

Table of Contents

Cover Sheet.....	2
Warnings and Errors.....	3
Input Echo.....	4
XY Coordinate Calculations.....	8
Internal Pressure Calculations.....	9
External Pressure Calculations.....	12
Element and Detail Weights.....	14
Nozzle Flange MAWP.....	15
Wind Load Calculation.....	16
Earthquake Load Calculation.....	18
Center of Gravity Calculation.....	19
Horizontal Vessel Analysis (Ope.).....	20
Horizontal Vessel Analysis (Test).....	25
Nozzle Calcs. Inspection.....	30
Nozzle Calcs. Outlet.....	34
Nozzle Calcs. Manhole.....	38
Nozzle Calcs. Drain.....	42
Nozzle Calcs. Inlet.....	45
Nozzle Schedule.....	49
Nozzle Summary.....	50
Vessel Design Summary.....	51
Problems/Failures Summary.....	53

DESIGN CALCULATION

In Accordance with ASME Section VIII Division 1

ASME Code Version : 2007

Analysis Performed by : KEDKEP CONSULTING, INC.

Job File : E:\WEB\HORIZONTAL TANK.PVI

Date of Analysis : Oct 23,2008

PV Elite 2008, May 2008

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Warnings and Errors Step: 0 4:19p Oct 23,2008

Class From To : Basic Element Checks.

=====

Class From To: Check of Additional Element Data

=====

There were no geometry errors or warnings.

PV Elite 2008 c1993-2008 by COADE Engineering Software

FileName : Horizontal Tank -----

Input Echo Step: 1 4:19p Oct 23,2008

PV Elite Vessel Analysis Program: Input Data

Design Internal Pressure (for Hydrotest)	0.0000	psig
Design Internal Temperature	0	F
Type of Hydrotest	UG99-b Note [34]	
Hydrotest Position	Horizontal	
Projection of Nozzle from Vessel Top	0.0000	in.
Projection of Nozzle from Vessel Bottom	0.0000	in.
Minimum Design Metal Temperature	-20	F
Type of Construction	Welded	
Special Service	Air/Water/Steam	
Degree of Radiography	RT-3	
Miscellaneous Weight Percent	0.	
Use Higher Longitudinal Stresses (Flag)	Y	
Select t for Internal Pressure (Flag)	N	
Select t for External Pressure (Flag)	N	
Select t for Axial Stress (Flag)	N	
Select Location for Stiff. Rings (Flag)	N	
Use Hydrotest Allowable Unmodified	Y	
Consider Vortex Shedding	N	
Perform a Corroded Hydrotest	N	
Is this a Heat Exchanger	No	
User Defined Hydro. Press. (Used if > 0)	0.0000	psig
User defined MAWP	0.0000	psig
User defined MAPnc	0.0000	psig
Load Case 1	NP+EW+WI+FW+BW	
Load Case 2	NP+EW+EE+FS+BS	
Load Case 3	NP+OW+WI+FW+BW	
Load Case 4	NP+OW+EQ+FS+BS	
Load Case 5	NP+HW+HI	
Load Case 6	NP+HW+HE	
Load Case 7	IP+OW+WI+FW+BW	
Load Case 8	IP+OW+EQ+FS+BS	
Load Case 9	EP+OW+WI+FW+BW	
Load Case 10	EP+OW+EQ+FS+BS	
Load Case 11	HP+HW+HI	
Load Case 12	HP+HW+HE	
Load Case 13	IP+WE+EW	
Load Case 14	IP+WF+CW	
Load Case 15	IP+VO+OW	
Load Case 16	IP+VE+EW	
Load Case 17	NP+VO+OW	
Load Case 18	FS+BS+IP+OW	
Load Case 19	FS+BS+EP+OW	
Wind Design Code	IBC-2006	
Design Wind Speed	70.000	mile/hr
Exposure Constant	C	
Importance Factor	1.	
Roughness Factor	1	
Base Elevation	0.0000	ft.
Percent Wind for Hydrotest	33.	
Use Wind Profile (Y/N)	N	
Damping Factor (Beta) for Wind (Ope)	0.0100	
Damping Factor (Beta) for Wind (Empty)	0.0000	
Damping Factor (Beta) for Wind (Filled)	0.0000	
Seismic Design Code	IBC 2006	
Importance Factor	1.000	
Table Value Fa	1.000	
Table Value Fv	1.400	
Short Period Acceleration value Ss	1.000	

FileName : Horizontal Tank -----

Input Echo Step: 1 4:19p Oct 23,2008

Long Period Acceleration Value Sl		0.400
Moment Reduction Factor Tau		1.000
Force Modification Factor R		3.000
Site Class		C
Component Elevation Ratio	z/h	0.000
Amplification Factor	Ap	0.000
Force Factor		0.000
Consider Vertical Acceleration		No
Minimum Acceleration Multiplier		0.000
User Value of Sds (used if > 0)		0.000
User Value of Sd1 (used if > 0)		0.000
Design Nozzle for Des. Press. + St. Head		Y
Consider MAP New and Cold in Noz. Design		N
Consider External Loads for Nozzle Des.		Y
Consider Code Case 2168 for Nozzle Des.		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	Elliptical	
Description	LF Head	
Distance "FROM" to "TO"	0.1667	ft.
Inside Diameter	60.000	in.
Element Thickness	0.6250	in.
Internal Corrosion Allowance	0.1250	in.
Nominal Thickness	0.0000	in.
External Corrosion Allowance	0.0000	in.
Design Internal Pressure	100.00	psig
Design Temperature Internal Pressure	200	F
Design External Pressure	15.000	psig
Design Temperature External Pressure	200	F
Effective Diameter Multiplier	1.2	
Material Name	SA-516 70	
Allowable Stress, Ambient	20000.	psi
Allowable Stress, Operating	20000.	psi
Allowable Stress, Hydrotest	26000.	psi
Material Density	0.2830	lb./cu.in.
P Number Thickness	1.2500	in.
Yield Stress, Operating	34800.	psi
UCS-66 Chart Curve Designation	B	
External Pressure Chart Name	CS-2	
UNS Number	K02700	
Product Form	Plate	
Efficiency, Longitudinal Seam	1.	
Efficiency, Circumferential Seam	1.	
Elliptical Head Factor	2.	

Element From Node	10	
Detail Type	Nozzle	
Detail ID	Inspection	
Dist. from "FROM" Node / Offset dist	0.0000	in.
Nozzle Diameter	6.	in.
Nozzle Schedule	80	
Nozzle Class	150	
Layout Angle	0.	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	0.0000	lb.
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-106 B	
Element From Node	10	

FileName : Horizontal Tank

Input Echo

Step: 1 4:19p Oct 23,2008

Detail Type	Nozzle	
Detail ID	Outlet	
Dist. from "FROM" Node / Offset dist	15.000	in.
Nozzle Diameter	6.	in.
Nozzle Schedule	80	
Nozzle Class	150	
Layout Angle	0.	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	0.0000	lb.
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-106 B	
Element From Node	20	
Element To Node	30	
Element Type	Cylinder	
Description	Shell	
Distance "FROM" to "TO"	10.000	ft.
Inside Diameter	60.000	in.
Element Thickness	0.6250	in.
Internal Corrosion Allowance	0.1250	in.
Nominal Thickness	0.0000	in.
External Corrosion Allowance	0.0000	in.
Design Internal Pressure	150.00	psig
Design Temperature Internal Pressure	200	F
Design External Pressure	15.000	psig
Design Temperature External Pressure	200	F
Effective Diameter Multiplier	1.2	
Material Name	SA-516 70	
Efficiency, Longitudinal Seam	0.85	
Efficiency, Circumferential Seam	0.85	
Element From Node	20	
Detail Type	Saddle	
Detail ID	Lft Sdl	
Dist. from "FROM" Node / Offset dist	1.2500	ft.
Width of Saddle	8.0000	in.
Height of Saddle at Bottom	45.000	in.
Saddle Contact Angle	120.	
Height of Composite Ring Stiffener	0.0000	in.
Width of Wear Plate	12.000	in.
Thickness of Wear Plate	0.3750	in.
Contact Angle, Wear Plate (degrees)	132.	
Element From Node	20	
Detail Type	Saddle	
Detail ID	Sdl 2 Fr20	
Dist. from "FROM" Node / Offset dist	9.0000	ft.
Width of Saddle	8.0000	in.
Height of Saddle at Bottom	45.000	in.
Saddle Contact Angle	120.	
Height of Composite Ring Stiffener	0.0000	in.
Width of Wear Plate	12.000	in.
Thickness of Wear Plate	0.3750	in.
Contact Angle, Wear Plate (degrees)	132.	
Element From Node	20	
Detail Type	Nozzle	
Detail ID	Manhole	
Dist. from "FROM" Node / Offset dist	5.0000	ft.
Nozzle Diameter	16.	in.
Nozzle Schedule	None	
Nozzle Class	150	
Layout Angle	0.	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	0.0000	lb.

FileName : Horizontal Tank -----

Input Echo Step: 1 4:19p Oct 23,2008

Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-516 70	
Element From Node	20	
Detail Type	Nozzle	
Detail ID	Drain	
Dist. from "FROM" Node / Offset dist	5.0000	ft.
Nozzle Diameter	2.	in.
Nozzle Schedule	160	
Nozzle Class	150	
Layout Angle	180.	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	0.0000	lb.
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-106 B	

Element From Node	30	
Element To Node	40	
Element Type	Elliptical	
Description	RT Head	
Distance "FROM" to "TO"	0.1667	ft.
Inside Diameter	60.000	in.
Element Thickness	0.6250	in.
Internal Corrosion Allowance	0.1250	in.
Nominal Thickness	0.0000	in.
External Corrosion Allowance	0.0000	in.
Design Internal Pressure	150.00	psig
Design Temperature Internal Pressure	200	F
Design External Pressure	15.000	psig
Design Temperature External Pressure	200	F
Effective Diameter Multiplier	1.2	
Material Name	SA-516 70	
Efficiency, Longitudinal Seam	1.	
Efficiency, Circumferential Seam	0.85	
Elliptical Head Factor	2.	

Element From Node	30	
Detail Type	Nozzle	
Detail ID	Inlet	
Dist. from "FROM" Node / Offset dist	0.0000	in.
Nozzle Diameter	4.	in.
Nozzle Schedule	120	
Nozzle Class	150	
Layout Angle	0.	
Blind Flange (Y/N)	N	
Weight of Nozzle (Used if > 0)	0.0000	lb.
Grade of Attached Flange	GR 1.1	
Nozzle Matl	SA-106 B	

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

XY Coordinate Calculations Step: 2 4:19p Oct 23,2008

XY Coordinate Calculations

From	To	X (Horiz.) ft.	Y (Vert.) ft.	DX (Horiz.) ft.	DY (Vert.) ft.
LF Head		0.16667	0.00000	0.16667	0.00000
Shell		10.1667	0.00000	10.0000	0.00000
RT Head		10.3333	0.00000	0.16667	0.00000

PV Elite 2008 c1993-2008 by COADE Engineering Software

FileName : Horizontal Tank -----

Internal Pressure Calculations Step: 3 4:19p Oct 23,2008

Element Thickness, Pressure, Diameter and Allowable Stress :

From	To	Int. Press + Liq. Hd psig	Nominal Thickness in.	Total Corr Allowance in.	Element Diameter in.	Allowable Stress(SE) psi
LF Head		100.000	...	0.12500	60.0000	20000.0
Shell		150.000	...	0.12500	60.0000	17000.0
RT Head		150.000	...	0.12500	60.0000	20000.0

Element Required Thickness and MAWP :

From	To	Design Pressure psig	M.A.W.P. Corroded psig	M.A.P. New & Cold psig	Actual Thickness in.	Required Thickness in.
LF Head		100.000	331.400	415.800	0.62500	0.27570
Shell		150.000	279.376	349.794	0.62500	0.39222
RT Head		150.000	331.400	415.800	0.62500	0.35111
Minimum			260.000	285.000		

Note : The M.A.W.P is Governed by an ANSI Flange !

Note : The M.A.P. (NC) is Governed by a Flange !

Internal Pressure Calculation Results :

ASME Code, Section VIII, Division 1, 2007

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

LF Head

Thickness Due to Internal Pressure [Tr]:

$$= (P \cdot D \cdot K) / (2 \cdot S \cdot E - 0.2 \cdot P) \text{ Appendix 1-4(c)}$$

$$= (100.000 \cdot 60.2500 \cdot 0.12) / (2 \cdot 20000.00 \cdot 1.00 - 0.2 \cdot 100.000)$$

$$= 0.1507 + 0.1250 = 0.2757 \text{ in.}$$

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

$$= (2 \cdot S \cdot E \cdot t) / (K \cdot D + 0.2 \cdot t) \text{ per Appendix 1-4 (c)}$$

$$= (2 \cdot 20000.00 \cdot 1.00 \cdot 0.5000) / (1.00 \cdot 60.2500 + 0.2 \cdot 0.5000)$$

$$= 331.400 \text{ psig}$$

Maximum Allowable Pressure, New and Cold [MAPNC]:

$$= (2 \cdot S \cdot E \cdot t) / (K \cdot D + 0.2 \cdot t) \text{ per Appendix 1-4 (c)}$$

$$= (2 \cdot 20000.00 \cdot 1.00 \cdot 0.6250) / (1.00 \cdot 60.0000 + 0.2 \cdot 0.6250)$$

$$= 415.800 \text{ psig}$$

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

$$= (P \cdot (K \cdot D + 0.2 \cdot t)) / (2 \cdot E \cdot t)$$

$$= (100.000 \cdot (1.00 \cdot 60.2500 + 0.2 \cdot 0.5000)) / (2 \cdot 1.00 \cdot 0.5000)$$

$$= 6035.000 \text{ psi}$$

Required Thickness of Straight Flange = 0.276 in.

