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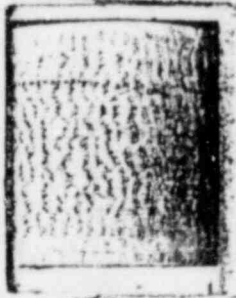
PDR - Return

396-55



Nuclear Assurance Corporation
24 Executive Park West
Atlanta, Georgia 30329

Mr. Charles E. MacDonald
Transportation Certification Branch
Division of Fuel Cycle and Materials
Safety, NMSS
United States Nuclear Regulatory Commission
Washington, D.C. 20555



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*add'l info*LOCAL BENDING

The critical buckling uniform radial edge moment around the circumference of a straight circular cylinder is calculated per Reference 2.8, page 4-63 as:

$$M_{cr}/N_a = q_3 \frac{Et^2}{(1-\nu^2)^{0.75}} \frac{t}{R} = 37.74 \text{ in-k/in @ } 750^\circ\text{F}$$

where: N_a = plasticity coefficient for bending - E_1 (Reference 2.27, page 267)
 q = 0.33 (@ $R/t = 22.1$) Reference 2.8, page 4-63
 E = 24.4×10^3 ksi (modulus of elasticity @ 750°F)
 ν = 0.275 (Poisson's ratio)
 t = 0.3125 in (cylinder thickness)
 R = 6.90625 in (cylinder mean radius)

Because bending due to a uniform radial edge moment is very localized, neither bow nor ovality of the cylinder affect the critical buckling edge moment.

For a loading case where the elastically calculated uniform radial moment is equivalent to a maximum local bending stress which exceeds the material yield strength, a procedure for inelastic buckling analysis is applied.

The true stress and true strain corresponding to an elastically calculated stress of -38.9 ksi are obtained from the true stress-strain curve for Type 321 stainless steel at 750°F (Reference Table 2-22 and Figure 2-4):

$$\begin{aligned} \sigma_{\text{true}} &= -19.5 \text{ ksi} \\ \epsilon_{\text{true}} &= 0.00159 \text{ in/in} \end{aligned}$$

The secant modulus, E_s , and the tangent modulus, E_t , of the shell material are calculated for the above temperature and true stress-strain values using the previously referenced true stress-strain curve:

$$E_s = \frac{19.5 - 0}{0.00159 - 0.0} = 12.3 \times 10^3 \text{ ksi}$$

FEE EXEMPT

Additional info

$$E_t = \frac{20.4 - 17.3}{0.002 - 0.000756} = 2.5 \times 10^3 \text{ ksi}$$

The plasticity coefficient, N_a , for the local bending buckling mode is calculated by substituting the previously calculated or defined material modulus values into the following equation:

$$N_a = \frac{\sqrt{E_s E_t}}{E} 0.227 \text{ (Table 10-1, page 267, Reference 2.27)}$$

where, E_s = secant modulus of shell material
 E_t = tangent modulus of shell material
 E = elastic modulus of shell material

Then, the critical inelastic buckling uniform radial edge moment for a cylinder at 750°F subjected to an edge moment equivalent to a local bending true stress of -19.5 ksi is:

$$M_{cr} = (M_{cr}/N_a) (N_a) = (37.74) (0.227) = 8.57 \text{ in-k/in}$$

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2.6.6 Free Drop

Appendix A of Part 71 of Title 10, Chapter 1 of the Code of Federal Regulations (Reference 2.2) requires that all transportation packages in excess of 30,000 pounds be evaluated to determine the consequences of a free fall through a distance of one foot onto a horizontal unyielding surface. The orientation of the cask is to be such that the maximum damage is inflicted on the cask. Since it is impossible to define the orientation of the cask that results in maximum damage, impacts on the end, side and corner will be considered.

The impact limiter is the device which enables the cask to be decelerated within a tolerable G-load envelope and crush distance. The envelope is described in Section 2.10.2.2.1. The cask inner containment was used to establish the limiting G-load envelope. The G-load envelope was used to guide the design of the impact limiter. The depth of the crush material, strength of the limiter material and, the size and shape of the backing disk were influenced by the G-load envelope. The backing disks cover all valve sites to containment. All valve sites are encased by heavy protective shells designed to work in unison to protect the valves. All lines which join the valve to the containment vessel are drilled through the end castings and are minute relative to the end casting through which the line passes. Therefore, neither the lines, fittings, or valves will be damaged in normal loading conditions.

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The consequences of a one foot fall must be evaluated for conditions ranging from -20°F to 100°F ambient temperature. The conditions employed in the analysis of the one foot free fall are summarized in Table 2-71.

Table 2-71
ANALYSIS CONDITIONS FOR ONE FOOT FREE FALL

Ambient Temperature (°F)	Insolance	Decay Heat (kw)	Cavity Pressure (psia) (psig)	Cask Wall Temperature (°F)	Impact Limiter Temperature (°F)	Cask Motion
100	Full	11.5	100.0 85.0	295	145	Stationary
-20	None	11.5	36.4 22.0	150	15	Stationary
-20	None	0	12.2 -2.5	-20	-20	Stationary

2.6.3.1 End Impact

This force that acts on the cask during an impact is the product of the crush strength of the wood and the area that is being crushed. The method employed to determine the force on the cask are described in Section 2.10.2 and the

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Table 2-99 - Summary of Calculated Stresses during 30 Foot Free Fall on End

Temperature: -20. °F No Heat Internal Pressure: -2. psig Axial Accel: 35.0 g's Transverse Accel: .0 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
	Containment Boundary											
A	2120.	5600.	-9140.	14700.	2120.	5600.	-9140.	14700.	2110.	5620.	-9120.	14700.
B	-313.	-3620.	-13800.	13500.	-313.	-3620.	-13800.	13500.	-313.	-3620.	-13800.	13500.
C	236.	-446.	-13600.	13800.	236.	-446.	-13600.	13800.	236.	-446.	-13600.	13800.
D	-1.84	-36.3	-13600.	13600.	-1.84	-36.3	-13600.	13600.	-1.84	-36.3	-13600.	13600.
E	89.2	797.	-10400.	11200.	89.2	797.	-10400.	11200.	89.2	797.	-10400.	11200.
F	86.4	1740.	-8410.	10200.	86.4	1740.	-8410.	10200.	86.4	1740.	-8410.	10200.
G	2120.	5600.	-9180.	14800.	2120.	5600.	-9180.	14800.	2110.	5590.	-9140.	14700.
P	2.20	2.20	0.	2.20	3850.	3850.	0.	3850.	3850.	3850.	0.	3850.
T	2.20	2.20	0.	2.20	1820.	2730.	0.	2730.	1820.	2730.	0.	2730.
V	-1.74	-4.78	-3220.	3220.	-457.	-35.5	-3220.	3180.	-457.	-35.5	-3220.	3180.
W	-1.28	-3.82	-3400.	3400.	-1.28	-5670.	-3400.	5670.	-1.28	-5670.	-3400.	5670.
X	-1.28	-3.82	-3310.	3310.	-1.28	-5670.	-3310.	5670.	-1.28	-5670.	-3310.	5670.
Z	0.	0.	0.	0.	713.	713.	0.	713.	713.	713.	0.	713.
BB	0.	0.	0.	0.	713.	713.	0.	713.	713.	713.	0.	713.
CC	0.	0.	-5710.	5710.	9630.	9600.	-5710.	15300.	9630.	9600.	-5710.	15300.
DD	0.	0.	-5710.	5710.	9630.	9600.	-5710.	15300.	9630.	9600.	-5710.	15300.
EE	0.	0.	-5710.	5710.	9630.	9600.	-5710.	15300.	9630.	9600.	-5710.	15300.
GG	0.	0.	-5710.	5710.	9630.	9600.	-5710.	15300.	9630.	9600.	-5710.	15300.
HH	0.	0.	-5710.	5710.	9630.	9600.	-5710.	15300.	9630.	9600.	-5710.	15300.
MAX Loc	2120. A	5600. A	-13800. B	14800. G	9630. CC	9600. CC	-13800. B	15300. CC	9630. CC	9600. CC	-13800. B	15300. CC
	Structure											
H	1020.	-642.	-17200.	18200.	1020.	-642.	-17200.	18200.	1020.	-642.	-17200.	18200.
J	722.	-4030.	-16700.	17400.	722.	-4030.	-16700.	17400.	722.	-4030.	-16700.	17400.
K	663.	-4740.	-12400.	13100.	663.	-4740.	-12400.	13100.	663.	-4740.	-12400.	13100.
L	589.	-5580.	-10300.	10900.	589.	-5580.	-10300.	10900.	589.	-5580.	-10300.	10900.
Q	719.	-4260.	-15700.	16400.	719.	-4260.	-15700.	16400.	719.	-4260.	-15700.	16400.
R	0.	0.	-2590.	2590.	735.	1370.	-2590.	3960.	735.	1370.	-2590.	3960.
S	0.	0.	-2590.	2590.	3850.	3850.	-2590.	6440.	3850.	3850.	-2590.	6440.
T	-1.74	-4.78	-3220.	3220.	-3220.	-490.	-3220.	2730.	-3220.	-490.	-3220.	2730.
Y	-1.28	-3.82	-3310.	3310.	-1.28	-5670.	-3310.	5670.	-1.28	-5670.	-3310.	5670.
AA	0.	0.	0.	0.	713.	713.	0.	713.	713.	713.	0.	713.
FF	0.	0.	-70.0	70.0	9630.	9600.	-70.0	9700.	9630.	9600.	-70.0	9700.
JJ	0.	0.	-2590.	2590.	5570.	1230.	-2590.	8160.	5570.	1230.	-2590.	8160.
MAX Loc	1020. H	-5580. L	-17200. H	18200. H	9630. FF	9600. FF	-17200. H	18200. H	9630. FF	9600. FF	-17200. H	18200. H
	Bolts											
N	0.	0.	52000.	52000.	0.	0.	52000.	52000.	0.	0.	52000.	52000.
MAX Loc	0. N	0. N	52000. N	52000. N	0. N	0. N	52000. N	52000. N	0. N	0. N	52000. N	52000. N

