 = (A-A1+2*tn*fr1*(E1*t-tr))*Sv
 = (2022.9143 - 571.4186 + 2 * 13.6500 * 1.0000 *
   (1.00 * 11.6500 - 10.2082 ) ) * 867
 = 12931.07 KG
```

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:

```
 = (A2+A5+A4-(Wi-Can/.707)²*fr2)*Sv
 = ( 728.9209 + 7104.4399 + 283.5927 - 0.0000 * 1.00 ) * 867
 = 70403.00 KG
```

Weld Load [W2]:

```
 = (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv
 = ( 728.9209 + 0.0000 + 225.0140 + ( 318.0647 ) ) * 867
```

= 11032.78 KG

Weld Load [W3]:
= (A2+A3+A4+A5+(2*tn*t*fr1))*S
= (728.9209 + 0.0000 + 283.5927 + 7104.4399 + (318.0647)) * 867
= 73161.75 KG

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:
= (pi/2) * Dlo * Wo * 0.49 * Snw
= (3.1416 / 2.0) * 430.3817 * 15.0000 * 0.49 * 867
= 43101. KG

Shear, Pad Element Weld [Spew]:
= (pi/2) * DP * WP * 0.49 * SEW
= (3.1416 / 2.0) * 700.0000 * 15.0000 * 0.49 * 867
= 70102. KG

Shear, Nozzle Wall [Snw]:
= (pi *(Dlr + Dlo)/4) * (Thk - Can) * 0.7 * Sn
= (3.1416 * 206.6718) * (20.0000 - 6.3500) * 0.7 * 867
= 53813. KG

Tension, Pad Groove Weld [Tpgw]:
= (pi/2) * Dlo * Wgpn * 0.74 * Seg
= (3.1416 / 2) * 430.3817 * 15.0000 * 0.74 * 867
= 65091. KG

Tension, Shell Groove Weld [Tngw]:
= (pi/2) * Dlo * (Wgnvi-Cas) * 0.74 * Sng
= (3.1416 / 2.0) * 430.3817 * (15.0000 - 6.3500) * 0.74 * 867
= 37536. KG

Strength of Failure Paths:

PATH11 = (SPEW + SNW) = (70101 + 53812) = 123914 KG
PATH22 = (Sonw + Tpgw + Tngw + Sinw)
= (43100 + 65091 + 37535 + 0) = 145727 KG
PATH33 = (Spew + Tngw + Sinw)
= (70101 + 37535 + 0) = 107637 KG

Summary of Failure Path Calculations:
Path 1-1 = 123914 KG , must exceed W = 12931 KG or W1 = 70403 KG
Path 2-2 = 145727 KG , must exceed W = 12931 KG or W2 = 11032 KG
Path 3-3 = 107637 KG , must exceed W = 12931 KG or W3 = 73161 KG

Maximum Allowable Pressure for this Nozzle at this Location:
Converged Max. Allow. Pressure in Operating case 5.742 KG/CM2

Note: The MAWP of this junction was limited by the shell.

Nozzle is O.K. for the External Pressure 1.055 KG/CM2

Note : Checking Nozzle in the Latitudinal direction.

Reinforcement CALCULATION, Description: VAPOR OL

ASME Code, Section VIII, Division 1, 2007, A-08 UG-37 to UG-45

Actual Inside Diameter Used in Calculation 304.800 mm.
Actual Thickness Used in Calculation 20.000 mm.

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)
= (3.52*3517.8999*1.000)/(2*867.59*1.00-0.2*3.52)
= 7.1299 mm.

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]
= (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
= (3.52*158.75)/(867*1.00-0.6*3.52)
= 0.6448 mm.

Required Nozzle thickness under External Pressure per UG-28 : 1.1371 mm.

UG-40, Limits of Reinforcement : [Int. Press]

Parallel to Vessel Wall (Diameter Limit)	Dl	635.0000	mm.