Percent Elongation per UCS-79 $(75 \cdot t_{nom} / R_f) \cdot (1 - R_f / R_o)$ 4.548 %

Min Metal Temp. w/o impact per UCS-66 6 F
 Min Metal Temp. at Rqd thickness (UCS 66.1)[rat 0.30] -134 F
 Min Metal Temp. w/o impact per UG-20(f) -20 F

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

Shell

Thickness Due to Internal Pressure [Tr]:

FileName : Horizontal Tank -----

Internal Pressure Calculations Step: 3 4:19p Oct 23,2008

$$= (P \cdot R) / (S \cdot E - 0.6 \cdot P) \text{ per UG-27 (c)(1)}$$

$$= (150.000 \cdot 30.1250) / (20000.00 \cdot 0.85 - 0.6 \cdot 150.000)$$

$$= 0.2672 + 0.1250 = 0.3922 \text{ in.}$$

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

$$= (S \cdot E \cdot t) / (R + 0.6 \cdot t) \text{ per UG-27 (c)(1)}$$

$$= (20000.00 \cdot 0.85 \cdot 0.5000) / (30.1250 + 0.6 \cdot 0.5000)$$

$$= 279.376 \text{ psig}$$

Maximum Allowable Pressure, New and Cold [MAPNC]:

$$= (S \cdot E \cdot t) / (R + 0.6 \cdot t) \text{ per UG-27 (c)(1)}$$

$$= (20000.00 \cdot 0.85 \cdot 0.6250) / (30.0000 + 0.6 \cdot 0.6250)$$

$$= 349.794 \text{ psig}$$

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

$$= (P \cdot (R + 0.6 \cdot t)) / (E \cdot t)$$

$$= (150.000 \cdot (30.1250 + 0.6 \cdot 0.5000)) / (0.85 \cdot 0.5000)$$

$$= 10738.235 \text{ psi}$$

Percent Elongation per UCS-79 $(50 \cdot t_{nom} / R_f) \cdot (1 - R_f / R_o)$ 1.031 %

Min Metal Temp. w/o impact per UCS-66	6	F
Min Metal Temp. at Rqd thickness (UCS 66.1)[rat 0.45]	-55	F
Min Metal Temp. w/o impact per UG-20(f)	-20	F

Elliptical Head From 30 To 40 SA-516 70, UCS-66 Crv. B at 200 F

RT Head

Thickness Due to Internal Pressure [Tr]:

$$= (P \cdot D \cdot K) / (2 \cdot S \cdot E - 0.2 \cdot P) \text{ Appendix 1-4 (c)}$$

$$= (150.000 \cdot 60.2500 \cdot 0.12) / (2 \cdot 20000.00 \cdot 1.00 - 0.2 \cdot 150.000)$$

$$= 0.2261 + 0.1250 = 0.3511 \text{ in.}$$

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

$$= (2 \cdot S \cdot E \cdot t) / (K \cdot D + 0.2 \cdot t) \text{ per Appendix 1-4 (c)}$$

$$= (2 \cdot 20000.00 \cdot 1.00 \cdot 0.5000) / (1.00 \cdot 60.2500 + 0.2 \cdot 0.5000)$$

$$= 331.400 \text{ psig}$$

Maximum Allowable Pressure, New and Cold [MAPNC]:

$$= (2 \cdot S \cdot E \cdot t) / (K \cdot D + 0.2 \cdot t) \text{ per Appendix 1-4 (c)}$$

$$= (2 \cdot 20000.00 \cdot 1.00 \cdot 0.6250) / (1.00 \cdot 60.0000 + 0.2 \cdot 0.6250)$$

$$= 415.800 \text{ psig}$$

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

$$= (P \cdot (K \cdot D + 0.2 \cdot t)) / (2 \cdot E \cdot t)$$

$$= (150.000 \cdot (1.00 \cdot 60.2500 + 0.2 \cdot 0.5000)) / (2 \cdot 1.00 \cdot 0.5000)$$

$$= 9052.500 \text{ psi}$$

Required Thickness of Straight Flange = 0.352 in.

Percent Elongation per UCS-79 $(75 \cdot t_{nom} / R_f) \cdot (1 - R_f / R_o)$ 4.548 %

Min Metal Temp. w/o impact per UCS-66	6	F
Min Metal Temp. at Rqd thickness (UCS 66.1)[rat 0.45]	-55	F
Min Metal Temp. w/o impact per UG-20(f)	-20	F

MINIMUM METAL DESIGN TEMPERATURE RESULTS :

Minimum Metal Temp. w/o impact per UCS-66	6.	F
Minimum Metal Temp. at Required thickness	-55.	F

Note: Heads and Shells Exempted to -20F (-29C) by paragraph UG-20F

Minimum Design Metal Temperature (Entered by User)	-20.	F
--	------	---

FileName : Horizontal Tank -----

Internal Pressure Calculations Step: 3 4:19p Oct 23,2008

Hydrostatic Test Pressure Results:

Pressure per UG99b = 1.3 * M.A.W.P. * Sa/S 338.000 psig
Pressure per UG99b[34] = 1.3 * Design Pres * Sa/S 0.000 psig
Pressure per UG99c = 1.3 * M.A.P. - Head(Hyd) 370.500 psig
Pressure per UG100 = 1.1 * M.A.W.P. * Sa/S 286.000 psig

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

= Test Factor * Design Pressure * Stress Ratio
= 1.3 * 0.000 * 1.000
= 0.000 psig

Horizontal Hydrotest performed in accordance with: UG-99b (Note 34)

Stresses on Elements due to Hydrostatic Test Pressure:

<u>From</u>	<u>To</u>	<u>Stress</u>	<u>Allowable</u>	<u>Ratio</u>	<u>Pressure</u>
-------------	-----------	---------------	------------------	--------------	-----------------

Elements Suitable for Internal Pressure.

PV Elite 2008 c1993-2008 by COADE Engineering Software

FileName : Horizontal Tank -----

External Pressure Calculations Step: 4 4:19p Oct 23,2008

External Pressure Calculation Results :

ASME Code, Section VIII, Division 1, 2007

Elliptical Head From 10 to 20 Ext. Chart: CS-2 at 200 F

LF Head

Elastic Modulus from Chart: CS-2 at 300 F : 0.29000E+08 psi

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	D/t	Factor A	B
0.500	61.25	122.50	0.0011338	12917.58

EMAP = $B / (K_0 * D/t) = 12917.5791 / (0.9000 * 122.5000) = 117.1663 \text{ psig}$

Results for Required Thickness (Tca):

Tca	OD	D/t	Factor A	B
0.159	61.25	386.22	0.0003596	5214.34

EMAP = $B / (K_0 * D/t) = 5214.3438 / (0.9000 * 386.2210) = 15.0010 \text{ psig}$

Cylindrical Shell From 20 to 30 Ext. Chart: CS-2 at 200 F

Shell

Elastic Modulus from Chart: CS-2 at 300 F : 0.29000E+08 psi

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	SLEN	D/t	L/D	Factor A	B
0.500	61.25	134.00	122.50	2.1878	0.0004466	6475.23

EMAP = $(4*B) / (3*(D/t)) = (4*6475.2334) / (3*122.5000) = 70.4787 \text{ psig}$

Results for Required Thickness (Tca):

Tca	OD	SLEN	D/t	L/D	Factor A	B
0.270	61.25	134.00	227.01	2.1878	0.0001761	2554.01

EMAP = $(4*B) / (3*(D/t)) = (4*2554.0081) / (3*227.0074) = 15.0010 \text{ psig}$

Results for Maximum Stiffened Length (Slen):

Tca	OD	SLEN	D/t	L/D	Factor A	B
0.500	61.25	620.37	122.50	10.1284	0.0000950	1378.20

EMAP = $(4*B) / (3*(D/t)) = (4*1378.1968) / (3*122.5000) = 15.0008 \text{ psig}$

Elliptical Head From 30 to 40 Ext. Chart: CS-2 at 200 F

RT Head

Elastic Modulus from Chart: CS-2 at 300 F : 0.29000E+08 psi

Results for Maximum Allowable External Pressure (MAEP):

Tca	OD	D/t	Factor A	B
0.500	61.25	122.50	0.0011338	12917.58

EMAP = $B / (K_0 * D/t) = 12917.5791 / (0.9000 * 122.5000) = 117.1663 \text{ psig}$

Results for Required Thickness (Tca):

Tca	OD	D/t	Factor A	B
0.159	61.25	386.22	0.0003596	5214.34

EMAP = $B / (K_0 * D/t) = 5214.3438 / (0.9000 * 386.2210) = 15.0010 \text{ psig}$

External Pressure Calculations

From	To	Section Length	Outside Diameter	Corroded Thickness	Factor A	Factor B
		ft.	in.	in.		psi
10	20	No Calc	61.2500	0.50000	0.0011338	12917.6
20	30	11.1667	61.2500	0.50000	0.00044657	6475.23

FileName : Horizontal Tank -----

External Pressure Calculations Step: 4 4:19p Oct 23,2008

30 | 40 | No Calc | 61.2500 | 0.50000 | 0.0011338 | 12917.6 |

External Pressure Calculations

From	To	External Actual T. in.	External Required T. in.	External Des. Press. psig	External M.A.W.P. psig
10	20	0.62500	0.28359	15.0000	117.166
20	30	0.62500	0.39481	15.0000	70.4787
30	40	0.62500	0.28359	15.0000	117.166
Minimum					70.479

External Pressure Calculations

From	To	Actual Len. Bet. Stiff. ft.	Allow. Len. Bet. Stiff. ft.	Ring Inertia Required in**4	Ring Inertia Available in**4
10	20	No Calc	No Calc	No Calc	No Calc
20	30	11.1667	51.6973	No Calc	No Calc
30	40	No Calc	No Calc	No Calc	No Calc

Elements Suitable for External Pressure.

FileName : Horizontal Tank -----

Element and Detail Weights

Step: 5 4:19p Oct 23,2008

Element and Detail Weights

From	To	Element Metal Wgt. lb.	Element ID Volume in3	Corroded Metal Wgt. lb.	Corroded ID Volume in3	Extra due Misc %
10	20	845.430	33929.2	676.344	34331.3	0.00000
20	30	4042.49	33929.2	3240.66	342125.	0.00000
30	40	845.430	33929.2	676.344	34331.3	0.00000
Total		5733	407150	4593	410788	0

Weight of Details

From	Type	Weight of Detail lb.	X Offset, Dtl. Cent. ft.	Y Offset, Dtl. Cent. ft.	Description
10	Noz1	23.8335	-0.10417	0.00000	Inspection
10	Noz1	23.8335	-0.10417	1.25000	Outlet
20	Sad1	88.0180	1.25000	3.08333	Lft Sdl
20	Sad1	88.0180	9.00000	3.08333	Sdl 2 Fr20
20	Noz1	139.364	5.00000	3.16667	Manhole
20	Noz1	6.76820	5.00000	2.58333	Drain
30	Noz1	15.1776	0.27083	0.00000	Inlet

Total Weight of Each Detail Type

Total Weight of Saddles	176.0
Total Weight of Nozzles	209.0

Sum of the Detail Weights	385.0 lb.

Weight Summary

Fabricated Wt. - Bare Weight W/O Removable Internals	6118.4 lb.
Shop Test Wt. - Fabricated Weight + Water (Full)	20821.0 lb.
Shipping Wt. - Fab. Wt + Rem. Intls.+ Shipping App.	6118.4 lb.
Erected Wt. - Fab. Wt + Rem. Intls.+ Insul. (etc)	6118.4 lb.
Op. Wt. no Liq - Fab. Wt + Intls. + Details + Wghts.	6118.4 lb.
Operating Wt. - Empty Wt. + Operating Liquid (No CA)	6118.4 lb.
Oper. Wt. + CA - Corr Wt. + Operating Liquid	4978.4 lb.
Field Test Wt. - Empty Weight + Water (Full)	20821.0 lb.

Note: The Corroded Weight and thickness are used in the Horizontal Vessel Analysis (Ope Case) and Earthquake Load Calculations.

Outside Surface Areas of Elements

From	To	Surface Area sq.in.
10	20	4451.48
20	30	23090.7
30	40	4451.48
Total		31993.676 sq.in. [222.2 Square Feet]

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Nozzle Flange MAWP Step: 6 4:19p Oct 23,2008

Nozzle Flange MAWP Results :

Flange Rating	Operating psig	Ambient psig	Temperature F	Class	Grade Group
-----	260.000	285.000	200	150	GR 1.1
-----	Minimum Rating	260.000	285.000	psig	

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

PV Elite 2008 c1993-2008 by COADE Engineering Software

FileName : Horizontal Tank -----

Wind Load Calculation Step: 7 4:19p Oct 23,2008

Wind Analysis Results

Wind Load Results per IBC 2006:

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 1.000
 Gust Effect Factor (Gpe)(G or Gf) 0.850
 User entered Beta Value (Operating Case) 0.0100
 Shape Factor (Cf) 0.522
 User Entered Basic Wind Speed 70.0 mile/hr

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 = 900.000 ft.

Effective Height [z]

= Centroid Hgt. + Vessel Base Elevation
 = 3.750 + 0.000 = 3.750 ft.

Compute [Kz]

Because z (3.750 ft.) < 15 ft.
 = 2.01 * (15 / Zg) ^{2 / Alpha}
 = 2.01 * (15 / 900.000)^{2 / 9.500}
 = 0.849

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 * 1.000 * 70.000
 = 10.116 psf

Force on the first element [F]:

= qz * Gh * Cf * WindArea
 = 10.116 * 0.850 * 0.522 * 898.651
 = 28.025 lb.

Element	Hgt (z) ft.	K1	K2	K3	Kz	Kzt	qz psf
LF Head	3.8	0.000	0.000	0.000	0.849	1.000	10.116
Shell	3.8	0.000	0.000	0.000	0.849	1.000	10.116
RT Head	3.8	0.000	0.000	0.000	0.849	1.000	10.116

Wind Load Calculation

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Wind Load Calculation Step: 7 4:19p Oct 23,2008

From	To	Wind Height ft.	Wind Diameter ft.	Wind Area sq.in.	Height Factor psf	Element Wind Load lb.
10	20	3.75000	6.12500	898.651	10.1160	28.0249
20	30	3.75000	6.12500	8820.00	10.1160	275.056
30	40	3.75000	6.12500	898.651	10.1160	28.0249

PV Elite 2008 c1993-2008 by COADE Engineering Software

FileName : Horizontal Tank -----

Earthquake Load Calculation Step: 8 4:19p Oct 23,2008

Earthquake Analysis Results per ASCE 7-2002/IBC 2003/06

User Entered Table Value 9.4.1.2.4a Fa: 1.000
 User Entered Table Value 9.4.1.2.4b Fv: 1.400
 Max. Mapped Acceleration Value for Short Periods Ss: 1.000
 Max. Mapped Acceleration Value for 1 Sec. Period S1: 0.400
 Force Modification Factor R: 3.000
 Importance Factor I: 1.000
 Site Class C

Sms = Fa * Ss = 1.000 * 1.000 = 1.000
 Sm1 = Fv * S1 = 1.400 * 0.400 = 0.560
 Sds = 2/3 * Sms = 2/3 * 1.000 = 0.667
 Sd1 = 2/3 * Sm1 = 2/3 * 0.560 = 0.373

Check the Period (1/Frequency) from 9.5.5.3.2-1 [T]:
 = Ct * hn^x where Ct = 0.020, x = 0.75 and hn = total Vessel Height
 = 0.020 * (5.0000^{0.75}) = 0.067 seconds

The Coefficient Cu from Table 9.5.5.3.1 is : 1.400

Check the Min. Value of T which is the Smaller of Cu*Ta and T [T]:
 = Minimum Value of (1.400 * 0.067 , 1/33.000) = 0.0303 per 9.5.5.3

As the time period is < 0.06 second, use section 9.14.5.2.

Compute the Base Shear per 9.14.5.2, [V]:
 = 0.3 * Sds * W * I
 = 0.3 * 0.667 * 4978 * 1.00 = 995.67 lb.

Note: Loads multiplied by the Scalar multiplier value of 0.7000

Final Base Shear, V = 696.97 lb.