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Hypothetical Accident Conditions

25 June 82

Table 2-100 - Summary of Calculated Stresses during 30 Foot Free Fall on End

Temperature: -20.°F Full Heat Internal Pressure: 229. psig Axial Accel: 35.0 g's Transverse Accel: .0 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
	Containment Boundary											
A	1720.	5190.	-5210.	10400.	1720.	5190.	-5210.	10400.	2450.	3810.	-7110.	10900.
B	-709.	-2160.	-9220.	8510.	-709.	-2160.	-9220.	8510.	-696.	-1610.	-8370.	7680.
C	-160.	1010.	-9050.	10100.	-160.	1010.	-9050.	10100.	-160.	1390.	-8670.	10100.
D	-398.	1420.	-9010.	10400.	-398.	1420.	-9010.	10400.	-398.	1800.	-8640.	10400.
E	-307.	2260.	-5900.	8150.	-307.	2260.	-5900.	8150.	-307.	2630.	-5520.	8150.
F	-310.	3200.	-3870.	7060.	-310.	3200.	-3870.	7060.	-310.	3570.	-3490.	7060.
G	1720.	5190.	-5250.	10400.	1720.	5190.	-5250.	10400.	1870.	6290.	-9110.	15400.
P	-252.	-252.	0.	252.	-4100.	-4100.	0.	4100.	-3880.	-3880.	0.	3880.
T	-252.	-252.	0.	252.	-2070.	-2980.	0.	2980.	-2070.	-2980.	0.	2980.
V	199.	54.7	-3220.	3420.	654.	89.7	-3220.	3870.	654.	89.7	-3220.	3870.
W	147.	437.	6690.	6540.	147.	6110.	6690.	6540.	147.	6110.	6690.	6540.
X	147.	437.	-3310.	3750.	147.	6110.	-3310.	9420.	147.	6110.	-3310.	9420.
Z	0.	0.	0.	0.	4140.	4140.	0.	4140.	4140.	4140.	0.	4140.
BB	0.	0.	0.	0.	4140.	4140.	0.	4140.	4140.	4140.	0.	4140.
CC	0.	0.	-5710.	5710.	14500.	10900.	-5710.	20200.	14500.	10900.	-5710.	20200.
DD	0.	0.	-5710.	5710.	14500.	10900.	-5710.	20200.	14500.	10900.	-5710.	20200.
EE	0.	0.	-5710.	5710.	14500.	10900.	-5710.	20200.	14500.	10900.	-5710.	20200.
GG	0.	0.	-5710.	5710.	14500.	10900.	-5710.	20200.	14500.	10900.	-5710.	20200.
HH	0.	0.	-5710.	5710.	14500.	10900.	-5710.	20200.	14500.	10900.	-5710.	20200.
MAX Loc	1720. A	5190. A	-9220. B	10400. G	14500. CC	10900. CC	-9220. B	20200. CC	14500. CC	10900. CC	-9110. G	20200. CC
	Structure											
H	51.7	10400.	-10100.	20600.	51.7	10400.	-10100.	20600.	51.7	11200.	-9380.	20600.
J	-242.	7060.	-9620.	16700.	-242.	7060.	-9620.	16700.	-242.	7790.	-8890.	16700.
K	-302.	6350.	-5380.	11700.	-302.	6350.	-5380.	11700.	-302.	7080.	-4650.	11700.
L	-375.	5510.	-3250.	8760.	-375.	5510.	-3250.	8760.	-375.	6250.	-2520.	8760.
M	-246.	6830.	-8790.	15600.	-246.	6830.	-8790.	15600.	-246.	7560.	-8050.	15600.
Q	0.	0.	-2590.	2590.	735.	1370.	-2590.	3960.	735.	1370.	-2590.	3960.
R	0.	0.	-2590.	2590.	3850.	3850.	-2590.	6440.	3850.	3850.	-2590.	6440.
S	199.	54.7	-3220.	3420.	3420.	545.	-3220.	6640.	3420.	545.	-3220.	6640.
Y	147.	437.	-3310.	3750.	147.	6110.	-3310.	9420.	147.	6110.	-3310.	9420.
AA	0.	0.	0.	0.	4140.	4140.	0.	4140.	4140.	4140.	0.	4140.
FF	0.	0.	-70.0	70.0	14500.	10900.	-70.0	14600.	14500.	10900.	-70.0	14600.
JJ	0.	0.	-2590.	2590.	5570.	1230.	-2590.	8160.	5570.	1230.	-2590.	8160.
MAX Loc	-375. L	10400. H	-10100. H	20600. H	14500. FF	10900. FF	-10100. H	20600. H	14500. FF	11200. H	-9380. H	20600. H
	Bolts											
N	0.	0.	73700.	73700.	0.	0.	73700.	73700.	0.	0.	73700.	73700.
MAX Loc	0. N	0. N	73700. N	73700. N	0. N	0. N	73700. N	73700. N	0. N	0. N	73700. N	73700. N

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Hypothetical Accident Conditions

25 June 82

Table 2-101 - Summary of Calculated Stresses during 30 Foot Free Fall on End

Temperature: 100. °F Full Heat Internal Pressure: 292. psig Axial Accel: 35.0 g's Transverse Accel: .0 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
	Containment Boundary											
A	1670.	6320.	-5320.	11600.	1670.	6320.	-5320.	11600.	2590.	4430.	-7880.	12300.
B	-761.	-516.	-9160.	8650.	-761.	-516.	-9160.	8650.	-744.	50.5	-8220.	8270.
C	-211.	2660.	-8990.	11600.	-211.	2660.	-8990.	11600.	-211.	3000.	-8650.	11600.
D	-449.	3070.	-8950.	12000.	-449.	3070.	-8950.	12000.	-449.	3410.	-8610.	12000.
E	-358.	3900.	-5840.	9740.	-358.	3900.	-5840.	9740.	-358.	4240.	-5500.	9740.
F	-361.	4840.	-3810.	8650.	-361.	4840.	-3810.	8650.	-361.	5180.	-3470.	8650.
G	1670.	6320.	-5360.	11700.	1670.	6320.	-5360.	11700.	1850.	7590.	-10400.	18000.
P	-321.	-321.	0.	321.	-4170.	-4170.	0.	4170.	-3890.	-3890.	0.	3890.
T	-321.	-321.	0.	321.	-2140.	-3050.	0.	3050.	-2140.	-3050.	0.	3050.
V	254.	69.8	-3220.	3470.	709.	105.	-3220.	3930.	709.	105.	-3220.	3930.
W	187.	558.	9440.	9250.	187.	6230.	9440.	9250.	187.	6230.	9440.	9250.
X	187.	558.	-3310.	3870.	187.	6230.	-3310.	9540.	187.	6230.	-3310.	9540.
Z	0.	0.	0.	0.	5090.	5090.	0.	5090.	5090.	5090.	0.	5090.
BB	0.	0.	0.	0.	5090.	5090.	0.	5090.	5090.	5090.	0.	5090.
CC	0.	0.	-5710.	5710.	15800.	11300.	-5710.	21500.	15800.	11300.	-5710.	21500.
DD	0.	0.	-5710.	5710.	15800.	11300.	-5710.	21500.	15800.	11300.	-5710.	21500.
EE	0.	0.	-5710.	5710.	15800.	11300.	-5710.	21500.	15800.	11300.	-5710.	21500.
GG	0.	0.	-5710.	5710.	15800.	11300.	-5710.	21500.	15800.	11300.	-5710.	21500.
HH	0.	0.	-5710.	5710.	15800.	11300.	-5710.	21500.	15800.	11300.	-5710.	21500.
MAX Loc	1670. A	6320. A	9440. W	12000. D	15800. CC	11300. CC	9440. W	21500. CC	15800. CC	11300. CC	-10400. G	21500. CC
	Structure											
H	156.	9240.	-10800.	20000.	156.	9240.	-10800.	20000.	156.	9910.	-10100.	20000.
J	-138.	5850.	-10300.	16100.	-138.	5850.	-10300.	16100.	-138.	6520.	-9620.	16100.
K	-197.	5140.	-6060.	11200.	-197.	5140.	-6060.	11200.	-197.	5810.	-5390.	11200.
L	-271.	4310.	-3930.	8230.	-271.	4310.	-3930.	8230.	-271.	4980.	-3250.	8230.
M	-141.	5620.	-9500.	15100.	-141.	5620.	-9500.	15100.	-141.	6290.	-8830.	15100.
Q	0.	0.	-2590.	2590.	735.	1370.	-2590.	3960.	735.	1370.	-2590.	3960.
R	0.	0.	-2590.	2590.	3850.	3850.	-2590.	6440.	3850.	3850.	-2590.	6440.
S	254.	69.8	-3220.	3470.	3470.	560.	-3220.	6690.	3470.	560.	-3220.	6690.
Y	187.	558.	-3310.	3870.	187.	6230.	-3310.	9540.	187.	6230.	-3310.	9540.
AA	0.	0.	0.	0.	5090.	5090.	0.	5090.	5090.	5090.	0.	5090.
FF	0.	0.	-70.0	70.0	15800.	11300.	-70.0	15900.	15800.	11300.	-70.0	15900.
JJ	0.	0.	-2590.	2590.	5570.	1230.	-2590.	8160.	5570.	1230.	-2590.	8160.
MAX Loc	-271. L	9240. H	-10800. H	20000. H	15800. FF	11300. FF	-10800. H	20000. H	15800. FF	11300. FF	-10100. H	20000. H
	Bolts											
N	0.	0.	81700.	81700.	0.	0.	81700.	81700.	0.	0.	81700.	81700.
MAX Loc	0.	0.	81700. N	81700. N	0.	0.	81700. N	81700. N	0.	0.	81700. N	81700. N