Parallel to Vessel Wall	d	317.5000	mm.
Normal to Vessel Wall (Thickness Limit), pad side	Tlwp	29.1250	mm.

Note : The Pad diameter is greater than the Diameter Limit, the excess will not be considered .

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc	
Area Required	Ar	2263.888	1620.656	NA	sq.mm.
Area in Shell	A1	1435.216	457.792	NA	sq.mm.
Area in Nozzle Wall	A2	757.600	728.921	NA	sq.mm.
Area in Inward Nozzle	A3	0.000	0.000	NA	sq.mm.
Area in Welds	A41+A42+A43	190.496	190.496	NA	sq.mm.
Area in Element	A5	5804.360	5804.360	NA	sq.mm.
TOTAL AREA AVAILABLE	Atot	8187.672	7181.568	NA	sq.mm.

The External Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Insufficient.
The area available with the given pad is Sufficient.

SELECTION OF POSSIBLE REINFORCING PADS:	Diameter	Thickness	
Based on given Pad Thickness:	356.9716	20.0000	mm.
Based on given Pad Diameter:	700.0000	0.8388	mm.
Based on Shell or Nozzle Thickness:	358.3240	18.0000	mm.

Area Required [A]:
= 0.5(d * tr*F + 2 * tn * tr*F * (1-fr1)) per UG-37(d) or UG-39
= 0.5(317.5000*10.2082*1+2*13.6500*10.2082*1*(1-1.00))
= 1620.656 sq.mm.

Reinforcement Areas per Figure UG-37.1

Area Available in Shell [A1]:
= d(E1*t - F*tr) - 2 * tn(E1*t - F*tr) * (1 - fr1)
= 317.500 (1.00 * 11.6500 - 1.0 * 10.208) - 2 * 13.650
(1.00 * 11.6500 - 1.0 * 10.2082) * (1 - 1.000)
= 457.792 sq.mm.

Area Available in Nozzle Wall Projecting Outward [A2]:
= (2 * Tlwp) * (tn - trn) * fr2
= (2 * 29.13) * (13.65 - 1.14) * 1.0000)
= 728.921 sq.mm.

Area Available in Welds [A41 + A42 + A43]:

= (Wo² - Ar Lost)*Fr3+((Wi-can/0.707)² - Ar Lost)*fr2 + Wp²*fr4
= (190.4962) * 1.00 + (0.0000) * 1.00 + 0.0000² * 1.00
= 190.496 sq.mm.

Area Available in Element [A5]:
= (min(Dp,DL)-(Nozzle OD))*(min(tp,Tlwp,te))*fr4
= (635.0000 - 344.8000) * 20.0000 * 1.0000
= 5804.360 sq.mm.

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness per UG45(a), tra = 7.4871 mm.
Wall Thickness per UG16(b), tr16b = 7.9375 mm.
Wall Thickness per UG45(b)(1), trb1 = 13.4799 mm.
Wall Thickness per UG45(b)(2), trb2 = 8.4884 mm.
Wall Thickness per UG45(b)(3), trb3 = Max(trb1, trb2, tr16b) = 13.4799 mm.
Std. Wall Pipe per UG45(b)(4), trb4 = 14.6844 mm.
Wall Thickness per UG45(b), trb = Min(trb3, trb4) = 13.4799 mm.

Final Required Thickness, tr45 = Max(tra, trb) = 13.4799 mm.
Available Nozzle Neck Thickness = 20.0000 mm. --> OK

Weld Size Calculations, Description: VAPOR OL

Intermediate Calc. for nozzle/shell Welds Tmin 13.6500 mm.
Intermediate Calc. for pad/shell Welds TminPad 13.6500 mm.

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	9.5550 = 0.7 * tmin.	10.6050 = 0.7 * Wo mm.
Pad Weld	6.8250 = 0.5*TminPad	10.6050 = 0.7 * Wp mm.