Earthquake Load Calculation

From	To	Earthquake Height	Earthquake Weight	Element Ope Load
		ft.	lb.	lb.
10	20	2.50000	995.672	139.394
20	Sad1	2.50000	995.672	139.394
Sad1	30	2.50000	995.672	139.394
20	30	2.50000	995.672	139.394
30	40	2.50000	995.672	139.394

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Center of Gravity Calculation Step: 9 4:19p Oct 23,2008

Shop/Field Installation Options :

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

Center of Gravity of Saddles	5.3 ft.
Center of Gravity of Nozzles	4.3 ft.

Center of Gravity of Bare Shell New and Cold	5.2 ft.
Center of Gravity of Bare Shell Corroded	5.2 ft.

Vessel CG in the Operating Condition	5.1 ft.
Vessel CG in the Fabricated (Shop/Empty) Condition	5.1 ft.

PV Elite 2008 c1993-2008 by COADE Engineering Software

FileName : Horizontal Tank -----
 Horizontal Vessel Analysis (Ope.) Step: 10 4:19p Oct 23,2008

Zick Analysis: Stresses for the Left Saddle

Horizontal Vessel Stress Calculations : Operating Case

Shell Allowable Stress used in Calculation 20000.00 psi
 Shell Comp. Yield Stress used in Calculation 34800.00 psi
 Head Allowable Stress used in Calculation 20000.00 psi

Saddle Force Q, Operating Case 3384.02 lb.

Stress Results for Zick Stresses:	Actual	Allowable	
Long. Stress at Top of Saddles	4533.24	17000.00	psi
Long. Stress at Bottom of Saddles	4444.26	17000.00	psi
Long. Stress at Top of Midspan	4460.11	17000.00	psi
Long. Stress at Bottom of Midspan	4517.39	17000.00	psi

Tangential Shear in Shell	141.91	16000.00	psi
Circ. Stress at Horn of Saddle	-836.44	-30000.00	psi
Circ. Stress at Tip of Wear Plate	-727.06	-30000.00	psi
Circ. Compressive Stress in Shell	-245.02	-17400.00	psi

Note: The Longitudinal Stress from the Zick Analysis is combined with the Longitudinal Pressure Stress to get the total stress.

Intermediate Results: Saddle Reaction Q due to Wind or Seismic

Saddle Reaction Force due to Wind Ft [Fwt]:
 = Ftr * (Ft/Num of Saddles + Z Force Load) * B / E
 = 3.00 * (331.1 / 2 + 0) * 45.0000 / 53.2606
 = 419.6 lb.

Saddle Reaction Force due to Wind Fl or Friction [Fwl]:
 = Max(Fl, Friction Load, Sum of X Forces) * B / Ls
 = Max(248.39 , 0.00 , 0) * 45.0000 / 93.0000
 = 120.2 lb.

Saddle Reaction Force due to Earthquake Fl or Friction [Fsl]:
 = Max(Fl, Friction Force, Sum of X Forces) * B / Ls
 = Max(696.97 , 0.00 , 0) * 45.0000 / 93.0000
 = 337.2 lb.

Saddle Reaction Force due to Earthquake Ft [Fst]:
 = Ftr * (Ft/Num of Saddles + Z Force Load) * B / E
 = 3.00 * (696 / 2 + 0) * 45.0000 / 53.2606
 = 883.3 lb.

Load Combination Results for Q + Wind or Seismic [Q]:
 = Saddle Load + Max(Fwl, Fwt, Fsl, Fst)
 = 2500 + Max(120 , 419 , 337 , 883)
 = 3384.0 lb.

Summary of Loads on this Saddle Support:

Vertical Load on this Saddle	3384.02	lb.
Transverse Shear Load on this Saddle	348.49	lb.
Longitudinal Shear Load on this Saddle	696.97	lb.

Formulas and Substitutions for Zick Analysis Results:

Longitudinal Bending (+-) at Midspan
 = (3 * Q * L * K.2 / (pi * R² * (Ts - Ca)))
 = (3 * 3384 * 10.33 * 0.3892) /
 (3.141 * 30.1250 * 30.1250 * (0.6250 - 0.1250))
 = 28.64 psi

FileName : Horizontal Tank -----
 Horizontal Vessel Analysis (Ope.) Step: 10 4:19p Oct 23,2008

Compute the area ratio [K]:

$$= \text{Pi} * (\text{Sin}(\text{Delta})/\text{Delta} - \text{Cos}(\text{Delta})) / (\text{Delta} + \text{Sin}(\text{Delta}) * \text{Cos}(\text{Delta}) - (\text{Delta} + \text{Sin}(\text{Delta}) * \text{Cos}(\text{Delta}) - 2 * \text{Sin}(\text{Delta}) * \text{Sin}(\text{Delta})/\text{Delta})$$

$$= \text{Pi} * (\text{Sin}(1.396) / 1.396 - \text{Cos}(1.396)) / (1.396 + \text{Sin}(1.396) * \text{Cos}(1.396) - 2 * \text{Sin}(1.396) * \text{Sin}(1.396) / 1.396)$$

$$= 9.3799$$

Compute the moment fraction [X]:

$$= 1 - (1 - A/L + (R^2 - H^2)/(2 * A * L)) / (1 + (4 * H)/(3 * L))$$

$$= 1 - (1 - 1.417 / 10.333 + (30.125^2 - 1.250^2)/(2 * 1.417 * 10.333)) / (1 + (4 * 1.250)/(3 * 10.333))$$

$$= 0.1175$$

Intermediate Product [K.1]:

$$= K * X * 4 * A / L$$

$$= 9.380 * 0.118 * 4 * 1.417 / 10.333 = 0.6046$$

Longitudinal Bending (+-) at Saddle

$$= (3 * Q * L * K.1 / (\text{pi} * R^2 * (Ts - Ca)))$$

$$= (3 * 3384 * 10.33 * 0.6046) / (3.141 * 30.1250 * 30.1250 * (0.6250 - 0.1250))$$

$$= 44.49 \text{ psi}$$

Tangential Shear in Shell near Saddle

$$= Q * K.4 * ((L - H - 2A)/(L + H)) / (R * (Ts - Ca))$$

$$= 3384 * 1.1707 * ((10.33 - 1.25 - 2 * 1.42) / (10.33 + 1.25)) / (30.1250 * (0.6250 - 0.1250))$$

$$= 141.91 \text{ psi}$$

Circumferential Stress at Tip of the Wear Plate

$$= -Q / (4 * (TS - CA) * (\text{SADWTH} + 1.56 * \text{Sqrt}(R * (TS - CA)))) - 12 * Q * R * K13 / (L * (TS - CA)^2)$$

$$= -3384 / (4 * 0.5000 * (8.00 + 1.56 * \text{Sqrt}(30.1250 * 0.5000))) - 12.0 * 3384 * 2.51 * 0.0154 / (10.3333 * 0.5000^2)$$

$$= -727.06 \text{ psi}$$

Note: Wear Plate thk. could Not be considered in this formula because:

Saddle-Tangent Distance A (1.42) is > R/2 (1.26 ft.)

Circumferential Stress at Hom of Saddle

$$= -Q / (4 * \text{TEM} * (\text{SADWTH} + 1.56 * \text{sqrt}(R * \text{TCA}))) - 12 * Q * R * K.7 / (L * \text{TEB})$$

$$= -3384 / (4 * 0.5000 * (8.00 + 1.56 * \text{sqrt}(30.1250 * 0.5000))) - 12.0 * 3384 * 2.51 * 0.0181 / (10.3333 * 0.2500)$$

$$= -836.44 \text{ psi}$$

Circumferential Compression at Bottom of Shell

$$= (Q * (K.9 / (\text{TEM9} * \text{WPDWTH})))$$

$$= (3384 * (0.7603 / (0.8750 * 12.000)))$$

$$= -245.02 \text{ psi}$$

Free Un-Restrained Thermal Expansion between the Saddles [Exp]:

$$= \text{Alpha} * Ls * (\text{Design Temperature} - \text{Ambient Temperature})$$

$$= 0.589\text{E-}05 * 93.000 * (200.0 - 70.0)$$

$$= 0.071 \text{ in.}$$

Input Data for Base Plate Bolting Calculations:

Total Number of Bolts per BasePlate	Nbolts	8	
Total Number of Bolts in Tension/Baseplate	Nbt	4	
Bolt Material Specification		SA-193 B7	
Bolt Allowable Stress	Stba	25000.00	psi
Bolt Corrosion Allowance	Bca	0.0000	in.
Distance from Bolts to Edge	Edgedis	2.0000	in.
Nominal Bolt Diameter	Bnd	1.3750	in.
Thread Series	Series	TEMA	

FileName : Horizontal Tank -----

Horizontal Vessel Analysis (Ope.) Step: 10 4:19p Oct 23,2008

BasePlate Allowable Stress	S	13800.00	psi
Area Available in a Single Bolt	BltArea	1.1550	sq.in.
Saddle Load QO (Weight)	QO	2500.7	lb.
Saddle Load QL (Wind/Seismic contribution)	QL	337.2	lb.
Maximum Transverse Force	Ft	348.5	lb.
Maximum Longitudinal Force	Fl	697.0	lb.

Bolt Area Calculation per Dennis R. Moss

Bolt Area Requirement Due to Longitudinal Load [Bltarearl]:
 = 0.0 (QO > QL --> No Uplift in Longitudinal direction)

Bolt Area due to Shear Load [Bltarears]:
 = Fl / (Stba * Nbolts)
 = 696.97 / (25000.00 * 8.00)
 = 0.0035 sq.in.

Bolt Area due to Transverse Load

Moment on Baseplate Due to Transverse Load [Rmom]:
 = B * Ft + Sum of X Moments
 = 3.75 * 348.49 + 0.00
 = 1306.82 ft.lb.

Eccentricity (e):
 = Rmom / QO
 = 15681.83 / 2500.72
 = 6.27 in. < Bplen/6 --> No Uplift in Transverse direction

Bolt Area due to Transverse Load [Bltareart]:
 = 0 (No Uplift)

Required of a Single Bolt [Bltarear]:
 = max[Bltarearl, Bltarears, Bltareart]
 = max[0.0000 , 0.0035 , 0.0000]
 = 0.0035 sq.in.

Zick Analysis: Stresses for the Right Saddle

Shell Allowable Stress used in Calculation	20000.00	psi
Shell Comp. Yield Stress used in Calculation	34800.00	psi
Head Allowable Stress used in Calculation	20000.00	psi

Saddle Force Q, Operating Case 3184.92 lb.

Stress Results for Zick Stresses:	Actual	Allowable
Long. Stress at Top of Saddles	4530.63	17000.00 psi
Long. Stress at Bottom of Saddles	4446.87	17000.00 psi
Long. Stress at Top of Midspan	4461.80	17000.00 psi
Long. Stress at Bottom of Midspan	4515.70	17000.00 psi

Tangential Shear in Shell	133.56	16000.00 psi
Circ. Stress at Horn of Saddle	-787.22	-30000.00 psi
Circ. Stress at Tip of Wear Plate	-684.28	-30000.00 psi
Circ. Compressive Stress in Shell	-230.61	-17400.00 psi

Note: The Longitudinal Stress from the Zick Analysis is combined with the Longitudinal Pressure Stress to get the total stress.

Intermediate Results: Saddle Reaction Q due to Wind or Seismic

Saddle Reaction Force due to Wind Ft [Fwt]:
 = Ftr * (Ft/Num of Saddles + Z Force Load) * B / E

FileName : Horizontal Tank -----

Horizontal Vessel Analysis (Ope.) Step: 10 4:19p Oct 23,2008

$$= 3.00 * (331.1 / 2 + 0) * 45.0000 / 53.2606$$

$$= 419.6 \text{ lb.}$$

Saddle Reaction Force due to Wind Fl or Friction [Fw]:

$$= \text{Max}(\text{Fl, Friction Load, Sum of X Forces}) * B / Ls$$

$$= \text{Max}(248.39 , 0.00 , 0) * 45.0000 / 93.0000$$

$$= 120.2 \text{ lb.}$$

Saddle Reaction Force due to Earthquake Fl or Friction [Fsl]:

$$= \text{Max}(\text{Fl, Friction Force, Sum of X Forces}) * B / Ls$$

$$= \text{Max}(696.97 , 0.00 , 0) * 45.0000 / 93.0000$$

$$= 337.2 \text{ lb.}$$

Saddle Reaction Force due to Earthquake Ft [Fst]:

$$= \text{Ftr} * (\text{Ft/Num of Saddles} + \text{Z Force Load}) * B / E$$

$$= 3.00 * (696 / 2 + 0) * 45.0000 / 53.2606$$

$$= 883.3 \text{ lb.}$$

Load Combination Results for Q + Wind or Seismic [Q]:

$$= \text{Saddle Load} + \text{Max}(\text{Fwl, Fwt, Fsl, Fst})$$

$$= 2301 + \text{Max}(120 , 419 , 337 , 883)$$

$$= 3184.9 \text{ lb.}$$

Summary of Loads on this Saddle Support:

Vertical Load on this Saddle	3184.92 lb.
Transverse Shear Load on this Saddle	348.49 lb.
Longitudinal Shear Load on this Saddle	696.97 lb.

Formulas and Substitutions for Zick Analysis Results:

Longitudinal Bending (+-) at Midspan

$$= (3 * Q * L * K.2 / (\text{pi} * R^2 * (\text{Ts} - \text{Ca})))$$

$$= (3 * 3184 * 10.33 * 0.3892) /$$

$$(3.141 * 30.1250 * 30.1250 * (0.6250 - 0.1250)))$$

$$= 26.95 \text{ psi}$$

Compute the area ratio [K]:

$$= \text{Pi} * (\text{Sin}(\text{Delta}) / \text{Delta} - \text{Cos}(\text{Delta})) / (\text{Delta} + \text{Sin}(\text{Delta}) * \text{Cos}(\text{Delta}) -$$

$$(\text{Delta} + \text{Sin}(\text{Delta}) * \text{Cos}(\text{Delta}) - 2 * \text{Sin}(\text{Delta}) * \text{Sin}(\text{Delta}) / \text{Delta})$$

$$= \text{Pi} * (\text{Sin}(1.396) / 1.396 - \text{Cos}(1.396)) / (1.396 + \text{Sin}(1.396) *$$

$$\text{Cos}(1.396) - 2 * \text{Sin}(1.396) * \text{Sin}(1.396) / 1.396)$$

$$= 9.3799$$

Compute the moment fraction [X]:

$$= 1 - (1 - A/L + (R^2 - H^2) / (2 * A * L)) / (1 + (4 * H) / (3 * L))$$

$$= 1 - (1 - 1.417 / 10.333 + (30.125^2 - 1.250^2) / (2 * 1.417 * 10.333)) /$$

$$(1 + (4 * 1.250) / (3 * 10.333))$$

$$= 0.1175$$

Intermediate Product [K.1]:

$$= K * X * 4 * A / L$$

$$= 9.380 * 0.118 * 4 * 1.417 / 10.333 = 0.6046$$

Longitudinal Bending (+-) at Saddle

$$= (3 * Q * L * K.1 / (\text{pi} * R^2 * (\text{Ts} - \text{Ca})))$$

$$= (3 * 3184 * 10.33 * 0.6046) /$$

$$(3.141 * 30.1250 * 30.1250 * (0.6250 - 0.1250)))$$

$$= 41.88 \text{ psi}$$

Tangential Shear in Shell near Saddle

$$= Q * K.4 * ((L - H - 2A) / (L + H)) / (R * (\text{Ts} - \text{Ca}))$$

$$= 3184 * 1.1707 * ((10.33 - 1.25 - 2 * 1.42) /$$

$$(10.33 + 1.25)) / (30.1250 * (0.6250 - 0.1250))$$

$$= 133.56 \text{ psi}$$

FileName : Horizontal Tank -----

Horizontal Vessel Analysis (Ope.) Step: 10 4:19p Oct 23,2008

Circumferential Stress at Tip of the Wear Plate

$$\begin{aligned} &= -Q / (4 * (TS - CA) * (SADWTH + 1.56 * \text{Sqrt}(R * (TS - CA)))) - 12 * Q * R * K13 / (L * (TS - CA)^2) \\ &= -3184 / (4 * 0.5000 * (8.00 + 1.56 * \text{Sqrt}(30.1250 * 0.5000))) \\ &\quad - 12.0 * 3184 * 2.51 * 0.0154 / (10.3333 * 0.5000^2) \\ &= -684.28 \text{ psi} \end{aligned}$$

Note: Wear Plate thk. could Not be considered in this formula because:

Saddle-Tangent Distance A (1.42) is > R/2 (1.26 ft.)