2-211

Table 2-122 - Summary of Calculated Stresses during 40 Inch Free Fall on Valve

Temperature: -20.°F No Heat Internal Pressure: -2. psig Axial Accel: .0 g's Transverse Accel: 24.5 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
Containment Boundary												
A	85.7	1820.	-3660.	5480.	5160.	1820.	-8750.	15900.	5150.	1840.	-8710.	15900.
B	85.7	1800.	-5430.	7230.	3930.	1800.	-9280.	15200.	3930.	1800.	-9280.	15200.
C	85.7	1800.	-6530.	8330.	3250.	1800.	-9690.	12900.	3250.	1800.	-9690.	12900.
D	85.7	1800.	-6800.	8600.	3100.	1800.	-9810.	12900.	3100.	1800.	-9810.	12900.
E	85.7	1800.	-15500.	17300.	85.7	1800.	-15500.	17300.	85.7	1800.	-15500.	17300.
F	85.7	1800.	-13400.	15200.	331.	1800.	-13600.	15400.	331.	1800.	-13600.	15400.
G	85.7	1820.	-3220.	5040.	5440.	1820.	-8570.	14000.	5440.	1810.	-8540.	14000.
P	2.20	2.20	0.	2.20	2.20	2.20	0.	2.20	.274	.274	0.	.274
T	2.20	2.20	0.	2.20	2.20	2.20	0.	2.20	2.20	2.20	0.	2.20
V	9010.	-478	0.	9010.	9010.	-478	0.	9010.	9010.	-478	0.	9010.
W	1150.	-3.82	-87.3	1240.	1150.	-3.82	-87.3	1240.	1150.	-3.82	-87.3	1240.
X	9620.	-3.82	0.	9620.	9620.	-3.82	0.	9620.	9620.	-3.82	0.	9620.
Z	0.	0.	0.	0.	30.2	30.2	0.	30.2	30.2	30.2	0.	30.2
BB	0.	1230.	0.	1230.	30.2	1260.	0.	1260.	30.2	1260.	0.	1260.
CC	0.	0.	0.	0.	42.8	11.8	0.	42.8	42.8	11.8	0.	42.8
DD	0.	0.	0.	0.	42.8	11.8	0.	42.8	42.8	11.8	0.	42.8
EE	0.	0.	0.	0.	42.8	11.8	0.	42.8	42.8	11.8	0.	42.8
GG	0.	0.	0.	0.	42.8	11.8	0.	42.8	42.8	11.8	0.	42.8
HH	0.	0.	0.	0.	42.8	11.8	0.	42.8	42.8	11.8	0.	42.8
MAX Loc	9620.	1820.	-15500.	17300.	9620.	1820.	-15500.	17300.	9620.	1840.	-15500.	17300.
	X	A	E	E	X	A	E	E	X	A	E	E
Structure												
H	537.	-6170.	-7450.	7980.	4330.	-6170.	-11200.	15600.	4330.	-6170.	-11200.	15600.
J	537.	-6170.	-15200.	15700.	2070.	-6170.	-16700.	18800.	2070.	-6170.	-16700.	18800.
K	537.	-6170.	-33300.	33900.	537.	-6170.	-33300.	33900.	537.	-6170.	-33300.	33900.
L	537.	-6170.	-28900.	29400.	651.	-6170.	-29000.	29600.	651.	-6170.	-29000.	29600.
M	537.	-6170.	-23000.	23500.	954.	-6170.	-23400.	24400.	954.	-6170.	-23400.	24400.
Q	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	9010.	-478	0.	9010.	9010.	-478	0.	9010.	9010.	-478	0.	9010.
Y	-1.28	9610.	0.	9620.	-1.28	9610.	0.	9620.	-1.28	9610.	0.	9620.
AA	0.	0.	0.	0.	30.2	30.2	0.	30.2	30.2	30.2	0.	30.2
FF	0.	6430.	0.	6430.	42.8	6440.	0.	6440.	42.8	6440.	0.	6440.
JJ	15000.	0.	0.	15000.	15000.	0.	0.	15000.	15000.	0.	0.	15000.
MAX Loc	15000.	9610.	-33300.	33900.	15000.	9610.	-33300.	33900.	15000.	9610.	-33300.	33900.
	JJ	Y	K	K	JJ	Y	K	K	JJ	Y	K	K
Bolts												
N	0.	0.	17700.	17700.	0.	0.	17700.	17700.	0.	0.	17700.	17700.
MAX Loc	0.	0.	17700.	17700.	0.	0.	17700.	17700.	0.	0.	17700.	17700.
			N	N			N	N			N	N

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Table 2-123 - Summary of Calculated Stresses during 40 Inch Free Fall on Valve

Temperature: -20.*F Full Heat Internal Pressure: 22. psig Axial Accel: .0 g's Transverse Accel: 24.5 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
	Containment Boundary											
A	-103.	-1490.	-614.	1390.	6330.	-1490.	-7050.	13400.	6490.	-1280.	-6390.	13500.
B	-103.	-1310.	-2320.	2220.	4890.	-1310.	-7320.	12200.	4890.	-920.	-6350.	11800.
C	-103.	-1310.	-3420.	3320.	4040.	-1310.	-7570.	11600.	4040.	-937.	-7190.	11200.
D	-103.	-1310.	-3690.	3590.	3850.	-1310.	-7650.	11500.	3850.	-937.	-7270.	11100.
E	-103.	-1310.	-12400.	12300.	-103.	-1310.	-12400.	12300.	-103.	-937.	-12100.	12000.
F	-103.	-1310.	-10300.	10200.	217.	-1310.	-10600.	10800.	217.	-937.	-10200.	10400.
G	-103.	-1490.	-173.	1390.	6670.	-1490.	-6950.	13600.	6690.	-1050.	-6980.	13700.
P	-24.2	-24.2	0.	24.2	-24.2	-24.2	0.	24.2	-3.01	-3.01	0.	3.01
T	-24.2	-24.2	0.	24.2	-24.2	-24.2	0.	24.2	-24.2	-24.2	0.	24.2
V	9030.	5.26	0.	9030.	9030.	5.26	0.	9030.	9030.	5.26	0.	9030.
W	1170.	42.0	961.	1130.	1170.	42.0	961.	1130.	1170.	42.0	961.	1130.
X	9630.	42.0	0.	9630.	9630.	42.0	0.	9630.	9630.	42.0	0.	9630.
Z	0.	0.	0.	0.	332.	332.	0.	332.	332.	332.	0.	332.
BB	0.	1230.	0.	1230.	332.	1560.	0.	1560.	332.	1560.	0.	1560.
CC	0.	0.	0.	0.	471.	129.	0.	471.	471.	129.	0.	471.
DD	0.	0.	0.	0.	471.	129.	0.	471.	471.	129.	0.	471.
EE	0.	0.	0.	0.	471.	129.	0.	471.	471.	129.	0.	471.
GG	0.	0.	0.	0.	471.	129.	0.	471.	471.	129.	0.	471.
HH	0.	0.	0.	0.	471.	129.	0.	471.	471.	129.	0.	471.
MAX Loc	9630.	-1490.	-12400.	12300.	9630.	1560.	-12400.	13600.	9630.	1560.	-12100.	13700.
	X	A	E	E	X	BB	E	G	X	BB	E	G
	Structure											
H	-428.	4920.	-645.	5550.	6150.	4920.	-7230.	13400.	6150.	5650.	-6490.	12600.
J	-428.	4920.	-8390.	13360.	2100.	4920.	-10900.	15800.	2100.	5650.	-10200.	15800.
K	-428.	4920.	-26500.	31400.	-428.	4920.	-26500.	31400.	-428.	5650.	-25800.	31400.
L	-428.	4920.	-22100.	27000.	-273.	4920.	-22200.	27200.	-273.	5650.	-21500.	27200.
M	-428.	4920.	-16200.	21100.	181.	4920.	-16800.	21700.	181.	5630.	-16100.	21700.
Q	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	9030.	5.26	0.	9030.	9030.	5.26	0.	9030.	9030.	5.26	0.	9030.
Y	14.1	9660.	0.	9660.	14.1	9660.	0.	9660.	14.1	9660.	0.	9660.
AA	0.	0.	0.	0.	332.	332.	0.	332.	332.	332.	0.	332.
FF	0.	6430.	0.	6430.	471.	6560.	0.	6560.	471.	6560.	0.	6560.
JJ	15000.	0.	0.	15000.	15000.	0.	0.	15000.	15000.	0.	0.	15000.
MAX Loc	15000.	9660.	-26500.	31400.	15000.	9660.	-26500.	31400.	15000.	9660.	-25800.	31400.
	JJ	Y	K	K	JJ	Y	K	K	JJ	Y	K	K
	Bolts											
N	0.	0.	29800.	29800.	0.	0.	29800.	29800.	0.	0.	29800.	29800.
MAX Loc	0.	0.	29800.	29800.	0.	0.	29800.	29800.	0.	0.	29800.	29800.
			N	N			N	N			N	N

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Hypothetical Accident Conditions