Weld Strength and Weld Loads per UG-41.1, Sketch (a) or (b)

Weld Load [W]:
= (A-A1+2*tn*fr1*(E1*t-tr))*Sv
= (1620.6565 - 457.7916 + 2 * 13.6500 * 1.0000 *
(1.00 * 11.6500 - 10.2082)) * 867
= 10427.61 KG

Note: F is always set to 1.0 throughout the calculation.

Weld Load [W1]:
= (A2+A5+A4-(Wi-Can/.707)²*fr2)*Sv
= (728.9209 + 5804.3599 + 190.4962 - 0.0000 * 1.00) * 867
= 58319.18 KG

Weld Load [W2]:
= (A2 + A3 + A4 + (2 * tn * t * fr1)) * Sv
= (728.9209 + 0.0000 + 225.0140 + (318.0647)) * 867
= 11032.78 KG

Weld Load [W3]:
= (A2+A3+A4+A5+(2*tn*t*fr1))*S
= (728.9209 + 0.0000 + 190.4962 + 5804.3599 + (318.0647)) * 867
= 61077.93 KG

Strength of Connection Elements for Failure Path Analysis

Shear, Outward Nozzle Weld [Sonw]:
= (pi/2) * Dlo * Wo * 0.49 * Snw
= (3.1416 / 2.0) * 344.8000 * 15.0000 * 0.49 * 867
= 34530. KG

Shear, Pad Element Weld [Spew]:

= (pi/2) * DP * WP * 0.49 * SEW
= (3.1416 / 2.0) * 700.0000 * 15.0000 * 0.49 * 867
= 70102. KG

Shear, Nozzle Wall [Snw]:
= (pi *(Dlr + Dlo)/4) * (Thk - Can) * 0.7 * Sn
= (3.1416 * 165.5750) * (20.0000 - 6.3500) * 0.7 * 867
= 43112. KG

Tension, Pad Groove Weld [Tpgw]:
= (pi/2) * Dlo * Wgpn * 0.74 * Seg
= (3.1416 / 2) * 344.8000 * 15.0000 * 0.74 * 867
= 52148. KG

Tension, Shell Groove Weld [Tngw]:
= (pi/2) * Dlo * (Wgnvi-Cas) * 0.74 * Sng
= (3.1416 / 2.0) * 344.8000 * (15.0000 - 6.3500) * 0.74 * 867
= 30072. KG

Strength of Failure Paths:

PATH11 = (SPEW + SNW) = (70101 + 43112) = 113214 KG
PATH22 = (Sonw + Tpgw + Tngw + Sinw)
= (34530 + 52147 + 30071 + 0) = 116749 KG
PATH33 = (Spew + Tngw + Sinw)
= (70101 + 30071 + 0) = 100173 KG

Summary of Failure Path Calculations:
Path 1-1 = 113214 KG , must exceed W = 10427 KG or W1 = 58319 KG
Path 2-2 = 116749 KG , must exceed W = 10427 KG or W2 = 11032 KG
Path 3-3 = 100173 KG , must exceed W = 10427 KG or W3 = 61077 KG

Maximum Allowable Pressure for this Nozzle at this Location:
Converged Max. Allow. Pressure in Operating case 5.742 KG/CM2

Note: The MAWP of this junction was limited by the shell.

Nozzle is O.K. for the External Pressure 1.055 KG/CM2

The Drop for this Nozzle is : 94.5402 mm.
The Cut Length for this Nozzle is, Drop + Ho + H + T : 414.7203 mm.

Nozzle Schedule:

Description	Nominal Size mm	Flange Sch/Type Cls		Noz. O/Dia mm	Wall Thk mm.	Re-Pad ODia mm.	Re-Pad Thick mm.	Cut Length mm.