Circumferential Stress at Horn of Saddle

$$\begin{aligned} &= -Q / (4 * TEM * (SADWTH + 1.56 * \text{sqrt}(R * TCA))) - 12 * Q * R * K.7 / (L * TEB) \\ &= -3184 / (4 * 0.5000 * (8.00 + 1.56 * \text{sqrt}(30.1250 * 0.5000))) \\ &\quad - 12.0 * 3184 * 2.51 * 0.0181 / (10.3333 * 0.2500) \\ &= -787.22 \text{ psi} \end{aligned}$$

Circumferential Compression at Bottom of Shell

$$\begin{aligned} &= (Q * (K.9 / (TEM9 * WPDWTH))) \\ &= (3184 * (0.7603 / (0.8750 * 12.000))) \\ &= -230.61 \text{ psi} \end{aligned}$$

PV Elite 2008 c1993-2008 by COADE Engineering Software

FileName : Horizontal Tank -----
 Horizontal Vessel Analysis (Test) Step: 11 4:19p Oct 23,2008

Zick Analysis: Stresses for the Left Saddle

Horizontal Vessel Stress Calculations : Test Case

Shell Allowable Stress used in Calculation	20000.00	psi
Shell Comp. Yield Stress used in Calculation	38000.00	psi
Head Allowable Stress used in Calculation	20000.00	psi
Saddle Force Q, Test Case, no Ext. Forces	10816.61	lb.
Stress Results for Zick Stresses:	Actual	Allowable
Long. Stress at Top of Saddles	116.22	17000.00 psi
Long. Stress at Bottom of Saddles	-116.22	15113.64 psi
Long. Stress at Top of Midspan	-73.69	-15113.64 psi
Long. Stress at Bottom of Midspan	73.69	17000.00 psi
Tangential Shear in Shell	364.40	16000.00 psi
Circ. Stress at Horn of Saddle	-1767.08	-30000.00 psi
Circ. Stress at Tip of Wear Plate	-1496.97	-30000.00 psi
Circ. Compressive Stress in Shell	-685.28	-19000.00 psi
Hydrostatic Test Pressure at top of Vessel	0.000	psig

Note: The Longitudinal Stress from the Zick Analysis is combined with the Longitudinal Pressure Stress to get the total stress.

Intermediate Results: Saddle Reaction Q due to Wind or Seismic

Saddle Reaction Force due to Wind Ft [Fwt]:
 = Ftr * (Ft/Num of Saddles + Z Force Load) * B / E
 = 3.00 * (109.3 / 2 + 0) * 45.0000 / 53.0441
 = 139.0 lb.

Saddle Reaction Force due to Wind Fl or Friction [Fw]:
 = Max(Fl, Friction Load, Sum of X Forces) * B / Ls
 = Max(81.97 , 0.00 , 0) * 45.0000 / 93.0000
 = 39.7 lb.

Load Combination Results for Q + Wind or Seismic [Q]:
 = Saddle Load + Max(Fwl, Fwt, Fsl, Fst)
 = 10677 + Max(39 , 139 , 0 , 0)
 = 10816.6 lb.

Summary of Loads on this Saddle Support:

Vertical Load on this Saddle	10816.61	lb.
Transverse Shear Load on this Saddle	54.63	lb.
Longitudinal Shear Load on this Saddle	81.97	lb.

Formulas and Substitutions for Zick Analysis Results:

Longitudinal Bending (+-) at Midspan
 = (3 * Q * L * K.2 / (pi * R² * (Ts - Ca)))
 = (3 * 10816 * 10.33 * 0.3883) /
 (3.141 * 30.0000 * 30.0000 * (0.6250 - 0.0000))
 = 73.69 psi

Compute the area ratio [K]:
 = Pi * (Sin(Delta)/Delta - Cos(Delta)) / (Delta + Sin(Delta) * Cos(Delta) -
 (Delta + Sin(Delta) * Cos(Delta) - 2 * Sin(Delta) * Sin(Delta)/Delta)
 = Pi * (Sin(1.396) / 1.396 - Cos(1.396)) / (1.396 + Sin(1.396) *
 Cos(1.396) - 2 * Sin(1.396) * Sin(1.396) / 1.396)
 = 9.3799

Compute the moment fraction [X]:

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Horizontal Vessel Analysis (Test) Step: 11 4:19p Oct 23,2008

$$= 1 - (1 - A/L + (R^2 - H^2)/(2 * A * L)) / (1 + (4 * H)/(3 * L))$$

$$= 1 - (1 - 1.417/10.333 + (30.000^2 - 1.250^2)/(2 * 1.417 * 10.333)) / (1 + (4 * 1.250)/(3 * 10.333))$$

$$= 0.1191$$

Intermediate Product [K.1]:

$$= K * X^4 * A / L$$

$$= 9.380 * 0.119^4 * 1.417 / 10.333 = 0.6125$$

Longitudinal Bending (+-) at Saddle

$$= (3 * Q * L * K.1 / (pi * R^2 * (Ts - Ca)))$$

$$= (3 * 10816 * 10.33 * 0.6125) / (3.141 * 30.0000 * 30.0000 * (0.6250 - 0.0000))$$

$$= 116.22 \text{ psi}$$

Tangential Shear in Shell near Saddle

$$= Q * K.4 * ((L - H - 2A)/(L + H)) / (R * (Ts - Ca))$$

$$= 10816 * 1.1707 * ((10.33 - 1.25 - 2 * 1.42) / (10.33 + 1.25)) / (30.0000 * (0.6250 - 0.0000))$$

$$= 364.40 \text{ psi}$$

Circumferential Stress at Tip of the Wear Plate

$$= -Q / (4 * (TS - CA) * (SADWTH + 1.56 * \text{sqrt}(R * (TS - CA)))) - 12 * Q * R * K13 / (L * (TS - CA)^2)$$

$$= -10816 / (4 * 0.6250 * (8.00 + 1.56 * \text{sqrt}(30.0000 * 0.6250))) - 12.0 * 10816 * 2.50 * 0.0150 / (10.3333 * 0.6250^2)$$

$$= -1496.97 \text{ psi}$$

Note: Wear Plate thk. could Not be considered in this formula because:

Saddle-Tangent Distance A (1.42) is > R/2 (1.25 ft.)

Circumferential Stress at Horn of Saddle

$$= -Q / (4 * TEM * (SADWTH + 1.56 * \text{sqrt}(R * TCA))) - 12 * Q * R * K.7 / (L * TEB)$$

$$= -10816 / (4 * 0.6250 * (8.00 + 1.56 * \text{sqrt}(30.0000 * 0.6250))) - 12.0 * 10816 * 2.50 * 0.0183 / (10.3333 * 0.3906)$$

$$= -1767.08 \text{ psi}$$

Circumferential Compression at Bottom of Shell

$$= (Q * (K.9 / (TEM9 * WPDWTH)))$$

$$= (10816 * (0.7603 / (1.0000 * 12.000)))$$

$$= -685.28 \text{ psi}$$

Input Data for Base Plate Bolting Calculations:

Total Number of Bolts per BasePlate	Nbolts	8
Total Number of Bolts in Tension/Baseplate	Nbt	4
Bolt Material Specification		SA-193 B7
Bolt Allowable Stress	Stba	25000.00 psi
Bolt Corrosion Allowance	Bca	0.0000 in.
Distance from Bolts to Edge	Edgedis	2.0000 in.
Nominal Bolt Diameter	Bnd	1.3750 in.
Thread Series	Series	TEMA
BasePlate Allowable Stress	S	13800.00 psi
Area Available in a Single Bolt	BltArea	1.1550 sq.in.
Saddle Load QO (Weight)	QO	10677.6 lb.
Saddle Load QL (Wind/Seismic contribution)	QL	39.7 lb.
Maximum Transverse Force	Ft	54.6 lb.
Maximum Longitudinal Force	Fl	82.0 lb.

Bolt Area Calculation per Dennis R. Moss

Bolt Area Requirement Due to Longitudinal Load [Bltarear]:

$$= 0.0 \text{ (} QO > QL \text{ --> No Uplift in Longitudinal direction)}$$

Bolt Area due to Shear Load [Bltarears]:

FileName : Horizontal Tank -----

Horizontal Vessel Analysis (Test) Step: 11 4:19p Oct 23,2008

$$\begin{aligned}
 &= F1 / (Stba * Nbolts) \\
 &= 81.97 / (25000.00 * 8.00) \\
 &= 0.0004 \text{ sq.in.}
 \end{aligned}$$

Bolt Area due to Transverse Load

Moment on Baseplate Due to Transverse Load [Rmom]:

$$\begin{aligned}
 &= B * Ft + \text{Sum of X Moments} \\
 &= 3.75 * 54.63 + 0.00 \\
 &= 204.87 \text{ ft.lb.}
 \end{aligned}$$

Eccentricity (e):

$$\begin{aligned}
 &= Rmom / QO \\
 &= 2458.46 / 10677.57 \\
 &= 0.23 \text{ in.} < Bplen/6 \text{ --> No Uplift in Transverse direction}
 \end{aligned}$$

Bolt Area due to Transverse Load [Bltareart]:

$$= 0 \text{ (No Uplift)}$$

Required of a Single Bolt [Bltarear]:

$$\begin{aligned}
 &= \max[\text{Bltarearl}, \text{Bltarears}, \text{Bltareart}] \\
 &= \max[0.0000, 0.0004, 0.0000] \\
 &= 0.0004 \text{ sq.in.}
 \end{aligned}$$

Zick Analysis: Stresses for the Right Saddle

Shell Allowable Stress used in Calculation	20000.00	psi
Shell Comp. Yield Stress used in Calculation	38000.00	psi
Head Allowable Stress used in Calculation	20000.00	psi
Saddle Force Q, Test Case, no Ext. Forces	10106.45	lb.
Stress Results for Zick Stresses:	Actual	Allowable
Long. Stress at Top of Saddles	108.59	17000.00 psi
Long. Stress at Bottom of Saddles	-108.59	15113.64 psi
Long. Stress at Top of Midspan	-68.85	-15113.64 psi
Long. Stress at Bottom of Midspan	68.85	17000.00 psi
Tangential Shear in Shell	340.48	16000.00 psi
Circ. Stress at Horn of Saddle	-1651.07	-30000.00 psi
Circ. Stress at Tip of Wear Plate	-1398.68	-30000.00 psi
Circ. Compressive Stress in Shell	-640.29	-19000.00 psi
Hydrostatic Test Pressure at top of Vessel	0.000	psig

Note: The Longitudinal Stress from the Zick Analysis is combined with the Longitudinal Pressure Stress to get the total stress.

Intermediate Results: Saddle Reaction Q due to Wind or Seismic

Saddle Reaction Force due to Wind Ft [Fwt]:

$$\begin{aligned}
 &= Ftr * (Ft/Num of Saddles + Z Force Load) * B / E \\
 &= 3.00 * (109.3 / 2 + 0) * 45.0000 / 53.0441 \\
 &= 139.0 \text{ lb.}
 \end{aligned}$$

Saddle Reaction Force due to Wind Fl or Friction [Fwl]:

$$\begin{aligned}
 &= \text{Max}(F1, \text{Friction Load}, \text{Sum of X Forces}) * B / Ls \\
 &= \text{Max}(81.97, 0.00, 0) * 45.0000 / 93.0000 \\
 &= 39.7 \text{ lb.}
 \end{aligned}$$

Load Combination Results for Q + Wind or Seismic [Q]:

$$\begin{aligned}
 &= \text{Saddle Load} + \text{Max}(Fwl, Fwt, Fsl, Fst) \\
 &= 9967 + \text{Max}(39, 139, 0, 0)
 \end{aligned}$$

FileName : Horizontal Tank -----
 Horizontal Vessel Analysis (Test) Step: 11 4:19p Oct 23,2008

= 10106.5 lb.

Summary of Loads on this Saddle Support:

Vertical Load on this Saddle 10106.45 lb.
 Transverse Shear Load on this Saddle 54.63 lb.
 Longitudinal Shear Load on this Saddle 81.97 lb.