25 June 82

Table 2-124 - Summary of Calculated Stresses during 40 Inch Free Fall on Valve

Temperature: 100.°F Full Heat Internal Pressure: 85. psig Axial Accel: .0 g's Transverse Accel: 24.5 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
	Containment Boundary											
A	-155.	-355.	-724.	569.	6250.	-355.	-7130.	13400.	6520.	-662.	-7640.	14200.
B	-155.	334.	-2260.	2600.	4890.	334.	-7300.	12200.	4890.	741.	-6780.	11700.
C	-155.	334.	-3360.	3700.	4030.	334.	-7550.	11600.	4030.	676.	-7210.	11200.
D	-155.	334.	-3630.	3970.	3840.	334.	-7630.	11500.	3840.	676.	-7290.	11100.
E	-155.	334.	-12400.	12700.	-155.	334.	-12400.	12700.	-155.	676.	-12000.	12700.
F	-155.	334.	-10200.	10500.	169.	334.	-10500.	10900.	169.	676.	-10200.	10900.
G	-155.	-355.	-283.	200.	6590.	-355.	-7030.	13600.	6650.	256.	-8260.	14900.
P	-93.6	-93.6	0.	93.6	-93.6	-93.6	0.	93.6	-11.6	-11.6	0.	11.6
T	-93.6	-93.6	0.	93.6	-93.6	-93.6	0.	93.6	-93.6	-93.6	0.	93.6
V	9090.	20.3	0.	9090.	9090.	20.3	0.	9090.	9090.	20.3	0.	9090.
W	1210.	162.	3710.	3550.	1210.	162.	3710.	3550.	1210.	162.	3710.	3550.
X	9670.	162.	0.	9670.	9670.	162.	0.	9670.	9670.	162.	0.	9670.
Z	0.	0.	0.	0.	1280.	1280.	0.	1280.	1280.	1280.	0.	1280.
BB	0.	1230.	0.	1230.	1280.	2510.	0.	2510.	1280.	2510.	0.	2510.
CC	0.	0.	0.	0.	1820.	500.	0.	1820.	1820.	500.	0.	1820.
DD	0.	0.	0.	0.	1820.	500.	0.	1820.	1820.	500.	0.	1820.
EE	0.	0.	0.	0.	1820.	500.	0.	1820.	1820.	500.	0.	1820.
GG	0.	0.	0.	0.	1820.	500.	0.	1820.	1820.	500.	0.	1820.
HH	0.	0.	0.	0.	1820.	500.	0.	1820.	1820.	500.	0.	1820.
MAX Loc	9670. X	1230. BB	-12400. E	12700. E	9670. X	2510. BB	-12400. E	13600. G	9670. X	2510. BB	-12000. E	14900. G
	Structure											
H	-323.	3710.	-1520.	5030.	5880.	3710.	-7550.	13400.	5880.	4380.	-6860.	12700.
J	-323.	3710.	-9060.	12800.	2060.	3710.	-11400.	15200.	2060.	4380.	-10800.	15200.
K	-323.	3710.	-27200.	30900.	-323.	3710.	-27200.	30900.	-323.	4380.	-26500.	30900.
L	-323.	3710.	-22800.	26500.	-174.	3710.	-22900.	26600.	-174.	4380.	-22200.	26600.
M	-323.	3710.	-16900.	20600.	258.	3710.	-17500.	21200.	258.	4380.	-16800.	21200.
Q	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	9090.	20.3	0.	9090.	9090.	20.3	0.	9090.	9090.	20.3	0.	9090.
Y	54.4	9780.	0.	9780.	54.4	9780.	0.	9780.	54.4	9780.	0.	9780.
AA	0.	0.	0.	0.	1280.	1280.	0.	1280.	1280.	1280.	0.	1280.
FF	0.	6430.	0.	6430.	1820.	6930.	0.	6930.	1820.	6930.	0.	6930.
JJ	15000.	0.	0.	15000.	15000.	0.	0.	15000.	15000.	0.	0.	15000.
MAX Loc	15000. JJ	9780. Y	-27200. K	30900. K	15000. JJ	9780. Y	-27200. K	30900. K	15000. JJ	9780. Y	-26500. K	30900. K
	Bolts											
N	0.	0.	37800.	37800.	0.	0.	37800.	37800.	0.	0.	37800.	37800.
MAX Loc	0. N	0. N	37800. N	37800. N	0. N	0. N	37800. N	37800. N	0. N	0. N	37800. N	37800. N

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Hypothetical Accident Conditions

25 June 82

Table 2-127 - Summary of Calculated Stresses during 40 Inch Free Fall on Cask Mid Length

Temperature: -20. °F No Heat Internal Pressure: -2. psig Axial Accel: .0 g's Transverse Accel: 24.5 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
Containment Boundary												
A	85.7	1820.	-1830.	3650.	194.	1820.	-1940.	3760.	187.	1840.	-1920.	3760.
B	85.7	1800.	-2040.	3850.	305.	1800.	-2260.	4060.	305.	1800.	-2260.	4070.
C	85.7	1800.	-2190.	3990.	352.	1800.	-2460.	4260.	352.	1800.	-2460.	4260.
D	85.7	1800.	-2230.	4030.	365.	1800.	-2510.	4310.	365.	1800.	-2510.	4310.
E	85.7	1800.	-8170.	9980.	835.	1800.	-8920.	10700.	835.	1800.	-8920.	10700.
F	85.7	1800.	-14900.	16700.	937.	1800.	-15800.	17600.	937.	1800.	-15800.	17600.
G	85.7	1820.	-1840.	3660.	230.	1820.	-1990.	3810.	228.	1810.	-1950.	3770.
P	2.20	2.20	0.	2.20	2.20	2.20	0.	2.20	.274	.274	0.	.274
T	2.20	2.20	0.	2.20	2.20	2.20	0.	2.20	2.20	2.20	0.	2.20
V	427.	-478	0.	427.	427.	-478	0.	427.	427.	-478	0.	427.
W	1150.	-3.82	-87.3	1240.	1150.	-3.82	-87.3	1240.	1150.	-3.82	-87.3	1240.
X	565.	-3.82	0.	568.	565.	-3.82	0.	568.	565.	-3.82	0.	568.
Z	0.	0.	0.	0.	30.2	30.2	0.	30.2	30.2	30.2	0.	30.2
BB	0.	1230.	0.	1230.	30.2	1260.	0.	1260.	30.2	1260.	0.	1260.
CC	0.	0.	0.	0.	42.8	11.8	0.	42.8	42.8	11.8	0.	42.8
DD	0.	0.	0.	0.	42.8	11.8	0.	42.8	42.8	11.8	0.	42.8
EE	0.	0.	0.	0.	42.8	11.8	0.	42.8	42.8	11.8	0.	42.8
GG	0.	0.	0.	0.	42.8	11.8	0.	42.8	42.8	11.8	0.	42.8
HH	0.	0.	0.	0.	42.8	11.8	0.	42.8	42.8	11.8	0.	42.8
MAX Loc	1150. W	1820. A	-14900. F	16700. F	1150. W	1820. A	-15800. F	17600. F	1150. W	1840. A	-15800. F	17600. F
Structure												
H	557.	-6170.	-4050.	6710.	601.	-6170.	-4110.	6770.	601.	-6170.	-4110.	6770.
J	557.	-6170.	-5080.	6710.	687.	-6170.	-5230.	6860.	687.	-6170.	-5230.	6860.
K	557.	-6170.	-17400.	17900.	905.	-6170.	-17800.	18700.	905.	-6170.	-17800.	18700.
L	557.	-6170.	-31500.	32000.	953.	-6170.	-31900.	32900.	953.	-6170.	-31900.	32900.
M	557.	-6170.	-7300.	7840.	805.	-6170.	-7570.	8370.	805.	-6170.	-7570.	8370.
Q	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	427.	-478	0.	427.	427.	-478	0.	427.	427.	-478	0.	427.
Y	-1.28	562.	0.	563.	-1.28	562.	0.	563.	-1.28	562.	0.	563.
AA	0.	0.	0.	0.	30.2	30.2	0.	30.2	30.2	30.2	0.	30.2
FF	0.	6430.	0.	6430.	42.8	6440.	0.	6440.	42.8	6440.	0.	6440.
JJ	6320.	0.	0.	6320.	6320.	0.	0.	6320.	6320.	0.	0.	6320.
MAX Loc	6320. JJ	6430. FF	-31500. L	32000. L	6320. JJ	6440. FF	-31900. L	32900. L	6320. JJ	6440. FF	-31900. L	32900. L
Bolts												
N	0.	0.	17700.	17700.	0.	0.	17700.	17700.	0.	0.	17700.	17700.
MAX Loc	0.	0.	17700. N	17700. N	0.	0.	17700. N	17700. N	0.	0.	17700. N	17700. N

Table 2-128 - Summary of Calculated Stresses during 40 Inch Free Fall on Cask Mid Length