VAPOR OL	304	150	WNF	344.800	20.000	700.00	20.00	414
1M	609	150	WNF	633.600	12.000	1220.00	12.00	290
1M2	609	150	WNF	633.600	12.000	1220.00	12.00	290
1M3	609	150	WNF	633.600	12.000	1220.00	12.00	290
1M4	609	150	WNF	641.600	16.000	1400.00	16.00	295

Note on the Cut Length Calculation:
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.

Please Note: 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

Nozzle Material and Weld Fillet Leg Size Details:

Nozzle	Material	Shl Grve Weld mm.	Noz Shl/Pad Weld mm.	Pad OD Weld mm.	Pad Grve Weld mm.	Inside Weld mm.
VAPOR O	SA-516 60	15.000	15.000	15.000	15.000	-
1M	SA-516 60	12.000	12.000	9.000	9.000	-
1M2	SA-516 60	12.000	12.000	9.000	9.000	-
1M3	SA-516 60	9.000	12.000	9.000	9.000	-
1M4	SA-516 60	16.000	16.000	8.000	8.000	-

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

Nozzle Miscellaneous Data:

Nozzle	Elevation/Distance From Datum mm.	Layout Angle deg.	Projection Outside mm.	Projection Inside mm.	Installed In Component
VAPOR OL		45.00	300.00	0.00	TOP HD
1M	658.367	0.00	250.00	0.00	Shell1
1M2	10411.969	0.00	250.00	0.00	SHELL4
1M3	19555.967	0.00	250.00	0.00	SHELL7
1M4	23789.641	0.00	250.00	0.00	SHELL9

Nozzle Calculation Summary

Description	MAWP KG/CM2	Ext	MAPNC KG/CM2	UG45 [tr]	Weld Path	Areas
1M	5.02	OK	...	...	OK	Passed
1M2	5.02	OK	...	...	OK	Passed
1M3	5.02	OK	...	...	OK	Passed
1M4	4.03	OK	...	...	OK	Passed
VAPOR OL	5.74	OK	...	OK 13.48	OK	Passed
VAPOR OL	5.74	OK	...	OK 13.48	OK	Passed
Min. - Nozzles	4.03 1M4					
Min. Shell&Flgs	4.03 140 150		6.96			

Computed Vessel M.A.W.P. 4.03 KG/CM2

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

Warning: A Nozzle Reinforcement is governing the MAWP of this Vessel.

Check the Spatial Relationship between the Nozzles

From Node	Nozzle Description	Y Coordinate,	Layout Angle,	Dia. Limit
60	1M	658.368	0.000	1219.200
90	1M2	10411.969	0.000	1219.200
120	1M3	19555.965	0.000	1219.200
140	1M4	23789.641	0.000	1244.600
150	VAPOR OL	0.000	45.000	635.000

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 !

Minimum Design Metal Temperature Results Summary :

Required Minimum Design Metal Temperature 19 C

Description	Notes	Curve	Basic MDMT C	Reduced MDMT C	UG-20(f) MDMT C	Thickness ratio	Gov Thk mm.	E*
BTM HD	[10]	C	-56	-65		0.491	12.000	1.000
BTM HD	[7]	C	-52	-65		0.421	14.000	1.000
Shell1	[8]	C	-56	-65		0.492	12.000	0.850
Shell2	[8]	C	-56	-65		0.492	12.000	0.850
SHELL3	[8]	C	-56	-65		0.492	12.000	0.850
SHELL4	[8]	C	-56	-65		0.492	12.000	0.850
SHELL5	[8]	C	-56	-65		0.492	12.000	0.850
SHELL6	[8]	C	-56	-65		0.492	12.000	0.850
SHELL7	[8]	C	-56	-65		0.492	12.000	0.850
SHELL8	[8]	C	-56	-65		0.492	12.000	0.850
SHELL9	[8]	C	-49	-65		0.613	16.000	0.850
TOP HD	[10]	C	-46	-65		0.507	18.000	1.000
TOP HD	[7]	C	-43	-65		0.433	20.000	1.000
1M	[1]	C	-56	-65		0.429	12.000	1.000
1M2	[1]	C	-56	-65		0.429	12.000	1.000
1M3	[1]	C	-56	-65		0.429	12.000	1.000
1M4	[1]	C	-49	-65		0.534	16.000	1.000
VAPOR OL	[1]	C	-46	-65		0.442	18.000	1.000

Notes:
[!] - This was an impact tested material.