Formulas and Substitutions for Zick Analysis Results:

Longitudinal Bending (+-) at Midspan

$$= (3 * Q * L * K.2 / (pi * R^2 * (Ts - Ca)))$$

$$= (3 * 10106 * 10.33 * 0.3883) /$$

$$(3.141 * 30.0000 * 30.0000 * (0.6250 - 0.0000)))$$

$$= 68.85 \text{ psi}$$

Compute the area ratio [K]:

$$= Pi * (Sin(Delta)/Delta - Cos(Delta)) / (Delta + Sin(Delta) * Cos(Delta) -$$

$$(Delta + Sin(Delta) * Cos(Delta) - 2 * Sin(Delta) * Sin(Delta)/Delta)$$

$$= Pi * (Sin(1.396) / 1.396 - Cos(1.396)) / (1.396 + Sin(1.396) *$$

$$Cos(1.396) - 2 * Sin(1.396) * Sin(1.396) / 1.396)$$

$$= 9.3799$$

Compute the moment fraction [X]:

$$= 1 - (1 - A/L + (R^2 - H^2) / (2 * A * L)) / (1 + (4 * H) / (3 * L))$$

$$= 1 - (1 - 1.417 / 10.333 + (30.000^2 - 1.250^2) / (2 * 1.417 * 10.333))$$

$$(1 + (4 * 1.250) / (3 * 10.333))$$

$$= 0.1191$$

Intermediate Product [K.1]:

$$= K * X * 4 * A / L$$

$$= 9.380 * 0.119 * 4 * 1.417 / 10.333 = 0.6125$$

Longitudinal Bending (+-) at Saddle

$$= (3 * Q * L * K.1 / (pi * R^2 * (Ts - Ca)))$$

$$= (3 * 10106 * 10.33 * 0.6125) /$$

$$(3.141 * 30.0000 * 30.0000 * (0.6250 - 0.0000)))$$

$$= 108.59 \text{ psi}$$

Tangential Shear in Shell near Saddle

$$= Q * K.4 * ((L-H-2A) / (L+H)) / (R * (Ts-Ca))$$

$$= 10106 * 1.1707 * ((10.33 - 1.25 - 2 * 1.42) /$$

$$(10.33 + 1.25)) / (30.0000 * (0.6250 - 0.0000))$$

$$= 340.48 \text{ psi}$$

Circumferential Stress at Tip of the Wear Plate

$$= -Q / (4 * (TS-CA) * (SADWTH + 1.56 * Sqrt(R * (TS-CA)))) - 12 * Q * R * K13 / (L * (TS-CA)^2)$$

$$= -10106 / (4 * 0.6250 * (8.00 + 1.56 * Sqrt(30.0000 * 0.6250)))$$

$$- 12.0 * 10106 * 2.50 * 0.0150 / (10.3333 * 0.6250^2)$$

$$= -1398.68 \text{ psi}$$

Note: Wear Plate thk. could Not be considered in this formula because:

Saddle-Tangent Distance A (1.42) is > R/2 (1.25 ft.)

Circumferential Stress at Hom of Saddle

$$= -Q / (4 * TEM * (SADWTH + 1.56 * Sqrt(R * TCA))) - 12 * Q * R * K.7 / (L * TEB)$$

$$= -10106 / (4 * 0.6250 * (8.00 + 1.56 * Sqrt(30.0000 * 0.6250)))$$

$$- 12.0 * 10106 * 2.50 * 0.0183 / (10.3333 * 0.3906)$$

$$= -1651.07 \text{ psi}$$

Circumferential Compression at Bottom of Shell

$$= (Q * (K.9 / (TEM9 * WPDWTH)))$$

$$= (10106 * (0.7603 / (1.0000 * 12.000)))$$

$$= -640.29 \text{ psi}$$

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Horizontal Vessel Analysis (Test) Step: 11 4:19p Oct 23,2008

PV Elite 2008 c1993-2008 by COADE Engineering Software

FileName : Horizontal Tank -----

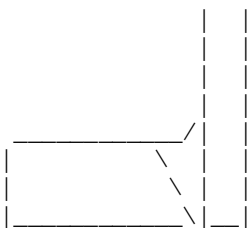
Nozzle Calcs. Inspection Nozl: 1 4:19p Oct 23,2008

INPUT VALUES, Nozzle Description: Inspection From : 10

Pressure for Nozzle Reinforcement Calculations P		100.000	psig
Temperature for Internal Pressure	Temp	200	F
Design External Pressure	Pext	15.00	psig
Temperature for External Pressure	Tempex	200	F
Shell Material		SA-516 70	
Shell Allowable Stress at Temperature	S	20000.00	psi
Shell Allowable Stress At Ambient	Sa	20000.00	psi
Inside Diameter of Elliptical Head	D	60.0000	in.
Aspect Ratio of Elliptical Head	Ar	2.00	
Head Actual Thickness	T	0.6250	in.
Head Internal Corrosion Allowance	Cas	0.1250	in.
Head External Corrosion Allowance	Caext	0.0000	in.
Distance from Head Centerline	L1	0.0000	in.
User Entered Minimum Design Metal Temperature		-20.00	F
Nozzle Material		SA-106 B	
Nozzle Allowable Stress at Temperature	Sn	17100.00	psi
Nozzle Allowable Stress At Ambient	Sna	17100.00	psi
Nozzle Diameter Basis (for tr calc only)	Inbase	ID	
Layout Angle		0.00	deg
Nozzle Diameter	Dia	6.0000	in.
Nozzle Size and Thickness Basis	Idbn	Nominal	
Nominal Thickness of Nozzle	Thknom	80	
Nozzle Flange Material		SA-105	
Nozzle Flange Type	Weld Neck	Flange	
Nozzle Corrosion Allowance	Can	0.1250	in.
Joint Efficiency of Shell Seam at Nozzle	Es	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Nozzle Outside Projection	Ho	2.0000	in.
Weld leg size between Nozzle and Pad/Shell	Wo	0.3750	in.
Groove weld depth between Nozzle and Vessel	Wgnv	0.6250	in.
Nozzle Inside Projection	H	0.0000	in.
Weld leg size, Inside Nozzle to Shell	Wi	0.0000	in.
ASME Code Weld Type per UW-16		None	
Class of attached Flange		150	
Grade of attached Flange		GR 1.1	

The Pressure Design option was Design Pressure + static head

Nozzle Sketch



Insert Nozzle No Pad, no Inside projection

FileName : Horizontal Tank -----
 Nozzle Calcs. Inspection Nozl: 1 4:19p Oct 23,2008

NOZZLE CALCULATION, Description: Inspection

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

Actual Nozzle Inside Diameter Used in Calculation 5.761 in.
 Actual Nozzle Thickness Used in Calculation 0.432 in.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a) of Elliptical Head, Tr [Int. Press]
 = $(P \cdot K1 \cdot D) / (2 \cdot S \cdot E - 0.2 \cdot P)$ per UG-37(a)(3)
 = $(100.00 \cdot 0.90 \cdot 60.2500) / (2 \cdot 20000.00 \cdot 1.00 - 0.2 \cdot 100.00)$
 = 0.1356 in.

Reqd thk per UG-37(a) of Nozzle Wall, Trn [Int. Press]
 = $(P \cdot R) / (S \cdot E - 0.6 \cdot P)$ per UG-27 (c)(1)
 = $(100.00 \cdot 3.01) / (17100 \cdot 1.00 - 0.6 \cdot 100.00)$
 = 0.0176 in.

Required Nozzle thickness under External Pressure per UG-28 : 0.0129 in.

UG-40, Thickness and Diameter Limit Results : [Int. Press]

Effective material diameter limit, Dl 12.0220 in.
 Effective material thickness limit, no pad Tlnp 0.7675 in.

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5	Design	External	Mapnc
Area Required Ar	0.827	0.484	NA sq.in.
Area in Shell A1	2.158	2.022	NA sq.in.
Area in Nozzle Wall A2	0.380	0.386	NA sq.in.
Area in Inward Nozzle A3	0.000	0.000	NA sq.in.
Area in Welds A4	0.120	0.120	NA sq.in.
Area in Pad A5	0.000	0.000	NA sq.in.
TOTAL AREA AVAILABLE Atot	2.658	2.528	NA sq.in.

The Internal Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Reinforcement Area Required for Nozzle [Ar]:
 = $(Dlr \cdot Tr + 2 \cdot Thk \cdot Tr \cdot (1 - fr1))$ UG-37(c)
 = $(6.0110 \cdot 0.1356 + 2 \cdot (0.4320 - 0.1250) \cdot 0.1356 \cdot (1 - 0.8550))$
 = 0.827 sq.in.

Areas per UG-37.1 but with DL = Diameter Limit, DLR = Corroded ID:

Area Available in Shell [A1]:
 = $(DL - Dlr) \cdot (ES \cdot (T - Cas) - Tr) - 2 \cdot (Thk - Can) \cdot (ES \cdot (T - Cas) - Tr) \cdot (1 - fr1)$
 = $(12.022 - 6.011) \cdot (1.00 \cdot (0.6250 - 0.125) - 0.136) - 2 \cdot (0.432 - 0.125)$
 $\cdot (1.00 \cdot (0.6250 - 0.1250) - 0.1356) \cdot (1 - 0.8550)$
 = 2.158 sq.in.

Area Available in Nozzle Wall, no Pad [A2np]:
 = $(2 \cdot \min(Tlnp, ho)) \cdot (Thk - Can - Trn) \cdot fr2$
 = $(2 \cdot \min(0.768, 2.000)) \cdot (0.4320 - 0.1250 - 0.0176) \cdot 0.8550$
 = 0.380 sq.in.

Area Available in Welds, no Pad [A4np]:
 = $Wo^2 \cdot fr2 + (Wi - Can / 0.707)^2 \cdot fr2$
 = $0.3750^2 \cdot 0.8550 + (0.0000)^2 \cdot 0.8550$
 = 0.120 sq.in.

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Nozzle Calcs. Inspection Nozl: 1 4:19p Oct 23,2008

Wall Thickness per UG45(a), tra = 0.1426 in.
 Wall Thickness per UG16(b), tr16b = 0.2188 in.
 Wall Thickness per UG45(b)(1), trb1 = 0.2757 in.
 Wall Thickness per UG45(b)(2), trb2 = 0.1476 in.
 Wall Thickness per UG45(b)(3), trb3 = Max(trb1, trb2, tr16b) = 0.2757 in.
 Std. Wall Pipe per UG45(b)(4), trb4 = 0.3700 in.
 Wall Thickness per UG45(b), trb = Min(trb3, trb4) = 0.2757 in.

Final Required Thickness, tr45 = Max(tra, trb) = 0.2757 in.
 Available Nozzle Neck Thickness = .875 * 0.4320 = 0.3780 in. --> OK

M.A.W.P. Results for this Nozzle (Based on Areas and UG-45) at this Location

Approximate M.A.W.P. for given geometry 210.688 psig
 Nozzle is O.K. for the External Pressure 15.000 psig

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

Minimum Design Metal Temperature (Nozzle Neck), Curve: B

Minimum Temp. w/o impact per UCS-66 -20 F
 Minimum Temp. at required thickness -155 F

Nozzle MDMT Thickness Calc. per UCS-66 (a)1(b), MIN(tn,t,te), Curve: B

Minimum Temp. w/o impact per UCS-66 -20 F
 Minimum Temp. at required thickness -155 F
 Minimum Temp. w/o impact per UG-20(f) -20 F

ANSI Flange MDMT including temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -20 F
 Flange MDMT with Temperature reduction per UCS-66(b)(1)(b) -55 F

Where the Temperature Reduction per UCS-66(b)(1)(b) is:

Stress ratio, P / Ambient Rating = 100.00 / 285.00 = 0.351

Weld Size Calculations, Description: Inspection

Intermediate Calc. for nozzle/shell Welds Tmin 0.3070 in.

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	0.2149 = 0.7 * TMIN	0.2651 = 0.7 * Wo in.

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

Weld Load [W]:

$$= (Ar - A1 + 2 * (Thk - can) * Ffr1 * (E1(T - Cas) - Tr)) * S$$

$$= (0.8273 - 2.1578 + 2 * (0.4320 - 0.1250) * 0.8550 * (1.00 * (0.6250 - 0.1250) - 0.1356)) * 20000$$

$$= 0.00 \text{ lb.}$$

Weld Load [W1]:

$$= (A2 + A5 + A4 - (Wi - Can / .707)^2 * Ffr2) * S$$

$$= (0.3798 + 0.0000 + 0.1202 - 0.0000 * 0.86) * 20000$$

$$= 10000.01 \text{ lb.}$$

Weld Load [W2]:

$$= ((A2 + A6) + A3 + A4 + (2 * (Thk - Can) * (T - Ca) * Fr1)) * S$$

$$= (0.3798 + 0.0000 + 0.1202 + 0.2625) * 20000$$

$$= 15249.71 \text{ lb.}$$

Weld Load [W3]:

$$= ((A2 + A6) + A3 + A4 + A5 + (2 * (Thk - Can) * (T - Ca) * Fr1)) * S$$

$$= (0.3798 + 0.0000 + 0.1202 + 0.0000 + 0.2625) * 20000$$

$$= 15249.71 \text{ lb.}$$

Strength of Connection Elements for Failure Path Analysis

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Nozzle Calcs. Inspection Nozl: 1 4:19p Oct 23,2008

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wo * 0.49 * Snw \\
 &= (3.1416 / 2.0) * 6.6250 * 0.3750 * 0.49 * 17100 \\
 &= 32699. \text{ lb.}
 \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned}
 &= (\pi * (Dlr + Dlo) / 4) * (Thk - Can) * 0.7 * Sn \\
 &= (3.1416 * 3.1590) * (0.4320 - 0.1250) * 0.7 * 17100 \\
 &= 36470. \text{ lb.}
 \end{aligned}$$

Tension, Nozzle Groove Weld [Tngw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * (Wgnvi-Cas) * 0.74 * Sng \\
 &= (3.1416 / 2.0) * 6.6250 * (0.6250 - 0.1250) * 0.74 * 17100 \\
 &= 65842. \text{ lb.}
 \end{aligned}$$

Strength of Failure Paths:

$$\begin{aligned}
 \text{PATH11} &= (\text{SONW} + \text{SNW}) = (32698 + 36469) = 69168 \text{ lb.} \\
 \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\
 &= (32698 + 0 + 65842 + 0) = 98540 \text{ lb.} \\
 \text{PATH33} &= (\text{Sonw} + \text{Tngw} + \text{Sinw}) \\
 &= (32698 + 65842 + 0) = 98540 \text{ lb.}
 \end{aligned}$$

Summary of Failure Path Calculations:

Path 1-1 = 69168 lb., must exceed W = 0 lb. or W1 = 10000 lb.
 Path 2-2 = 98540 lb., must exceed W = 0 lb. or W2 = 15249 lb.
 Path 3-3 = 98540 lb., must exceed W = 0 lb. or W3 = 15249 lb.

The Drop for this Nozzle is : 0.1008 in.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 2.7258 in.