Temperature: -20.°F Full Heat Internal Pressure: 22. psig Axial Accel: .0 g's Transverse Accel: 24.5 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
Containment Boundary												
A	-103.	-1490.	1210.	2700.	-253.	-1490.	1360.	2850.	-183.	-1280.	1520.	2800.
B	-103.	-1310.	1070.	2380.	-444.	-1310.	1410.	2720.	-443.	-920.	1830.	2750.
C	-103.	-1310.	917.	2230.	-562.	-1310.	1380.	2690.	-562.	-937.	1750.	2690.
D	-103.	-1310.	880.	2190.	-594.	-1310.	1370.	2680.	-594.	-937.	1740.	2680.
E	-103.	-1310.	-5060.	4960.	1010.	-1310.	-6170.	7180.	1010.	-937.	-5800.	6810.
F	-103.	-1310.	-11800.	11700.	954.	-1310.	-12900.	13800.	954.	-937.	-12500.	15500.
G	-103.	-1490.	1200.	2690.	-302.	-1490.	1400.	2890.	-288.	-1050.	1360.	2410.
P	-24.2	-24.2	0.	24.2	-24.2	-24.2	0.	24.2	-3.01	-3.01	0.	3.01
T	-24.2	-24.2	0.	24.2	-24.2	-24.2	0.	24.2	-24.2	-24.2	0.	24.2
V	448.	5.26	0.	448.	448.	5.26	0.	448.	448.	5.26	0.	448.
W	1170.	42.0	961.	1130.	1170.	42.0	961.	1130.	1170.	42.0	961.	1130.
X	580.	42.0	0.	580.	580.	42.0	0.	580.	580.	42.0	0.	580.
Z	0.	0.	0.	0.	332.	332.	0.	332.	332.	332.	0.	332.
BB	0.	1230.	0.	1230.	332.	1560.	0.	1560.	332.	1560.	0.	1560.
CC	0.	0.	0.	0.	471.	129.	0.	471.	471.	129.	0.	471.
DD	0.	0.	0.	0.	471.	129.	0.	471.	471.	129.	0.	471.
EE	0.	0.	0.	0.	471.	129.	0.	471.	471.	129.	0.	471.
GG	0.	0.	0.	0.	471.	129.	0.	471.	471.	129.	0.	471.
HH	0.	0.	0.	0.	471.	129.	0.	471.	471.	129.	0.	471.
MAX Loc	1170.	-1490.	-11800.	11700.	1170.	1560.	-12900.	13800.	1170.	1560.	-12500.	15500.
	W	A	F	F	W	BB	F	F	W	BB	F	F
Structure												
H	-428.	4920.	2750.	5350.	-519.	4920.	2840.	5440.	-519.	5650.	3580.	6170.
J	-428.	4920.	1720.	5350.	-775.	4920.	2070.	5690.	-775.	5650.	2800.	6430.
K	-428.	4920.	-10600.	15500.	197.	4920.	-11200.	16100.	197.	5650.	-10500.	15100.
L	-428.	4920.	-24700.	29600.	117.	4920.	-25200.	30100.	117.	5650.	-24500.	30100.
M	-428.	4920.	-512.	5430.	1010.	4920.	-1950.	6860.	1010.	5650.	-1210.	6860.
Q	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	448.	5.26	0.	448.	448.	5.26	0.	448.	448.	5.26	0.	448.
Y	14.1	608.	0.	608.	14.1	608.	0.	608.	14.1	608.	0.	608.
AA	0.	0.	0.	0.	332.	332.	0.	332.	332.	332.	0.	332.
FF	0.	6430.	0.	6430.	471.	6560.	0.	6560.	471.	6560.	0.	6560.
JJ	6320.	0.	0.	6320.	6320.	0.	0.	6320.	6320.	0.	0.	6320.
MAX Loc	6320.	6430.	-24700.	29600.	6320.	6560.	-25200.	30100.	6320.	6560.	-24500.	30100.
	JJ	FF	L	L	JJ	FF	L	L	JJ	FF	L	L
Bolts												
N	0.	0.	29800.	29800.	0.	0.	29800.	29800.	0.	0.	29800.	29800.
MAX Loc	0.	0.	29800.	29800.	0.	0.	29800.	29800.	0.	0.	29800.	29800.
			N	N			N	N			N	N

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Hypothetical Accident Conditions

25 June 82

Table 2-129 - Summary of Calculated Stresses during 40 Inch Free Fall on Cask Mid Length

Temperature: 100, °F Full Heat Internal Pressure: 25, psig Axial Accel: .0 g's Transverse Accel: 24.5 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
Containment Boundary												
A	-155.	-355.	1100.	1460.	-310.	-355.	1260.	1610.	-40.4	-662.	755.	1420.
B	-155.	334.	1120.	1280.	-477.	334.	1450.	1920.	-472.	741.	1960.	2440.
C	-155.	334.	974.	1130.	-589.	334.	1410.	2000.	-589.	676.	1750.	2340.
D	-155.	334.	938.	1090.	-619.	334.	1400.	2020.	-619.	676.	1740.	2360.
E	-155.	334.	-5010.	5340.	973.	334.	-6130.	7110.	973.	676.	-5790.	6770.
F	-155.	334.	-11800.	12100.	910.	334.	-12800.	13700.	910.	676.	-12500.	13400.
G	-155.	-355.	1090.	1440.	-361.	-355.	1300.	1660.	-306.	256.	62.9	563.
P	-93.6	-93.6	0.	93.6	-93.6	-93.6	0.	93.6	-11.6	-11.6	0.	11.6
T	-93.6	-93.6	0.	93.6	-93.6	-93.6	0.	93.6	-93.6	-93.6	0.	93.6
V	503.	20.3	0.	503.	503.	20.3	0.	503.	503.	20.3	0.	503.
W	1210.	162.	3710.	3550.	1210.	162.	3710.	3550.	1210.	162.	3710.	3550.
X	620.	162.	0.	620.	620.	162.	0.	620.	620.	162.	0.	620.
Z	0.	0.	0.	0.	1280.	1280.	0.	1280.	1280.	1280.	0.	1280.
BB	0.	1230.	0.	1230.	1280.	2510.	0.	2510.	1280.	2510.	0.	2510.
CC	0.	0.	0.	0.	1820.	500.	0.	1820.	1820.	500.	0.	1820.
DD	0.	0.	0.	0.	1820.	500.	0.	1820.	1820.	500.	0.	1820.
EE	0.	0.	0.	0.	1820.	500.	0.	1820.	1820.	500.	0.	1820.
GG	0.	0.	0.	0.	1820.	500.	0.	1820.	1820.	500.	0.	1820.
HH	0.	0.	0.	0.	1820.	500.	0.	1820.	1820.	500.	0.	1820.
MAX Loc	1210. W	1230. BB	-11800. F	12100. F	1820. CC	2510. BB	-12800. F	13700. F	1820. CC	2510. BB	-12500. F	13400. F
Structure												
H	-323.	3710.	2080.	4030.	-442.	3710.	2190.	4130.	-442.	4380.	2870.	4820.
J	-323.	3710.	1040.	4030.	-794.	3710.	1520.	4500.	-794.	4380.	2190.	5180.
K	-323.	3710.	-11300.	15000.	262.	3710.	-11900.	15600.	262.	4380.	-11200.	15600.
L	-323.	3710.	-25400.	29100.	205.	3710.	-25900.	29600.	205.	4380.	-25200.	29600.
M	-323.	3710.	-1230.	4940.	766.	3710.	-2320.	6030.	766.	4380.	-1650.	6030.
Q	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	503.	20.3	0.	503.	503.	20.3	0.	503.	503.	20.3	0.	503.
Y	54.4	728.	0.	728.	54.4	728.	0.	728.	54.4	728.	0.	728.
AA	0.	0.	0.	0.	1280.	1280.	0.	1280.	1280.	1280.	0.	1280.
FF	0.	6430.	0.	6430.	1820.	6930.	0.	6930.	1820.	6930.	0.	6930.
JJ	6320.	0.	0.	6320.	6320.	0.	0.	6320.	6320.	0.	0.	6320.
MAX Loc	6320. JJ	6430. FF	-25400. L	29100. L	6320. JJ	6930. FF	-25900. L	29600. L	6320. JJ	6930. FF	-25200. L	29600. L
Bolts												
N	0.	0.	37800.	37800.	0.	0.	37800.	37800.	0.	0.	37800.	37800.
MAX Loc	0. N	0. N	37800. N	37800. N	0. N	0. N	37800. N	37800. N	0. N	0. N	37800. N	37800. N

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Table 2-131 - Summary of Calculated Stresses during 40 Inch Free Fall on Closure Lid

Temperature: -20.°F No Heat Internal Pressure: -2, psig Axial Accel: 24.5 g's Transverse Accel: .0 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
	Containment Boundary											
A	1510.	4470.	-6320.	11400.	1510.	4470.	-6920.	11400.	1500.	4480.	-6900.	11400.
B	-194.	-1990.	-10200.	9960.	-194.	-1990.	-10200.	9960.	-194.	-1990.	-10200.	9970.
C	191.	229.	-10000.	10500.	191.	229.	-10000.	10500.	191.	229.	-10000.	10300.
D	24.4	516.	-10000.	10500.	24.4	516.	-10000.	10500.	24.4	516.	-10000.	10500.
E	88.1	1100.	-7850.	8930.	88.1	1100.	-7850.	8930.	88.1	1100.	-7850.	8930.
F	86.1	1760.	-6410.	8160.	86.1	1760.	-6410.	8160.	86.1	1760.	-6410.	8160.
G	1510.	4470.	-6940.	11400.	1510.	4470.	-6940.	11400.	1510.	4460.	-6900.	11400.
P	2.20	2.20	0.	2.20	2700.	2700.	0.	2700.	2700.	2700.	0.	2700.
T	2.20	2.20	0.	2.20	1280.	1910.	0.	1910.	1280.	1910.	0.	1910.
V	-1.74	-4.78	-2250.	2250.	-320.	-25.0	-2250.	2230.	-320.	-25.0	-2250.	2250.
W	-1.28	-3.82	-2410.	2400.	-1.28	-3970.	-2410.	3970.	-1.28	-3970.	-2410.	3970.
X	-1.28	-3.82	-2320.	2320.	-1.28	-3970.	-2320.	3970.	-1.28	-3970.	-2320.	3970.
Z	0.	0.	0.	0.	508.	508.	0.	508.	508.	508.	0.	508.
BB	0.	0.	0.	0.	508.	508.	0.	508.	508.	508.	0.	508.
CC	0.	0.	-3990.	3990.	6760.	6720.	-3990.	10700.	6760.	6720.	-3990.	10700.
DD	0.	0.	-3990.	3990.	6760.	6720.	-3990.	10700.	6760.	6720.	-3990.	10700.
EE	0.	0.	-3990.	3990.	6760.	6720.	-3990.	10700.	6760.	6720.	-3990.	10700.
GG	0.	0.	-3990.	3990.	6760.	6720.	-3990.	10700.	6760.	6720.	-3990.	10700.
HH	0.	0.	-3990.	3990.	6760.	6720.	-3990.	10700.	6760.	6720.	-3990.	10700.
MAX Loc	1510.	4470.	-10200.	11400.	6760.	6720.	-10200.	11400.	6760.	6720.	-10200.	11400.
	A	A	B	G	CC	CC	B	G	CC	CC	B	A
	Structure											
H	872.	-2300.	-13200.	14000.	872.	-2300.	-13200.	14000.	872.	-2300.	-13200.	14000.
J	667.	-4670.	-12800.	13500.	667.	-4670.	-12800.	13500.	667.	-4670.	-12800.	13500.
K	625.	-5170.	-9850.	10500.	625.	-5170.	-9850.	10500.	625.	-5170.	-9850.	10500.
L	573.	-5760.	-8350.	8930.	573.	-5760.	-8350.	8930.	573.	-5760.	-8350.	8930.
M	664.	-4830.	-12100.	12800.	664.	-4830.	-12100.	12800.	664.	-4830.	-12100.	12800.
Q	0.	0.	-1810.	1810.	515.	956.	-1810.	2770.	515.	956.	-1810.	2770.
R	0.	0.	-1810.	1810.	2700.	2700.	-1810.	4510.	2700.	2700.	-1810.	4510.
S	-1.74	-4.78	-2250.	2250.	-2260.	-343.	-2250.	1910.	-2260.	-343.	-2250.	1910.
Y	-1.28	-3.82	-2320.	2320.	-1.28	-3970.	-2320.	3970.	-1.28	-3970.	-2320.	3970.
AA	0.	0.	0.	0.	508.	508.	0.	508.	508.	508.	0.	508.
FF	0.	0.	-49.0	49.0	6760.	6720.	-49.0	6800.	6760.	6720.	-49.0	6800.
JJ	0.	0.	-1810.	1810.	3900.	858.	-1810.	5710.	3900.	858.	-1810.	5710.
MAX Loc	872.	-5760.	-13200.	14000.	6760.	6720.	-13200.	14000.	6760.	6720.	-13200.	14000.
	H	L	H	H	FF	FF	H	H	FF	FF	H	H
	Bolts											
N	0.	0.	41700.	41700.	0.	0.	41700.	41700.	0.	0.	41700.	41700.
MAX Loc	0.	0.	41700.	41700.	0.	0.	41700.	41700.	0.	0.	41700.	41700.
			N	N			N	N			N	N