[1] - Governing Nozzle Weld.
[5] - ANSI Flange MDMT Calcs. The thickness ratio is the pressure ratio.
[6] - MDMT Calculations at the Shell/Head Joint.
[7] - MDMT Calculations for the Straight Flange.
[8] - Cylinder/Cone/Flange Junction MDMT.
[9] - Calculations in the Spherical Portion of the Head.
[10] - Calculations in the Knuckle Portion of the Head.
[11] - Calculated (Body Flange) Flange MDMT.
[12] - Calculated Flat Head MDMT per UCS-66.3

UG-84(b)(2) was not considered.
UCS-66(g) was not considered.
UCS-66(i) was not considered.

Notes:
Impact test temps were not entered in and not considered in the analysis.
UCS-66(i) applies to impact tested materials not by specification and
UCS-66(g) applies to materials impact tested per UG-84.1 General Note (c).
The Basic MDMT includes the (30F) PWHT credit if applicable.

Design Code: ASME Code Section VIII Division 1, 2007 A-08

Diameter Spec : 3511.550 x 3505.200 mm. ID
Vessel Design Length, Tangent to Tangent 24551.64 mm.

Distance of Bottom Tangent above Grade 8104.80 mm.
Distance of Base above Grade 304.80 mm.
Specified Datum Line Distance 7800.00 mm.

Skirt Material Specification SA-516 60
Shell Material Specification SA-516 60
Stiffening Ring Material Specification SA-516 60
Re-Pad Material Specification SA-516 60

Internal Design Temperature 407 C
Internal Design Pressure 3.52 KG/CM2

External Design Temperature 407 C
External Design Pressure 1.05 KG/CM2

Maximum Allowable Working Pressure 4.03 KG/CM2
External Max. Allowable Working Pressure 1.14 KG/CM2
Hydrostatic Test Pressure 8.30 KG/CM2

Required Minimum Design Metal Temperature 19 C
Warmest Computed Minimum Design Metal Temperature -65 C

Wind Design Code ASCE-98\02\05\IBC-03\06\STS-1
Earthquake Design Code No Seismic

Element Pressures and MAWP: KG/CM2

Element Desc	Internal	External	M.A.W.P	Corr. All.
BTM HD	3.515	1.055	5.926	0.0000
Shell1	3.515	1.055	5.020	0.0000
Shell2	3.515	1.055	5.020	0.0000
SHELL3	3.515	1.055	5.020	0.0000
SHELL4	3.515	1.055	5.020	0.0000
SHELL5	3.515	1.055	5.020	0.0000
SHELL6	3.515	1.055	5.020	0.0000
SHELL7	3.515	1.055	5.020	0.0000
SHELL8	3.515	1.055	5.020	0.0000
SHELL9	3.515	1.055	4.033	6.3500
TOP HD	3.515	1.055	5.742	6.3500

Stiffener Ring Specifications:

Elevation mm.	Selected Type	User Description
2487.17	Bar 203.3 x 12.	RING1
5077.97	Bar 203.2 x 12.	RING2
7668.77	Bar 215.9 x 12.	RING3
10716.77	Bar 202.6 x 12.	RING4
13764.77	Bar 215.9 x 12.	RING5
16812.77	Bar 215.9 x 9.	RING6
19860.77	Bar 215.9 x 9.	RING7
22299.17	Bar 215.9 x 9.	RING8
23789.64	Bar 139.7 x 15.	RING9

Element Type	"To" Elev mm.	Length mm.	Element Thk mm.	R e q d T h k Int.	Ext.	Joint Eff Long	Circ