PV Elite 2008 c1993-2008 by COADE Engineering Software

FileName : Horizontal Tank -----

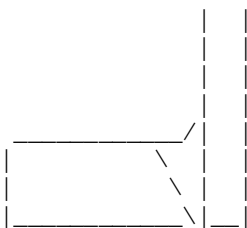
Nozzle Calcs. Outlet Nozl: 2 4:19p Oct 23,2008

INPUT VALUES, Nozzle Description: Outlet From : 10

Pressure for Nozzle Reinforcement Calculations	P	100.000	psig
Temperature for Internal Pressure	Temp	200	F
Design External Pressure	Pext	15.00	psig
Temperature for External Pressure	Tempex	200	F
Shell Material		SA-516 70	
Shell Allowable Stress at Temperature	S	20000.00	psi
Shell Allowable Stress At Ambient	Sa	20000.00	psi
Inside Diameter of Elliptical Head	D	60.0000	in.
Aspect Ratio of Elliptical Head	Ar	2.00	
Head Actual Thickness	T	0.6250	in.
Head Internal Corrosion Allowance	Cas	0.1250	in.
Head External Corrosion Allowance	Caext	0.0000	in.
Distance from Head Centerline	L1	15.0000	in.
User Entered Minimum Design Metal Temperature		-20.00	F
Nozzle Material		SA-106 B	
Nozzle Allowable Stress at Temperature	Sn	17100.00	psi
Nozzle Allowable Stress At Ambient	Sna	17100.00	psi
Nozzle Diameter Basis (for tr calc only)	Inbase	ID	
Layout Angle		0.00	deg
Nozzle Diameter	Dia	6.0000	in.
Nozzle Size and Thickness Basis	Idbn	Nominal	
Nominal Thickness of Nozzle	Thknom	80	
Nozzle Flange Material		SA-105	
Nozzle Flange Type	Weld Neck	Flange	
Nozzle Corrosion Allowance	Can	0.1250	in.
Joint Efficiency of Shell Seam at Nozzle	Es	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Nozzle Outside Projection	Ho	2.0000	in.
Weld leg size between Nozzle and Pad/Shell	Wo	0.3750	in.
Groove weld depth between Nozzle and Vessel	Wgnv	0.6250	in.
Nozzle Inside Projection	H	0.0000	in.
Weld leg size, Inside Nozzle to Shell	Wi	0.0000	in.
ASME Code Weld Type per UW-16		None	
Class of attached Flange		150	
Grade of attached Flange		GR 1.1	

The Pressure Design option was Design Pressure + static head

Nozzle Sketch



Insert Nozzle No Pad, no Inside projection

FileName : Horizontal Tank -----
 Nozzle Calcs. Outlet Nozl: 2 4:19p Oct 23,2008

NOZZLE CALCULATION, Description: Outlet

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

Actual Nozzle Inside Diameter Used in Calculation 5.761 in.
 Actual Nozzle Thickness Used in Calculation 0.432 in.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a)of Elliptical Head, Tr [Int. Press]
 = $(P \cdot K1 \cdot D) / (2 \cdot S \cdot E - 0.2 \cdot P)$ per UG-37(a)(3)
 = $(100.00 \cdot 0.90 \cdot 60.2500) / (2 \cdot 20000.00 \cdot 1.00 - 0.2 \cdot 100.00)$
 = 0.1356 in.

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]
 = $(P \cdot R) / (S \cdot E - 0.6 \cdot P)$ per UG-27 (c)(1)
 = $(100.00 \cdot 3.01) / (17100 \cdot 1.00 - 0.6 \cdot 100.00)$
 = 0.0176 in.

Required Nozzle thickness under External Pressure per UG-28 : 0.0129 in.

UG-40, Thickness and Diameter Limit Results : [Int. Press]

Effective material diameter limit, D1 12.0220 in.
 Effective material thickness limit, no pad Tlnp 0.7675 in.

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc	
Area Required	Ar	0.827	0.484	NA	sq.in.
Area in Shell	A1	2.158	2.022	NA	sq.in.
Area in Nozzle Wall	A2	0.380	0.386	NA	sq.in.
Area in Inward Nozzle	A3	0.000	0.000	NA	sq.in.
Area in Welds	A4	0.120	0.120	NA	sq.in.
Area in Pad	A5	0.000	0.000	NA	sq.in.
TOTAL AREA AVAILABLE	Atot	2.658	2.528	NA	sq.in.

The Internal Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Reinforcement Area Required for Nozzle [Ar]:
 = $(Dlr \cdot Tr + 2 \cdot Thk \cdot Tr \cdot (1 - fr1))$ UG-37(c)
 = $(6.0110 \cdot 0.1356 + 2 \cdot (0.4320 - 0.1250) \cdot 0.1356 \cdot (1 - 0.8550))$
 = 0.827 sq.in.

Areas per UG-37.1 but with DL = Diameter Limit, DLR = Corroded ID:

Area Available in Shell [A1]:
 = $(DL - Dlr) \cdot (ES \cdot (T - Cas) - Tr) - 2 \cdot (Thk - Can) \cdot (ES \cdot (T - Cas) - Tr) \cdot (1 - fr1)$
 = $(12.022 - 6.011) \cdot (1.00 \cdot (0.6250 - 0.125) - 0.136) - 2 \cdot (0.432 - 0.125)$
 = $1.00 \cdot (0.6250 - 0.1250) - 0.1356 \cdot (1 - 0.8550)$
 = 2.158 sq.in.

Area Available in Nozzle Wall, no Pad [A2np]:
 = $(2 \cdot \min(Tlnp, ho)) \cdot (Thk - Can - Trn) \cdot fr2$
 = $(2 \cdot \min(0.768, 2.000)) \cdot (0.4320 - 0.1250 - 0.0176) \cdot 0.8550$
 = 0.380 sq.in.

Area Available in Welds, no Pad [A4np]:
 = $Wo^2 \cdot fr2 + (Wi - Can / 0.707)^2 \cdot fr2$
 = $0.3750^2 \cdot 0.8550 + (0.0000)^2 \cdot 0.8550$
 = 0.120 sq.in.

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Nozzle Calcs. Outlet Nozl: 2 4:19p Oct 23,2008

Wall Thickness per UG45(a), tra = 0.1426 in.
 Wall Thickness per UG16(b), tr16b = 0.2188 in.
 Wall Thickness per UG45(b)(1), trb1 = 0.2757 in.
 Wall Thickness per UG45(b)(2), trb2 = 0.1476 in.
 Wall Thickness per UG45(b)(3), trb3 = Max(trb1, trb2, tr16b) = 0.2757 in.
 Std. Wall Pipe per UG45(b)(4), trb4 = 0.3700 in.
 Wall Thickness per UG45(b), trb = Min(trb3, trb4) = 0.2757 in.

Final Required Thickness, tr45 = Max(tra, trb) = 0.2757 in.
 Available Nozzle Neck Thickness = .875 * 0.4320 = 0.3780 in. --> OK

M.A.W.P. Results for this Nozzle (Based on Areas and UG-45) at this Location

Approximate M.A.W.P. for given geometry 210.688 psig
 Nozzle is O.K. for the External Pressure 15.000 psig

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

Minimum Design Metal Temperature (Nozzle Neck), Curve: B

Minimum Temp. w/o impact per UCS-66 -20 F
 Minimum Temp. at required thickness -155 F

Nozzle MDMT Thickness Calc. per UCS-66 (a)1(b), MIN(tn,t,te), Curve: B

Minimum Temp. w/o impact per UCS-66 -20 F
 Minimum Temp. at required thickness -155 F
 Minimum Temp. w/o impact per UG-20(f) -20 F

ANSI Flange MDMT including temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -20 F
 Flange MDMT with Temperature reduction per UCS-66(b)(1)(b) -55 F

Where the Temperature Reduction per UCS-66(b)(1)(b) is:

Stress ratio, P / Ambient Rating = 100.00 / 285.00 = 0.351

Weld Size Calculations, Description: Outlet

Intermediate Calc. for nozzle/shell Welds Tmin 0.3070 in.

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	0.2149 = 0.7 * TMIN	0.2651 = 0.7 * Wo in.

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

Weld Load [W]:

$$= (Ar-A1+2*(Thk-can)*Ffr1*(E1(T-Cas)-Tr))*S$$

$$= (0.8273 - 2.1578 + 2 * (0.4320 - 0.1250) * 0.8550 * (1.00 * (0.6250 - 0.1250) - 0.1356)) * 20000$$

$$= 0.00 \text{ lb.}$$

Weld Load [W1]:

$$= (A2+A5+A4-(Wi-Can/.707)^2*Ffr2)*S$$

$$= (0.3798 + 0.0000 + 0.1202 - 0.0000 * 0.86) * 20000$$

$$= 10000.01 \text{ lb.}$$

Weld Load [W2]:

$$= ((A2+A6)+A3+A4+(2*(Thk-Can)*(T-Ca)*Fr1))*S$$

$$= (0.3798 + 0.0000 + 0.1202 + 0.2625) * 20000$$

$$= 15249.71 \text{ lb.}$$

Weld Load [W3]:

$$= ((A2+A6)+A3+A4+A5+(2*(Thk-Can)*(T-Ca)*Fr1))*S$$

$$= (0.3798 + 0.0000 + 0.1202 + 0.0000 + 0.2625) * 20000$$

$$= 15249.71 \text{ lb.}$$

Strength of Connection Elements for Failure Path Analysis

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Nozzle Calcs. Outlet Nozl: 2 4:19p Oct 23,2008

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wo * 0.49 * Snw \\
 &= (3.1416 / 2.0) * 6.6250 * 0.3750 * 0.49 * 17100 \\
 &= 32699. \text{ lb.}
 \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned}
 &= (\pi * (Dlr + Dlo) / 4) * (Thk - Can) * 0.7 * Sn \\
 &= (3.1416 * 3.1590) * (0.4320 - 0.1250) * 0.7 * 17100 \\
 &= 36470. \text{ lb.}
 \end{aligned}$$

Tension, Nozzle Groove Weld [Tngw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * (Wgnvi-Cas) * 0.74 * Sng \\
 &= (3.1416 / 2.0) * 6.6250 * (0.6250 - 0.1250) * 0.74 * 17100 \\
 &= 65842. \text{ lb.}
 \end{aligned}$$

Strength of Failure Paths:

$$\begin{aligned}
 \text{PATH11} &= (\text{SONW} + \text{SNW}) = (32698 + 36469) = 69168 \text{ lb.} \\
 \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\
 &= (32698 + 0 + 65842 + 0) = 98540 \text{ lb.} \\
 \text{PATH33} &= (\text{Sonw} + \text{Tngw} + \text{Sinw}) \\
 &= (32698 + 65842 + 0) = 98540 \text{ lb.}
 \end{aligned}$$

Summary of Failure Path Calculations:

Path 1-1 = 69168 lb., must exceed W = 0 lb. or W1 = 10000 lb.
 Path 2-2 = 98540 lb., must exceed W = 0 lb. or W2 = 15249 lb.
 Path 3-3 = 98540 lb., must exceed W = 0 lb. or W3 = 15249 lb.

The Drop for this Nozzle is : 0.1008 in.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 2.7258 in.

PV Elite 2008 c1993-2008 by COADE Engineering Software

FileName : Horizontal Tank -----

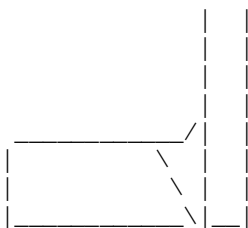
Nozzle Calcs. Manhole Nozl: 3 4:19p Oct 23,2008

INPUT VALUES, Nozzle Description: Manhole From : 20

Pressure for Nozzle Reinforcement Calculations P		150.000	psig
Temperature for Internal Pressure	Temp	200	F
Design External Pressure	Pext	15.00	psig
Temperature for External Pressure	Tempex	200	F
Shell Material		SA-516 70	
Shell Allowable Stress at Temperature	S	20000.00	psi
Shell Allowable Stress At Ambient	Sa	20000.00	psi
Inside Diameter of Cylindrical Shell	D	60.0000	in.
Design Length of Section	L	134.0000	in.
Shell Actual Thickness	T	0.6250	in.
Shell Internal Corrosion Allowance	Cas	0.1250	in.
Shell External Corrosion Allowance	Caext	0.0000	in.
Distance from Bottom/Left Tangent		5.1667	ft.
User Entered Minimum Design Metal Temperature		-20.00	F
Nozzle Material		SA-516 70	
Nozzle Allowable Stress at Temperature	Sn	20000.00	psi
Nozzle Allowable Stress At Ambient	Sna	20000.00	psi
Nozzle Diameter Basis (for tr calc only)	Inbase	ID	
Layout Angle		0.00	deg
Nozzle Diameter	Dia	16.0000	in.
Nozzle Size and Thickness Basis	Idbn	Actual	
Actual Thickness of Nozzle	Thk	0.7500	in.
Nozzle Flange Material		SA-105	
Nozzle Flange Type	Weld Neck	Flange	
Nozzle Corrosion Allowance	Can	0.1250	in.
Joint Efficiency of Shell Seam at Nozzle	Es	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Nozzle Outside Projection	Ho	4.0000	in.
Weld leg size between Nozzle and Pad/Shell	Wo	0.3750	in.
Groove weld depth between Nozzle and Vessel	Wgnv	0.6250	in.
Nozzle Inside Projection	H	0.0000	in.
Weld leg size, Inside Nozzle to Shell	Wi	0.0000	in.
ASME Code Weld Type per UW-16		None	
Class of attached Flange		150	
Grade of attached Flange		GR 1.1	

The Pressure Design option was Design Pressure + static head

Nozzle Sketch



Insert Nozzle No Pad, no Inside projection

FileName : Horizontal Tank -----
 Nozzle Calcs. Manhole Nozl: 3 4:19p Oct 23,2008

NOZZLE CALCULATION, Description: Manhole

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

Actual Nozzle Inside Diameter Used in Calculation 16.000 in.
 Actual Nozzle Thickness Used in Calculation 0.750 in.

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)
 = (150.00*30.1250)/(20000*1.00-0.6*150.00)
 = 0.2270 in.

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]
 = (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
 = (150.00*8.12)/(20000*1.00-0.6*150.00)
 = 0.0612 in.

Required Nozzle thickness under External Pressure per UG-28 : 0.0303 in.

UG-40, Thickness and Diameter Limit Results : [Int. Press]

Effective material diameter limit, D1 32.5000 in.
 Effective material thickness limit, no pad Tlnp 1.2500 in.

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5	Design	External	Mapnc
Area Required Ar	3.688	2.192	NA sq.in.
Area in Shell A1	4.437	3.741	NA sq.in.
Area in Nozzle Wall A2	1.409	1.487	NA sq.in.
Area in Inward Nozzle A3	0.000	0.000	NA sq.in.
Area in Welds A4	0.141	0.141	NA sq.in.
Area in Pad A5	0.000	0.000	NA sq.in.
TOTAL AREA AVAILABLE Atot	5.987	5.368	NA sq.in.

The Internal Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Reinforcement Area Required for Nozzle [Ar]:
 = (Dlr*Tr+2*Thk*Tr*(1-fr1)) UG-37(c)
 = (16.2500*0.2270+2*(0.7500-0.1250)*0.2270*(1-1.0000))
 = 3.688 sq.in.

Areas per UG-37.1 but with DL = Diameter Limit, DLR = Corroded ID:

Area Available in Shell [A1]:
 = (DL-Dlr)*(ES*(T-Cas)-Tr)-2*(Thk-Can)*(ES*(T-Cas)-Tr)*(1-fr1)
 = (32.500-16.250)*(1.00*(0.6250-0.125)-0.227)-2*(0.750-0.125)
 (1.00(0.6250-0.125)-0.2270)*(1-1.0000)
 = 4.437 sq.in.

Area Available in Nozzle Wall, no Pad [A2np]:
 = (2 * min(Tlnp,ho)) * (Thk - Can - Trn) * fr2
 = (2 * min(1.250 ,4.000)) * (0.7500 - 0.1250 - 0.0612) * 1.0000)
 = 1.409 sq.in.

Area Available in Welds, no Pad [A4np]:
 = Wo² * fr2 + (Wl-Can/0.707)² * fr2
 = 0.3750² * 1.0000 + (0.0000)² * 1.0000
 = 0.141 sq.in.