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Table 2-152 - Summary of Calculated Stresses during 40 Inch Free Fall on Closure Lid

Temperature: -20. °F Full Heat Internal Pressure: 167. psig Axial Accel: 24.5 g's Transverse Accel: .0 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
	Containment Boundary											
A	1170.	3190.	-3250.	6440.	1170.	3190.	-3250.	6440.	1700.	2280.	-4540.	6820.
B	-528.	-1900.	-6040.	5510.	-528.	-1900.	-6040.	5510.	-518.	-1400.	-5520.	4800.
C	-143.	319.	-5920.	6240.	-143.	319.	-5920.	6240.	-143.	693.	-5540.	6240.
D	-310.	605.	-5890.	6500.	-310.	605.	-5890.	6500.	-310.	979.	-5520.	6500.
E	-246.	1190.	-3710.	4900.	-246.	1190.	-3710.	4900.	-246.	1560.	-3340.	4900.
F	-248.	1850.	-2290.	4140.	-248.	1850.	-2290.	4140.	-248.	2220.	-1920.	4140.
G	1170.	3190.	-3280.	6460.	1170.	3190.	-3280.	6460.	1280.	4090.	-5990.	10100.
P	-184.	-184.	0.	184.	-2880.	-2880.	0.	2880.	-2720.	-2720.	0.	2720.
T	-184.	-184.	0.	184.	-1460.	-2090.	0.	2090.	-1460.	-2090.	0.	2090.
V	145.	39.9	-2250.	2400.	464.	64.4	-2250.	2720.	464.	64.4	-2250.	2720.
W	107.	319.	4980.	4870.	107.	4290.	4980.	4870.	107.	4290.	4980.	4870.
X	107.	319.	-2320.	2640.	107.	4290.	-2320.	6610.	107.	4290.	-2320.	6610.
Z	0.	0.	0.	0.	3000.	3000.	0.	3000.	3000.	3000.	0.	3000.
BB	0.	0.	0.	0.	3000.	3000.	0.	3000.	3000.	3000.	0.	3000.
CC	0.	0.	-3990.	3990.	10300.	7690.	-3990.	14300.	10300.	7690.	-3990.	14300.
DD	0.	0.	-3990.	3990.	10300.	7690.	-3990.	14300.	10300.	7690.	-3990.	14300.
EE	0.	0.	-3990.	3990.	10300.	7690.	-3990.	14300.	10300.	7690.	-3990.	14300.
GG	0.	0.	-3990.	3990.	10300.	7690.	-3990.	14300.	10300.	7690.	-3990.	14300.
HH	0.	0.	-3990.	3990.	10300.	7690.	-3990.	14300.	10300.	7690.	-3990.	14300.
MAX Loc	1170.	3190.	-6040.	6500.	10300.	7690.	-6040.	14300.	10300.	7690.	-5990.	14300.
	A	A	B	D	CC	CC	B	CC	CC	CC	G	CC
	Structure											
H	-92.2	8790.	-6170.	15000.	-92.2	8790.	-6170.	15000.	-92.2	9520.	-5440.	15000.
J	-298.	6420.	-5830.	12200.	-298.	6420.	-5830.	12200.	-298.	7150.	-5100.	12200.
K	-340.	5920.	-2870.	8790.	-340.	5920.	-2870.	8790.	-340.	6650.	-2130.	8790.
L	-391.	5340.	-1370.	6710.	-391.	5340.	-1370.	6710.	-391.	6070.	-639.	6710.
M	-300.	6260.	-5250.	11500.	-300.	6260.	-5250.	11500.	-300.	6990.	-4520.	11500.
Q	0.	0.	-1810.	1810.	515.	956.	-1810.	2770.	515.	956.	-1810.	2770.
R	0.	0.	-1810.	1810.	2700.	2700.	-1810.	4510.	2700.	2700.	-1810.	4510.
S	145.	39.9	-2250.	2400.	2400.	383.	-2250.	4650.	2400.	383.	-2250.	4650.
Y	107.	319.	-2320.	2640.	107.	4290.	-2320.	6610.	107.	4290.	-2320.	6610.
AA	0.	0.	0.	0.	3000.	3000.	0.	3000.	3000.	3000.	0.	3000.
FF	0.	0.	-49.0	49.0	10300.	7690.	-49.0	10300.	10300.	7690.	-49.0	10300.
JJ	0.	0.	-1810.	1810.	3900.	858.	-1810.	5710.	3900.	858.	-1810.	5710.
MAX Loc	-391.	8790.	-6170.	15000.	10300.	8790.	-6170.	15000.	10300.	9520.	-5440.	15000.
	L	H	H	H	FF	H	H	H	FF	H	H	H
	Bolts											
N	0.	0.	60500.	60500.	0.	0.	60500.	60500.	0.	0.	60500.	60500.
MAX Loc	0.	0.	60500.	60500.	0.	0.	60500.	60500.	0.	0.	60500.	60500.
			N	N			N	N			N	N

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Hypothetical Accident Conditions

25 June 82

Table 2-153 - Summary of Calculated Stresses during 40 Inch Free Fall on Closure Lid

Temperature: 100. °F Full Heat Internal Pressure: 230. psig Axial Accel: 24.5 g's Transverse Accel: .0 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
	Containment Boundary											
A	1120.	4320.	-3360.	7680.	1120.	4320.	-3360.	7680.	1850.	2900.	-5300.	8210.
B	-579.	-259.	-5980.	5720.	-579.	-259.	-5980.	5720.	-566.	260.	-5160.	5420.
C	-195.	1960.	-5860.	7820.	-195.	1960.	-5860.	7820.	-195.	2310.	-5520.	7820.
D	-361.	2250.	-5840.	8090.	-361.	2250.	-5840.	8090.	-361.	2590.	-5490.	8090.
E	-297.	2830.	-3660.	6490.	-297.	2830.	-3660.	6490.	-297.	3170.	-3310.	6490.
F	-299.	3490.	-2230.	5730.	-299.	3490.	-2230.	5730.	-299.	3830.	-1890.	5730.
G	1120.	4320.	-3390.	7710.	1120.	4320.	-3390.	7710.	1270.	5390.	-7300.	12700.
P	-253.	-253.	0.	253.	-2950.	-2950.	0.	2950.	-2730.	-2730.	0.	2730.
T	-253.	-253.	0.	253.	-1530.	-2160.	0.	2160.	-1530.	-2160.	0.	2160.
V	200.	55.0	-2250.	2450.	518.	79.5	-2250.	2770.	518.	79.5	-2250.	2770.
W	147.	439.	7730.	7580.	147.	4410.	7730.	7580.	147.	4410.	7730.	7580.
X	147.	439.	-2320.	2760.	147.	4410.	-2320.	6730.	147.	4410.	-2320.	6730.
Z	0.	0.	0.	0.	3950.	3950.	0.	3950.	3950.	3950.	0.	3950.
BB	0.	0.	0.	0.	3950.	3950.	0.	3950.	3950.	3950.	0.	3950.
CC	0.	0.	-3990.	3990.	11600.	8070.	-3990.	15600.	11600.	8070.	-3990.	15600.
DD	0.	0.	-3990.	3990.	11600.	8070.	-3990.	15600.	11600.	8070.	-3990.	15600.
EE	0.	0.	-3990.	3990.	11600.	8070.	-3990.	15600.	11600.	8070.	-3990.	15600.
GG	0.	0.	-3990.	3990.	11600.	8070.	-3990.	15600.	11600.	8070.	-3990.	15600.
HH	0.	0.	-3990.	3990.	11600.	8070.	-3990.	15600.	11600.	8070.	-3990.	15600.
MAX Loc	1120.	4320.	7730.	8090.	11600.	8070.	7730.	15600.	11600.	8070.	7730.	15600.
	A	A	W	D	CC	CC	W	CC	CC	CC	W	CC
	Structure											
H	12.5	7580.	-6850.	14400.	12.5	7580.	-6850.	14400.	12.5	8250.	-6180.	14400.
J	-193.	5210.	-6510.	11700.	-193.	5210.	-6510.	11700.	-193.	5880.	-5840.	11700.
K	-235.	4710.	-3540.	8260.	-235.	4710.	-3540.	8260.	-235.	5380.	-2870.	8260.
L	-286.	4130.	-2050.	6180.	-286.	4130.	-2050.	6180.	-286.	4800.	-1380.	6180.
M	-196.	5050.	-5970.	11000.	-196.	5050.	-5970.	11000.	-196.	5720.	-5300.	11000.
Q	0.	0.	-1810.	1810.	515.	956.	-1810.	2770.	515.	956.	-1810.	2770.
R	0.	0.	-1810.	1810.	2700.	2700.	-1810.	4510.	2700.	2700.	-1810.	4510.
S	200.	55.0	-2250.	2450.	2450.	398.	-2250.	4710.	2450.	398.	-2250.	4710.
Y	147.	439.	-2320.	2760.	147.	4410.	-2320.	6730.	147.	4410.	-2320.	6730.
AA	0.	0.	0.	0.	3950.	3950.	0.	3950.	3950.	3950.	0.	3950.
FF	0.	0.	-49.0	49.0	11600.	8070.	-49.0	11700.	11600.	8070.	-49.0	11700.
JJ	0.	0.	-1810.	1810.	3900.	858.	-1810.	5710.	3900.	858.	-1810.	5710.
MAX Loc	-286.	7580.	-6850.	14400.	11600.	8070.	-6850.	14400.	11600.	8250.	-6180.	14400.
	L	H	H	H	FF	FF	H	H	FF	H	H	H
	Bolts											
N	0.	0.	68600.	68600.	0.	0.	68600.	68600.	0.	0.	68600.	68600.
MAX Loc	0.	0.	68600.	68600.	0.	0.	68600.	68600.	0.	0.	68600.	68600.
			N	N			N	N			N	N