Skirt	-6600.0	1200.0	20.0	No Cal	-------	0.70	0.70
Skirt	-3600.0	3000.0	16.0	No Cal	-------	0.70	0.70
Skirt	-600.0	3000.0	14.0	No Cal	-------	0.70	0.70
Skirt	0.0	600.0	14.0	No Cal	-------	0.70	0.70

Ellipse	48.8	48.8	14.0	7.1	-------	1.00	1.00
Cylinder	3096.8	3048.0	12.0	8.4	-------	0.85	0.85
Cylinder	6144.8	3048.0	12.0	8.4	-------	0.85	0.85
Cylinder	9192.8	3048.0	12.0	8.4	-------	0.85	0.85
Cylinder	12240.8	3048.0	12.0	8.4	-------	0.85	0.85
Cylinder	15288.8	3048.0	12.0	8.4	-------	0.85	0.85
Cylinder	18336.8	3048.0	12.0	8.4	-------	0.85	0.85
Cylinder	21384.8	3048.0	12.0	8.4	-------	0.85	0.85
Cylinder	23180.0	1795.3	12.0	8.4	-------	0.85	0.85
Cylinder	24502.9	1322.8	16.0	14.8	-------	0.85	0.85
Ellipse	24551.6	48.8	20.0	13.5	-------	1.00	1.00

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

External Pressure Calculations

From	To	External Actual T. mm.	External Required T. mm.	External Des. Press. KG/CM2	External M.A.W.P. KG/CM2
10	20	0.00000	No Calc	0.00000	No Calc
20	30	0.00000	No Calc	0.00000	No Calc
30	40	0.00000	No Calc	0.00000	No Calc
40	50	0.00000	No Calc	0.00000	No Calc
50	60	12.0000	10.1920	1.05461	1.46206
60	Ring	12.0000	11.1854	1.05461	1.25880
Ring	70	12.0000	10.8663	1.05461	1.35403
70	Ring	12.0000	10.8663	1.05461	1.35403
Ring	80	12.0000	10.8663	1.05461	1.35403
80	Ring	12.0000	10.8663	1.05461	1.35403
Ring	90	12.0000	11.6159	1.05461	1.14456
90	Ring	12.0000	11.6159	1.05461	1.14456
Ring	100	12.0000	11.6159	1.05461	1.14456
100	Ring	12.0000	11.6159	1.05461	1.14456
Ring	110	12.0000	11.6159	1.05461	1.14456
110	Ring	12.0000	11.6159	1.05461	1.14456
Ring	120	12.0000	11.6159	1.05461	1.14456
120	Ring	12.0000	11.6159	1.05461	1.14456
Ring	130	12.0000	10.5986	1.05461	1.44201
130	Ring	12.0000	10.5986	1.05461	1.44201
Ring	140	12.0000	8.64248	1.05461	2.10145
140	Ring	16.0000	14.9948	1.05461	1.39285
Ring	150	16.0000	13.8232	1.05461	1.70727
150	160	18.0000	16.5582	1.05461	1.37362

External Pressure Calculations

From	To	Actual Len. Bet. Stiff. mm.	Allow. Len. Bet. Stiff. mm.	Ring Inertia Required mm**4	Ring Inertia Available mm**4
10	20	No Calc	No Calc	No Calc	No Calc
20	30	No Calc	No Calc	No Calc	No Calc
30	40	No Calc	No Calc	No Calc	No Calc
40	50	No Calc	No Calc	No Calc	No Calc
50	60	No Calc	No Calc	No Calc	No Calc
60	Ring	2779.80	3299.86	No Calc	No Calc
Ring	70	2590.80	3299.92	10.45E+06	23.26E+06
70	Ring	2590.80	3299.92	No Calc	No Calc
Ring	80	2590.80	3299.92	10.07E+06	23.22E+06
80	Ring	2590.80	3299.92	No Calc	No Calc
Ring	90	3048.00	3299.88	10.94E+06	27.22E+06
90	Ring	3048.00	3299.88	No Calc	No Calc
Ring	100	3048.00	3299.88	11.85E+06	23.03E+06
100	Ring	3048.00	3299.88	No Calc	No Calc