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Nozzle Calcs. Manhole Nozl: 3 4:19p Oct 23,2008

Wall Thickness per UG45(a), tra = 0.1862 in.
 Wall Thickness per UG16(b), tr16b = 0.2188 in.
 Wall Thickness per UG45(b)(1), trb1 = 0.3520 in.
 Wall Thickness per UG45(b)(2), trb2 = 0.1476 in.
 Wall Thickness per UG45(b)(3), trb3 = Max(trb1, trb2, tr16b) = 0.3520 in.
 Std. Wall Pipe per UG45(b)(4), trb4 = 0.4531 in.
 Wall Thickness per UG45(b), trb = Min(trb3, trb4) = 0.3520 in.

Final Required Thickness, tr45 = Max(tra, trb) = 0.3520 in.
 Available Nozzle Neck Thickness = 0.7500 in. --> OK

M.A.W.P. Results for this Nozzle (Based on Areas and UG-45) at this Location

Approximate M.A.W.P. for given geometry 195.800 psig
 Nozzle is O.K. for the External Pressure 15.000 psig

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

Minimum Design Metal Temperature (Nozzle Neck), Curve: B

Minimum Temp. w/o impact per UCS-66 16 F
 Minimum Temp. at required thickness -124 F
 Minimum Temp. w/o impact per UG-20(f) -20 F

Nozzle MDMT Thickness Calc. per UCS-66 (a)1(b), MIN(tn,t,te), Curve: B

Minimum Temp. w/o impact per UCS-66 6 F
 Minimum Temp. at required thickness -134 F
 Minimum Temp. w/o impact per UG-20(f) -20 F

ANSI Flange MDMT including temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -20 F
 Flange MDMT with Temperature reduction per UCS-66(b)(1)(b) -55 F

Where the Temperature Reduction per UCS-66(b)(1)(b) is:

Stress ratio, P / Ambient Rating = 150.00 / 285.00 = 0.526

Weld Size Calculations, Description: Manhole

Intermediate Calc. for nozzle/shell Welds Tmin 0.5000 in.

Results Per UW-16.1:

Required Thickness Actual Thickness
 Nozzle Weld 0.2500 = Min per Code 0.2651 = 0.7 * Wo in.

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

Weld Load [W]:

= (Ar-A1+2*(Thk-can)*Ffr1*(E1(T-Cas)-Tr))*S
 = (3.6881 - 4.4369 + 2 * (0.7500 - 0.1250) * 1.0000 *
 (1.00 * (0.6250 - 0.1250) - 0.2270)) * 20000
 = 0.00 lb.

Weld Load [W1]:

= (A2+A5+A4-(Wi-Can/.707)^2*Ffr2)*S
 = (1.4095 + 0.0000 + 0.1406 - 0.0000 * 1.00) * 20000
 = 31001.85 lb.

Weld Load [W2]:

= ((A2+A6)+A3+A4+(2*(Thk-Can)*(T-Ca)*Fr1))*S
 = (1.4095 + 0.0000 + 0.1406 + 0.6250) * 20000
 = 43501.85 lb.

Weld Load [W3]:

= ((A2+A6)+A3+A4+A5+(2*(Thk-Can)*(T-Ca)*Fr1))*S
 = (1.4095 + 0.0000 + 0.1406 + 0.0000 + 0.6250) * 20000
 = 43501.85 lb.

Strength of Connection Elements for Failure Path Analysis

FileName : Horizontal Tank

Nozzle Calcs. Manhole

Noz1: 3 4:19p Oct 23,2008

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned} &= (\pi/2) * Dlo * Wo * 0.49 * Snw \\ &= (3.1416 / 2.0) * 17.5000 * 0.3750 * 0.49 * 20000 \\ &= 101022. \text{ lb.} \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned} &= (\pi * (Dlr + Dlo) / 4) * (Thk - Can) * 0.7 * Sn \\ &= (3.1416 * 8.4375) * (0.7500 - 0.1250) * 0.7 * 20000 \\ &= 231938. \text{ lb.} \end{aligned}$$

Tension, Nozzle Groove Weld [Tngw]:

$$\begin{aligned} &= (\pi/2) * Dlo * (Wgnvi-Cas) * 0.74 * Sng \\ &= (3.1416 / 2.0) * 17.5000 * (0.6250 - 0.1250) * 0.74 * 20000 \\ &= 203418. \text{ lb.} \end{aligned}$$

Strength of Failure Paths:

$$\begin{aligned} \text{PATH11} &= (\text{SONW} + \text{SNW}) = (101021 + 231937) = 332959 \text{ lb.} \\ \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\ &= (101021 + 0 + 203418 + 0) = 304439 \text{ lb.} \\ \text{PATH33} &= (\text{Sonw} + \text{Tngw} + \text{Sinw}) \\ &= (101021 + 203418 + 0) = 304439 \text{ lb.} \end{aligned}$$

Summary of Failure Path Calculations:

Path 1-1 = 332959 lb., must exceed W = 0 lb. or W1 = 31001 lb.
Path 2-2 = 304439 lb., must exceed W = 0 lb. or W2 = 43501 lb.
Path 3-3 = 304439 lb., must exceed W = 0 lb. or W3 = 43501 lb.

The Drop for this Nozzle is : 1.3044 in.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 5.9294 in.

FileName : Horizontal Tank -----

Nozzle Calcs. Drain

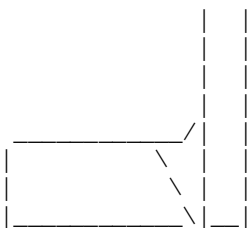
Nozl: 4 4:19p Oct 23,2008

INPUT VALUES, Nozzle Description: Drain From : 20

Pressure for Nozzle Reinforcement Calculations P		150.000	psig
Temperature for Internal Pressure	Temp	200	F
Design External Pressure	Pext	15.00	psig
Temperature for External Pressure	Tempex	200	F
Shell Material		SA-516 70	
Shell Allowable Stress at Temperature	S	20000.00	psi
Shell Allowable Stress At Ambient	Sa	20000.00	psi
Inside Diameter of Cylindrical Shell	D	60.0000	in.
Design Length of Section	L	134.0000	in.
Shell Actual Thickness	T	0.6250	in.
Shell Internal Corrosion Allowance	Cas	0.1250	in.
Shell External Corrosion Allowance	Caext	0.0000	in.
Distance from Bottom/Left Tangent		5.1667	ft.
User Entered Minimum Design Metal Temperature		-20.00	F
Nozzle Material		SA-106 B	
Nozzle Allowable Stress at Temperature	Sn	17100.00	psi
Nozzle Allowable Stress At Ambient	Sna	17100.00	psi
Nozzle Diameter Basis (for tr calc only)	Inbase	ID	
Layout Angle		180.00	deg
Nozzle Diameter	Dia	2.0000	in.
Nozzle Size and Thickness Basis	Idbn	Nominal	
Nominal Thickness of Nozzle	Thknom	160	
Nozzle Flange Material		SA-105	
Nozzle Flange Type	Weld Neck	Flange	
Nozzle Corrosion Allowance	Can	0.1250	in.
Joint Efficiency of Shell Seam at Nozzle	Es	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Nozzle Outside Projection	Ho	2.0000	in.
Weld leg size between Nozzle and Pad/Shell	Wo	0.3750	in.
Groove weld depth between Nozzle and Vessel	Wgnv	0.6250	in.
Nozzle Inside Projection	H	0.0000	in.
Weld leg size, Inside Nozzle to Shell	Wi	0.0000	in.
ASME Code Weld Type per UW-16		None	
Class of attached Flange		150	
Grade of attached Flange		GR 1.1	

The Pressure Design option was Design Pressure + static head

Nozzle Sketch



Insert Nozzle No Pad, no Inside projection

FileName : Horizontal Tank -----
 Nozzle Calcs. Drain Nozl: 4 4:19p Oct 23,2008

NOZZLE CALCULATION, Description: Drain

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

Actual Nozzle Inside Diameter Used in Calculation 1.687 in.
 Actual Nozzle Thickness Used in Calculation 0.344 in.

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)
 = (150.00*30.1250)/(20000*1.00-0.6*150.00)
 = 0.2270 in.

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]
 = (P*R)/(S*E-0.6*P) per UG-27 (c)(1)
 = (150.00*0.97)/(17100*1.00-0.6*150.00)
 = 0.0085 in.

Required Nozzle thickness under External Pressure per UG-28 : 0.0071 in.

UG-40, Thickness and Diameter Limit Results : [Int. Press]

Effective material diameter limit, D1 3.8740 in.
 Effective material thickness limit, no pad Tlnp 0.5475 in.

Note: Taking a UG-36(c)(3)(a) exemption for Drain .
 This calculation is valid for nozzles that meet all the requirements of paragraph UG-36. Please check the Code carefully, especially for nozzles that are not isolated or do not meet Code spacing requirements. It may be necessary to force the program to print the areas per UG-37.

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

Wall Thickness per UG45(a), tra = 0.1335 in.
 Wall Thickness per UG16(b), tr16b = 0.2188 in.
 Wall Thickness per UG45(b)(1), trb1 = 0.3520 in.
 Wall Thickness per UG45(b)(2), trb2 = 0.1476 in.
 Wall Thickness per UG45(b)(3), trb3 = Max(trb1, trb2, tr16b) = 0.3520 in.
 Std. Wall Pipe per UG45(b)(4), trb4 = 0.2598 in.
 Wall Thickness per UG45(b), trb = Min(trb3, trb4) = 0.2598 in.

Final Required Thickness, tr45 = Max(tra, trb) = 0.2598 in.
 Available Nozzle Neck Thickness = .875 * 0.3440 = 0.3010 in. --> OK

Minimum Design Metal Temperature (Nozzle Neck), Curve: B

Minimum Temp. w/o impact per UCS-66 -20 F
 Minimum Temp. at required thickness -155 F

Nozzle MDMT Thickness Calc. per UCS-66 (a)1(b), MIN(tn,t,te), Curve: B

Minimum Temp. w/o impact per UCS-66 -20 F
 Minimum Temp. at required thickness -155 F
 Minimum Temp. w/o impact per UG-20(f) -20 F

ANSI Flange MDMT including temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -20 F
 Flange MDMT with Temperature reduction per UCS-66(b)(1)(b) -55 F

Where the Temperature Reduction per UCS-66(b)(1)(b) is:

Stress ratio, P / Ambient Rating = 150.00 / 285.00 = 0.526

Weld Size Calculations, Description: Drain

Intermediate Calc. for nozzle/shell Welds Tmin 0.2190 in.

Results Per UW-16.1:

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Nozzle Calcs. Drain Nozl: 4 4:19p Oct 23,2008

	Required Thickness	Actual Thickness
Nozzle Weld	$0.1533 = 0.7 * TMIN$	$0.2651 = 0.7 * Wo \text{ in.}$

NOTE : Skipping the nozzle attachment weld strength calculations.
Per UW-15(b)(2) the nozzles exempted by UG-36(c)(3)(a)
(small nozzles) do not require a weld strength check.

The Drop for this Nozzle is : 0.0235 in.
The Cut Length for this Nozzle is, Drop + Ho + H + T : 2.6485 in.

PV Elite 2008 c1993-2008 by COADE Engineering Software

FileName : Horizontal Tank -----

Nozzle Calcs. Inlet

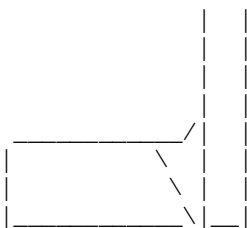
Nozl: 5 4:19p Oct 23,2008

INPUT VALUES, Nozzle Description: Inlet From : 30

Pressure for Nozzle Reinforcement Calculations P		150.000	psig
Temperature for Internal Pressure	Temp	200	F
Design External Pressure	Pext	15.00	psig
Temperature for External Pressure	Tempex	200	F
Shell Material		SA-516 70	
Shell Allowable Stress at Temperature	S	20000.00	psi
Shell Allowable Stress At Ambient	Sa	20000.00	psi
Inside Diameter of Elliptical Head	D	60.0000	in.
Aspect Ratio of Elliptical Head	Ar	2.00	
Head Actual Thickness	T	0.6250	in.
Head Internal Corrosion Allowance	Cas	0.1250	in.
Head External Corrosion Allowance	Caext	0.0000	in.
Distance from Head Centerline	L1	0.0000	in.
User Entered Minimum Design Metal Temperature		-20.00	F
Nozzle Material		SA-106 B	
Nozzle Allowable Stress at Temperature	Sn	17100.00	psi
Nozzle Allowable Stress At Ambient	Sna	17100.00	psi
Nozzle Diameter Basis (for tr calc only)	Inbase	ID	
Layout Angle		0.00	deg
Nozzle Diameter	Dia	4.0000	in.
Nozzle Size and Thickness Basis	Idbn	Nominal	
Nominal Thickness of Nozzle	Thknom	120	
Nozzle Flange Material		SA-105	
Nozzle Flange Type	Weld Neck	Flange	
Nozzle Corrosion Allowance	Can	0.1250	in.
Joint Efficiency of Shell Seam at Nozzle	Es	1.00	
Joint Efficiency of Nozzle Neck	En	1.00	
Nozzle Outside Projection	Ho	2.0000	in.
Weld leg size between Nozzle and Pad/Shell	Wo	0.3750	in.
Groove weld depth between Nozzle and Vessel	Wgnv	0.6250	in.
Nozzle Inside Projection	H	0.0000	in.
Weld leg size, Inside Nozzle to Shell	Wi	0.0000	in.
ASME Code Weld Type per UW-16		None	
Class of attached Flange		150	
Grade of attached Flange		GR 1.1	

The Pressure Design option was Design Pressure + static head

Nozzle Sketch



Insert Nozzle No Pad, no Inside projection

FileName : Horizontal Tank -----

Nozzle Calcs. Inlet

Noz1: 5 4:19p Oct 23,2008

NOZZLE CALCULATION, Description: Inlet

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

Actual Nozzle Inside Diameter Used in Calculation 3.624 in.
 Actual Nozzle Thickness Used in Calculation 0.438 in.

Nozzle input data check completed without errors.

Reqd thk per UG-37(a)of Elliptical Head, Tr [Int. Press]
 = $(P \cdot K1 \cdot D) / (2 \cdot S \cdot E - 0.2 \cdot P)$ per UG-37(a)(3)
 = $(150.00 \cdot 0.90 \cdot 60.2500) / (2 \cdot 20000.00 \cdot 1.00 - 0.2 \cdot 150.00)$
 = 0.2035 in.

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]
 = $(P \cdot R) / (S \cdot E - 0.6 \cdot P)$ per UG-27 (c)(1)
 = $(150.00 \cdot 1.94) / (17100 \cdot 1.00 - 0.6 \cdot 150.00)$
 = 0.0171 in.

Required Nozzle thickness under External Pressure per UG-28 : 0.0103 in.