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Hypothetical Accident Conditions

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Table 2-140 - Summary of Calculated Stresses during -40°F Ambient Conditions

Temperature: -40.°F	No Heat	Internal Pressure: 0. psig	Axial Accel: .0 g's	Transverse Accel: .0 g's	Primary Membrane			Primary Membrane and Primary Bending			Primary Membrane, Bending and Secondary					
					P1	P2	P3	P1	P2	P3	P1	P2	P3	Stress Intensity	Stress Intensity	Stress Intensity
A	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.
B	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.
C	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.
D	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.
E	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.
F	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.
G	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.
P	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Z	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BB	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CC	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DD	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HH	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MAX	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.	83.9	1850.	-1770.	3630.
Loc	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
H	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.
J	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.
K	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.
L	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.
M	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.
Q	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Y	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
AA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FF	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
JJ	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MAX	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.	550.	-6330.	-3900.	6880.
Loc	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
N	0.	0.	16400.	16400.	0.	0.	16400.	16400.	0.	0.	16400.	16400.	0.	0.	16400.	16400.
MAX	0.	0.	16400.	16400.	0.	0.	16400.	16400.	0.	0.	16400.	16400.	0.	0.	16400.	16400.
Loc	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Table 2-141 - Summary of Calculated Stresses during -40°F Ambient Conditions

Temperature: -40.°F Full Heat		Internal Pressure: 0. psig		Axial Accel: .0 g's		Transverse Accel: .0 g's						
Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary				
MAX LOC	Principal Stresses		Stress Intensity	Principal Stresses		Stress Intensity	Principal Stresses		Stress Intensity	Principal Stresses		Stress Intensity
	P1	P2		P3	P1		P2	P1		P2	P3	
A	-83.8	-1850.	1310.	3160.	-83.8	3160.	-83.8	-1470.	1690.	3160.	3160.	
B	-83.8	-1850.	1310.	3160.	-83.8	3160.	-83.8	-1470.	1690.	3160.	3160.	
C	-83.8	-1850.	1310.	3160.	-83.8	3160.	-83.8	-1470.	1690.	3160.	3160.	
D	-83.8	-1850.	1310.	3160.	-83.8	3160.	-83.8	-1470.	1690.	3160.	3160.	
E	-83.8	-1850.	1310.	3160.	-83.8	3160.	-83.8	-1470.	1690.	3160.	3160.	
F	-83.8	-1850.	1310.	3160.	-83.8	3160.	-83.8	-1470.	1690.	3160.	3160.	
G	-83.8	-1850.	1310.	3160.	-83.8	3160.	-83.8	-1470.	1690.	3160.	3160.	
P	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
T	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
V	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
W	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
Z	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
BB	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
CC	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
DD	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
EE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
GG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
HH	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MAX LOC	-83.8	-1850.	1310.	3160.	-83.8	3160.	-83.8	-1470.	1690.	3160.	3160.	
H	-450.	5180.	3140.	5630.	-450.	5630.	-450.	5920.	3880.	6370.	6370.	
J	-450.	5180.	3140.	5630.	-450.	5630.	-450.	5920.	3880.	6370.	6370.	
K	-450.	5180.	3140.	5630.	-450.	5630.	-450.	5920.	3880.	6370.	6370.	
L	-450.	5180.	3140.	5630.	-450.	5630.	-450.	5920.	3880.	6370.	6370.	
M	-450.	5180.	3140.	5630.	-450.	5630.	-450.	5920.	3880.	6370.	6370.	
Q	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
S	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
Y	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
AA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
FF	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
JJ	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MAX LOC	-450.	5180.	3140.	5630.	-450.	5630.	-450.	5920.	3880.	6370.	6370.	
N	0.	0.	27800.	27800.	0.	27800.	0.	0.	27800.	27800.	27800.	
MAX LOC	0.	0.	27800.	27800.	0.	27800.	0.	0.	27800.	27800.	27800.	

Table 2-142 - Summary of Calculated Stresses during -20°F Ambient Conditions

Temperature: -20, °F		No Heat		Internal Pressure: 0, psig		Axial Accel: .0 g's		Transverse Accel: .0 g's			
Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
Principal Stresses		Stress Intensity		Principal Stresses		Stress Intensity		Principal Stresses		Stress Intensity	
P1	P2	P3		P1	P2	P3		P1	P2	P3	
A	83.7	1850.	-1710.	83.7	1850.	-1710.	3560.	83.7	1850.	-1710.	3560.
B	83.7	1850.	-1710.	83.7	1850.	-1710.	3560.	83.7	1850.	-1710.	3560.
C	83.7	1850.	-1710.	83.7	1850.	-1710.	3560.	83.7	1850.	-1710.	3560.
D	83.7	1850.	-1710.	83.7	1850.	-1710.	3560.	83.7	1850.	-1710.	3560.
E	83.7	1850.	-1710.	83.7	1850.	-1710.	3560.	83.7	1850.	-1710.	3560.
F	83.7	1850.	-1710.	83.7	1850.	-1710.	3560.	83.7	1850.	-1710.	3560.
G	83.7	1850.	-1710.	83.7	1850.	-1710.	3560.	83.7	1850.	-1710.	3560.
P	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Z	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BB	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CC	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DD	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HH	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MAX Loc	83.7	1850.	-1710.	83.7	1850.	-1710.	3560.	83.7	1850.	-1710.	3560.
H	537.	-6170.	-3790.	537.	-6170.	-3790.	6710.	537.	-6170.	-3790.	6710.
J	537.	-6170.	-3790.	537.	-6170.	-3790.	6710.	537.	-6170.	-3790.	6710.
K	537.	-6170.	-3790.	537.	-6170.	-3790.	6710.	537.	-6170.	-3790.	6710.
L	537.	-6170.	-3790.	537.	-6170.	-3790.	6710.	537.	-6170.	-3790.	6710.
M	537.	-6170.	-3790.	537.	-6170.	-3790.	6710.	537.	-6170.	-3790.	6710.
Q	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Y	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
AA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FF	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
JJ	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MAX Loc	537.	-6170.	-3790.	537.	-6170.	-3790.	6710.	537.	-6170.	-3790.	6710.
N	0.	0.	17800.	0.	0.	17800.	17800.	0.	0.	17800.	17800.
MAX Loc	0.	0.	17800.	0.	0.	17800.	17800.	0.	0.	17800.	17800.