Ring	110	3048.00	3299.88	11.85E+06	27.22E+06
110	Ring	3048.00	3299.88	No Calc	No Calc
Ring	120	3048.00	3299.88	11.83E+06	22.10E+06
120	Ring	3048.00	3299.88	No Calc	No Calc
Ring	130	2438.40	3299.88	10.67E+06	22.10E+06
130	Ring	2438.40	3299.88	No Calc	No Calc
Ring	140	1490.47	3299.90	7.630E+06	22.10E+06
140	Ring	1490.47	1941.68	No Calc	No Calc
Ring	150	1054.10	1941.72	4.945E+06	9.170E+06
150	160	No Calc	No Calc	No Calc	No Calc

Wind/Earthquake Shear, Bending

From	To	Distance to Support mm.	Cummulative Wind Shear KG	Earthquake Shear KG	Wind Bending KG-M	Earthquake Bending KG-M
10	20	600.000	8368.83	0.00000	156499.	0.00000
20	30	2700.00	8165.04	0.00000	146581.	0.00000
30	40	5700.00	7655.79	0.00000	122854.	0.00000
40	50	7500.00	7116.23	0.00000	100700.	0.00000
50	60	7824.38	6825.83	0.00000	96518.6	0.00000
60	70	9372.77	6816.73	0.00000	96186.0	0.00000
70	80	12420.8	6226.34	0.00000	76312.2	0.00000
80	90	15468.8	5427.19	0.00000	58555.7	0.00000
90	100	18516.8	4772.85	0.00000	43013.9	0.00000
100	110	21564.8	4093.71	0.00000	29503.8	0.00000
110	120	24612.8	3191.39	0.00000	18403.5	0.00000
120	130	27660.8	2470.93	0.00000	9775.80	0.00000
130	140	30082.4	1532.70	0.00000	3675.46	0.00000
140	150	31641.5	1090.24	0.00000	1321.46	0.00000
150	160	32327.3	560.265	0.00000	230.006	0.00000

Abs Max of the all of the Stress Ratio's : 0.6013

Basering Data : Continuous Top Ring W/Gussets

Thickness of Basering	38.0000	mm.
Inside Diameter of Basering	3289.4600	mm.
Outside Diameter of Basering	3889.4597	mm.
Nominal Diameter of Bolts	48.0000	mm.
Diameter of Bolt Circle	3739.4600	mm.
Number of Bolts	20	
Thickness of Gusset Plates	16.0000	mm.
Average Width of Gusset Plates	150.0000	mm.
Height of Gussets	280.0000	mm.
Distance between Gussets	110.0000	mm.
Thickness of Top Plate or Ring	38.0000	mm.
Circumferential Width of the Top Plate	175.2600	mm.
Radial Width of the Top Plate	160.0000	mm.
Wind Moment on Support	161632.	KG-M
Total Wind Shear on Support	8369.	KG
Earthquake Moment on Support	5133.	KG-M

Note: Wind and Earthquake moments include the effects of user defined forces and moments if any exist in the job and were specified to act (compute loads and stresses) during these cases. Also included are moment effects due to eccentric weights if any are present in the input.

Weights:

Fabricated	- Bare W/O Removable Internals	62210.4	KG
Shop Test	- Fabricated + Water (Full)	311081.7	KG
Shipping	- Fab. + Rem. Intls.+ Shipping App.	141741.3	KG
Erected	- Fab. + Rem. Intls.+ Insul. (etc)	143631.3	KG
Empty	- Fab. + Intls. + Details + Wghts.	143631.3	KG
Operating	- Empty + Operating Liquid (No CA)	141841.3	KG
Field Test	- Empty Weight + Water (Full)	386972.7	KG