UG-40, Thickness and Diameter Limit Results : [Int. Press]

Effective material diameter limit, D1 7.7480 in.
 Effective material thickness limit, no pad Tlnp 0.7825 in.

Results of Nozzle Reinforcement Area Calculations:

AREA AVAILABLE, A1 to A5		Design	External	Mapnc	
Area Required	Ar	0.807	0.314	NA	sq.in.
Area in Shell	A1	1.122	1.292	NA	sq.in.
Area in Nozzle Wall	A2	0.396	0.405	NA	sq.in.
Area in Inward Nozzle	A3	0.000	0.000	NA	sq.in.
Area in Welds	A4	0.120	0.120	NA	sq.in.
Area in Pad	A5	0.000	0.000	NA	sq.in.
TOTAL AREA AVAILABLE	Atot	1.638	1.817	NA	sq.in.

The Internal Pressure Case Governs the Analysis.

Nozzle Angle Used in Area Calculations 90.00 Degs.

The area available without a pad is Sufficient.

Reinforcement Area Required for Nozzle [Ar]:
 = $(Dlr \cdot Tr + 2 \cdot Thk \cdot Tr \cdot (1 - fr1))$ UG-37(c)
 = $(3.8740 \cdot 0.2035 + 2 \cdot (0.4380 - 0.1250) \cdot 0.2035 \cdot (1 - 0.8550))$
 = 0.807 sq.in.

Areas per UG-37.1 but with DL = Diameter Limit, DLR = Corroded ID:

Area Available in Shell [A1]:
 = $(DL - Dlr) \cdot (ES \cdot (T - Cas) - Tr) - 2 \cdot (Thk - Can) \cdot (ES \cdot (T - Cas) - Tr) \cdot (1 - fr1)$
 = $(7.748 - 3.874) \cdot (1.00 \cdot (0.6250 - 0.125) - 0.203) - 2 \cdot (0.438 - 0.125) \cdot (1.00 \cdot (0.6250 - 0.125) - 0.2035) \cdot (1 - 0.8550)$
 = 1.122 sq.in.

Area Available in Nozzle Wall, no Pad [A2np]:
 = $(2 \cdot \min(Tlnp, ho)) \cdot (Thk - Can - Trn) \cdot fr2$
 = $(2 \cdot \min(0.782, 2.000)) \cdot (0.4380 - 0.1250 - 0.0171) \cdot 0.8550$
 = 0.396 sq.in.

Area Available in Welds, no Pad [A4np]:
 = $Wo^2 \cdot fr2 + (Wi - Can / 0.707)^2 \cdot fr2$
 = $0.3750^2 \cdot 0.8550 + (0.0000)^2 \cdot 0.8550$
 = 0.120 sq.in.

UG-45 Minimum Nozzle Neck Thickness Requirement: [Int. Press.]

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Nozzle Calcs. Inlet Nozl: 5 4:19p Oct 23,2008

Wall Thickness per UG45(a), tra = 0.1421 in.
 Wall Thickness per UG16(b), tr16b = 0.2188 in.
 Wall Thickness per UG45(b)(1), trb1 = 0.3511 in.
 Wall Thickness per UG45(b)(2), trb2 = 0.1476 in.
 Wall Thickness per UG45(b)(3), trb3 = Max(trb1, trb2, tr16b) = 0.3511 in.
 Std. Wall Pipe per UG45(b)(4), trb4 = 0.3324 in.
 Wall Thickness per UG45(b), trb = Min(trb3, trb4) = 0.3324 in.

Final Required Thickness, tr45 = Max(tra, trb) = 0.3324 in.
 Available Nozzle Neck Thickness = .875 * 0.4380 = 0.3832 in. --> OK

M.A.W.P. Results for this Nozzle (Based on Areas and UG-45) at this Location

Approximate M.A.W.P. for given geometry 227.940 psig
 Nozzle is O.K. for the External Pressure 15.000 psig

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

Minimum Design Metal Temperature (Nozzle Neck), Curve: B

Minimum Temp. w/o impact per UCS-66 -20 F
 Minimum Temp. at required thickness -155 F

Nozzle MDMT Thickness Calc. per UCS-66 (a)1(b), MIN(tn,t,te), Curve: B

Minimum Temp. w/o impact per UCS-66 -20 F
 Minimum Temp. at required thickness -155 F
 Minimum Temp. w/o impact per UG-20(f) -20 F

ANSI Flange MDMT including temperature reduction per UCS-66.1:

Unadjusted MDMT of ANSI B16.5/47 flanges per UCS-66(c) -20 F
 Flange MDMT with Temperature reduction per UCS-66(b)(1)(b) -55 F

Where the Temperature Reduction per UCS-66(b)(1)(b) is:

Stress ratio, P / Ambient Rating = 150.00 / 285.00 = 0.526

Weld Size Calculations, Description: Inlet

Intermediate Calc. for nozzle/shell Welds Tmin 0.3130 in.

Results Per UW-16.1:

	Required Thickness	Actual Thickness
Nozzle Weld	0.2191 = 0.7 * TMIN	0.2651 = 0.7 * Wo in.

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

Weld Load [W]:

$$= (Ar - A1 + 2 * (Thk - can) * Ffr1 * (El(T - Cas) - Tr)) * S$$

$$= (0.8068 - 1.1217 + 2 * (0.4380 - 0.1250) * 0.8550 * (1.00 * (0.6250 - 0.1250) - 0.2035)) * 20000$$

$$= 0.00 \text{ lb.}$$

Weld Load [W1]:

$$= (A2 + A5 + A4 - (Wi - Can / .707)^2 * Ffr2) * S$$

$$= (0.3960 + 0.0000 + 0.1202 - 0.0000 * 0.86) * 20000$$

$$= 10323.92 \text{ lb.}$$

Weld Load [W2]:

$$= ((A2 + A6) + A3 + A4 + (2 * (Thk - Can) * (T - Ca) * Fr1)) * S$$

$$= (0.3960 + 0.0000 + 0.1202 + 0.2676) * 20000$$

$$= 15676.22 \text{ lb.}$$

Weld Load [W3]:

$$= ((A2 + A6) + A3 + A4 + A5 + (2 * (Thk - Can) * (T - Ca) * Fr1)) * S$$

$$= (0.3960 + 0.0000 + 0.1202 + 0.0000 + 0.2676) * 20000$$

$$= 15676.22 \text{ lb.}$$

Strength of Connection Elements for Failure Path Analysis

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Nozzle Calcs. Inlet Nozl: 5 4:19p Oct 23,2008

Shear, Outward Nozzle Weld [Sonw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * Wo * 0.49 * Snw \\
 &= (3.1416 / 2.0) * 4.5000 * 0.3750 * 0.49 * 17100 \\
 &= 22210. \text{ lb.}
 \end{aligned}$$

Shear, Nozzle Wall [Snw]:

$$\begin{aligned}
 &= (\pi * (Dlr + Dlo) / 4) * (Thk - Can) * 0.7 * Sn \\
 &= (3.1416 * 2.0935) * (0.4380 - 0.1250) * 0.7 * 17100 \\
 &= 24641. \text{ lb.}
 \end{aligned}$$

Tension, Nozzle Groove Weld [Tngw]:

$$\begin{aligned}
 &= (\pi/2) * Dlo * (Wgnvi-Cas) * 0.74 * Sng \\
 &= (3.1416 / 2.0) * 4.5000 * (0.6250 - 0.1250) * 0.74 * 17100 \\
 &= 44723. \text{ lb.}
 \end{aligned}$$

Strength of Failure Paths:

$$\begin{aligned}
 \text{PATH11} &= (\text{SONW} + \text{SNW}) = (22210 + 24641) = 46851 \text{ lb.} \\
 \text{PATH22} &= (\text{Sonw} + \text{Tpgw} + \text{Tngw} + \text{Sinw}) \\
 &= (22210 + 0 + 44722 + 0) = 66933 \text{ lb.} \\
 \text{PATH33} &= (\text{Sonw} + \text{Tngw} + \text{Sinw}) \\
 &= (22210 + 44722 + 0) = 66933 \text{ lb.}
 \end{aligned}$$

Summary of Failure Path Calculations:

Path 1-1 = 46851 lb., must exceed W = 0 lb. or W1 = 10323 lb.
 Path 2-2 = 66933 lb., must exceed W = 0 lb. or W2 = 15676 lb.
 Path 3-3 = 66933 lb., must exceed W = 0 lb. or W3 = 15676 lb.

The Drop for this Nozzle is : 0.0465 in.

The Cut Length for this Nozzle is, Drop + Ho + H + T : 2.6715 in.

PV Elite 2008 c1993-2008 by COADE Engineering Software

FileName : Horizontal Tank -----

Nozzle Schedule

Step: 17 4:19p Oct 23,2008

Nozzle Schedule:

Description	Nominal Size in.	Flange Sch/Type Cls	Noz. O/Dia in.	Wall Thk in.	Re-Pad ODia in.	Re-Pad Thick in.	Cut Length in.
Drain	2.000	160 WNF	2.375	0.344	-	-	2.65
Inlet	4.000	120 WNF	4.500	0.438	-	-	2.67
Inspection	6.000	80 WNF	6.625	0.432	-	-	2.73
Outlet	6.000	80 WNF	6.625	0.432	-	-	2.73
Manhole	16.000	150 WNF	17.500	0.750	-	-	5.93

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 in.	Noz Shl/Pad Weld in.	Pad OD Weld in.	Pad Grve Weld in.	Inside Weld in.
Drain	SA-106 B	0.625	0.375	-	-	-
Inlet	SA-106 B	0.625	0.375	-	-	-
Inspect	SA-106 B	0.625	0.375	-	-	-
Outlet	SA-106 B	0.625	0.375	-	-	-
Manhole	SA-516 70	0.625	0.375	-	-	-

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

Nozzle Miscellaneous Data:

Nozzle	Elevation/Distance From Datum ft.	Layout Angle deg.	Projection Outside in.	Projection Inside in.	Installed In Component
Drain	5.167	180.00	2.00	0.00	Shell
Inlet		0.00	2.00	0.00	RT Head
Inspection		0.00	2.00	0.00	LF Head
Outlet		0.00	2.00	0.00	LF Head
Manhole	5.167	0.00	4.00	0.00	Shell

FileName : Horizontal Tank -----

Nozzle Summary Step: 18 4:19p Oct 23,2008

Nozzle Calculation Summary

Description	Internal psig	Ext	MAPNC psig	UG45 [tr]	Weld Path	Areas
Inspection	210.69	OK	...	OK 0.276	OK	Passed
Outlet	210.69	OK	...	OK 0.276	OK	Passed
Manhole	195.80	OK	...	OK 0.352	OK	Passed
Drain	2801.97	OK 0.260	OK	Passed
Inlet	227.94	OK	...	OK 0.332	OK	Passed
Min. - Nozzles	195.80	Manhole				
Min. Shell&Flgs	260.00					

Computed Vessel M.A.W.P. 195.80 psig

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	X Coordinate,	Layout Angle,	Dia. Limit
10	Inspection	0.000	0.000	12.022
10	Outlet	0.000	0.000	12.022
20	Manhole	62.000	0.000	32.500
20	Drain	62.000	180.000	3.874
30	Inlet	0.000	0.000	7.748

The nozzle spacing is computed by the following:

= Sqrt(ll² + lc²) 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 !

PV Elite 2008 c1993-2008 by COADE Engineering Software

FileName : Horizontal Tank -----

Vessel Design Summary Step: 19 4:19p Oct 23,2008

Design Code: ASME Code Section VIII Division 1, 2007

Diameter Spec : 60.000 in. ID
 Vessel Design Length, Tangent to Tangent 10.33 ft.
 Specified Datum Line Distance 0.00 ft.
 Shell/Head Matl SA-516 70
 Nozzle Material SA-106 B
 Nozzle Material SA-516 70
 Internal Design Temperature 0 F
 External Design Temperature 0 F
 Maximum Allowable Working Pressure 195.80 psig
 External Max. Allowable Working Pressure 70.48 psig
 Hydrostatic Test Pressure 0.00 psig
 Required Minimum Design Metal Temperature -20 F
 Warmest Computed Minimum Design Metal Temperature -55 F
 Wind Design Code IBC 2006
 Earthquake Design Code IBC 2006

Element Pressures and MAWP: psig

Element Desc	Internal	External	M. A. W. P	Corr. All.
LF Head	100.000	15.000	331.400	0.1250
Shell	150.000	15.000	279.376	0.1250
RT Head	150.000	15.000	331.400	0.1250

Element Type	"To" Elev ft.	Length ft.	Element Thk in.	Reqd Thk Int.	Ext.	Joint Eff Long	Circ
Ellipse	0.17	0.167	0.625	0.276	0.284	1.00	1.00
Cylinder	10.17	10.000	0.625	0.392	0.395	0.85	0.85
Ellipse	10.33	0.167	0.625	0.351	0.284	1.00	0.85

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

Saddle Parameters:

Saddle Width 8.000 in.
 Saddle Bearing Angle 120.000 deg.
 Centerline Dimension 45.000 in.
 Wear Pad Width 12.000 in.
 Wear Pad Thickness 0.375 in.
 Wear Pad Bearing Angle 132.000 deg.
 Distance from Saddle to Tangent 17.000 in.

Summary of Maximum Saddle Loads, Operating Case :

Maximum Vertical Saddle Load 3384.02 lb.
 Maximum Transverse Saddle Shear Load 348.49 lb.
 Maximum Longitudinal Saddle Shear Load 696.97 lb.

Summary of Maximum Saddle Loads, Hydrotest Case :

Maximum Vertical Saddle Load 10816.61 lb.
 Maximum Transverse Saddle Shear Load 54.63 lb.
 Maximum Longitudinal Saddle Shear Load 81.97 lb.

Weights:

Fabricated - Bare W/O Removable Internals 6118.4 lbm
 Shop Test - Fabricated + Water (Full) 20821.0 lbm
 Shipping - Fab. + Rem. Intls.+ Shipping App. 6118.4 lbm
 Erected - Fab. + Rem. Intls.+ Insul. (etc) 6118.4 lbm
 Empty - Fab. + Intls. + Details + Wghts. 6118.4 lbm

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

FileName : Horizontal Tank -----

Vessel Design Summary Step: 19 4:19p Oct 23,2008

Operating - Empty + Operating Liquid (No CA)	6118.4	lbm
Field Test - Empty Weight + Water (Full)	20821.0	lbm

PV Elite 2008 c1993-2008 by COADE Engineering Software

PV Elite 2008 Licensee: KEDKEP CONSULTING, INC.

53

FileName : Horizontal Tank -----

Problems/Failures Summary Step: 20 4:19p Oct 23,2008

Listed below are the known problem areas for the current design. If one or more of the design flags are turned on, please re-run the analysis. Some of these issues may be resolved when using updated input values.

*** Warning: An ANSI Flange is limiting the MAWP and this may affect the pressure used in the Nozzle Reinforcement Calculations.*

Please review all reports carefully!

PV Elite 2008 c1993-2008 by COADE Engineering Software