Table 2-143 - Summary of Calculated Stresses during -20°F Ambient Conditions

Temperature: -20, °F Full Heat Internal Pressure: 0, psig Axial Accel: .0 g's Transverse Accel: .0 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
	Containment Boundary											
A	-81.3	-1800.	1230.	3020.	-81.3	-1800.	1230.	3020.	-81.3	-1420.	1600.	3020.
B	-81.3	-1800.	1230.	3020.	-81.3	-1800.	1230.	3020.	-81.3	-1420.	1600.	3020.
C	-81.3	-1800.	1230.	3020.	-81.3	-1800.	1230.	3020.	-81.3	-1420.	1600.	3020.
D	-81.3	-1800.	1230.	3020.	-81.3	-1800.	1230.	3020.	-81.3	-1420.	1600.	3020.
E	-81.3	-1800.	1230.	3020.	-81.3	-1800.	1230.	3020.	-81.3	-1420.	1600.	3020.
F	-81.3	-1800.	1230.	3020.	-81.3	-1800.	1230.	3020.	-81.3	-1420.	1600.	3020.
G	-81.3	-1800.	1230.	3020.	-81.3	-1800.	1230.	3020.	-81.3	-1420.	1600.	3020.
P	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Z	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BB	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CC	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DD	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HH	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MAX Loc	-81.3	-1800.	1230.	3020.	-81.3	-1800.	1230.	3020.	-81.3	-1420.	1600.	3020.
	A	A	A	A	A	A	A	A	A	A	A	A
	Structure											
H	-428.	4920.	2980.	5350.	-428.	4920.	2980.	5350.	-428.	5650.	3710.	6080.
J	-428.	4920.	2980.	5350.	-428.	4920.	2980.	5350.	-428.	5650.	3710.	6080.
K	-428.	4920.	2980.	5350.	-428.	4920.	2980.	5350.	-428.	5650.	3710.	6080.
L	-428.	4920.	2980.	5350.	-428.	4920.	2980.	5350.	-428.	5650.	3710.	6080.
M	-428.	4920.	2980.	5350.	-428.	4920.	2980.	5350.	-428.	5650.	3710.	6080.
Q	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Y	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
AA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FF	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
JJ	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MAX Loc	-428.	4920.	2980.	5350.	-428.	4920.	2980.	5350.	-428.	5650.	3710.	6080.
	H	H	H	H	H	H	H	H	H	H	H	H
	Bolts											
N	0.	0.	28800.	28800.	0.	0.	28800.	28800.	0.	0.	28800.	28800.
MAX Loc	0.	0.	28800.	28800.	0.	0.	28800.	28800.	0.	0.	28800.	28800.
			N	N			N	N			N	N

2-277

Table 2-144 - Summary of Calculated Stresses during 100°F Ambient Conditions

Temperature: 100.°F Full Heat Internal Pressure: 0. psig Axial Accel: .0 g's Transverse Accel: .0 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity	Principal Stresses			Stress Intensity
	P1	P2	P3		P1	P2	P3		P1	P2	P3	
Containment Boundary												
A	-69.9	-1540.	847.	2390.	-69.9	-1540.	847.	2390.	-69.9	-1200.	1190.	2390.
B	-69.9	-1540.	847.	2390.	-69.9	-1540.	847.	2390.	-69.9	-1200.	1190.	2390.
C	-69.9	-1540.	847.	2390.	-69.9	-1540.	847.	2390.	-69.9	-1200.	1190.	2390.
D	-69.9	-1540.	847.	2390.	-69.9	-1540.	847.	2390.	-69.9	-1200.	1190.	2390.
E	-69.9	-1540.	847.	2390.	-69.9	-1540.	847.	2390.	-69.9	-1200.	1190.	2390.
F	-69.9	-1540.	847.	2390.	-69.9	-1540.	847.	2390.	-69.9	-1200.	1190.	2390.
G	-69.9	-1540.	847.	2390.	-69.9	-1540.	847.	2390.	-69.9	-1200.	1190.	2390.
P	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Z	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BB	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CC	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DD	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HH	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MAX Loc	-69.9 A	-1540. A	847. A	2390. A	-69.9 A	-1540. A	847. A	2390. A	-69.9 A	-1200. A	1190. A	2390. A
Structure												
H	-323.	3710.	2220.	4030.	-323.	3710.	2220.	4030.	-323.	4380.	2900.	4710.
J	-323.	3710.	2220.	4030.	-323.	3710.	2220.	4030.	-323.	4380.	2900.	4710.
K	-323.	3710.	2220.	4030.	-323.	3710.	2220.	4030.	-323.	4380.	2900.	4710.
L	-323.	3710.	2220.	4030.	-323.	3710.	2220.	4030.	-323.	4380.	2900.	4710.
M	-323.	3710.	2220.	4030.	-323.	3710.	2220.	4030.	-323.	4380.	2900.	4710.
Q	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Y	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
AA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FF	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
JJ	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MAX Loc	-323. H	3710. H	2220. H	4030. H	-323. H	3710. H	2220. H	4030. H	-323. H	4380. H	2900. H	4710. H
Bolts												
N	0.	0.	33900.	33900.	0.	0.	33900.	33900.	0.	0.	33900.	33900.
MAX Loc	0. N	0. N	33900. N	33900. N	0. N	0. N	33900. N	33900. N	0. N	0. N	33900. N	33900. N

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Table 2-145 - Summary of Calculated Stresses during 130°F Ambient Conditions

Temperature: 130.°F Full Heat Internal Pressure: 0. psig Axial Accel: .0 g's Transverse Accel: .0 g's

	Primary Membrane				Primary Membrane and Primary Bonding				Primary Membrane, Bonding and Secondary			
	Principal Stresses P1	P2	P3	Stress Intensity	Principal Stresses P1	P2	P3	Stress Intensity	Principal Stresses P1	P2	P3	Stress Intensity
Containment Boundary												
A	-65.8	-1450.	742.	2200.	-65.8	-1450.	742.	2200.	-65.8	-1120.	1080.	2200.
B	-65.8	-1450.	742.	2200.	-65.8	-1450.	742.	2200.	-65.8	-1120.	1080.	2200.
C	-65.8	-1450.	742.	2200.	-65.8	-1450.	742.	2200.	-65.8	-1120.	1080.	2200.
D	-65.8	-1450.	742.	2200.	-65.8	-1450.	742.	2200.	-65.8	-1120.	1080.	2200.
E	-65.8	-1450.	742.	2200.	-65.8	-1450.	742.	2200.	-65.8	-1120.	1080.	2200.
F	-65.8	-1450.	742.	2200.	-65.8	-1450.	742.	2200.	-65.8	-1120.	1080.	2200.
G	-65.8	-1450.	742.	2200.	-65.8	-1450.	742.	2200.	-65.8	-1120.	1080.	2200.
P	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Z	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BB	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CC	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DD	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HH	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MAX Loc	-65.8 A	-1450. A	742. A	2200. A	-65.8 A	-1450. A	742. A	2200. A	-65.8 A	-1120. A	1080. A	2200. A
Structure												
H	-292.	3360.	2000.	3650.	-292.	3360.	2000.	3650.	-292.	4020.	2670.	4320.
J	-292.	3360.	2000.	3650.	-292.	3360.	2000.	3650.	-292.	4020.	2670.	4320.
K	-292.	3360.	2000.	3650.	-292.	3360.	2000.	3650.	-292.	4020.	2670.	4320.
L	-292.	3360.	2000.	3650.	-292.	3360.	2000.	3650.	-292.	4020.	2670.	4320.
M	-292.	3360.	2000.	3650.	-292.	3360.	2000.	3650.	-292.	4020.	2670.	4320.
Q	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Y	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
AA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FF	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
JJ	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MAX Loc	-292. H	3360. H	2000. H	3650. H	-292. H	3360. H	2000. H	3650. H	-292. H	4020. H	2670. H	4320. H
Bolts												
N	0.	0.	34700.	34700.	0.	0.	34700.	34700.	0.	0.	34700.	34700.
MAX Loc	0.	0.	34700. N	34700. N	0.	0.	34700. N	34700. N	0.	0.	34700. N	34700. N

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Table 2-146 - Summary of Calculated Stresses during Fire Accident

Temperature: 100.°F Full Heat Internal Pressure: 0. psig Axial Accel: .0 g's Transverse Accel: .0 g's

	Primary Membrane				Primary Membrane and Primary Bending				Primary Membrane, Bending and Secondary			
	Principal Stresses P1	P2	P3	Stress Intensity	Principal Stresses P1	P2	P3	Stress Intensity	Principal Stresses P1	P2	P3	Stress Intensity
	Containment Boundary											
A	-24.4	-540.	163.	703.	-24.4	-540.	163.	703.	-24.4	-241.	462.	703.
B	-24.4	-540.	163.	703.	-24.4	-540.	163.	703.	-24.4	-241.	462.	703.
C	-24.4	-540.	163.	703.	-24.4	-540.	163.	703.	-24.4	-241.	462.	703.
D	-24.4	-540.	163.	703.	-24.4	-540.	163.	703.	-24.4	-241.	462.	703.
E	-24.4	-540.	163.	703.	-24.4	-540.	163.	703.	-24.4	-241.	462.	703.
F	-24.4	-540.	163.	703.	-24.4	-540.	163.	703.	-24.4	-241.	462.	703.
G	-24.4	-540.	163.	703.	-24.4	-540.	163.	703.	-24.4	-241.	462.	703.
P	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
T	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
V	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Z	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BB	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CC	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DD	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GG	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HH	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MAX Loc	-24.4 A	-540. A	163. A	703. A	-24.4 A	-540. A	163. A	703. A	-24.4 A	-241. A	462. A	703. A
	Structure											
H	-84.4	970.	562.	1050.	-84.4	970.	562.	1050.	-84.4	1560.	1150.	1640.
J	-84.4	970.	562.	1050.	-84.4	970.	562.	1050.	-84.4	1560.	1150.	1640.
K	-84.4	970.	562.	1050.	-84.4	970.	562.	1050.	-84.4	1560.	1150.	1640.
L	-84.4	970.	562.	1050.	-84.4	970.	562.	1050.	-84.4	1560.	1150.	1640.
M	-84.4	970.	562.	1050.	-84.4	970.	562.	1050.	-84.4	1560.	1150.	1640.
Q	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
R	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Y	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
AA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FF	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
JJ	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MAX Loc	-84.4 H	970. H	562. H	1050. H	-84.4 H	970. H	562. H	1050. H	-84.4 H	1560. H	1150. H	1640. H
	Bolts											
N	0.	0.	39500.	39500.	0.	0.	39500.	39500.	0.	0.	39500.	39500.
MAX Loc	0. N	0. N	39500. N	39500. N	0. N	0. N	39500. N	39500. N	0. N	0. N	39500. N	39500. N

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Hoop Bending Stress (Sg')

$$Sg' = \nu S'_1 \qquad \nu = 0.275 \text{ psi}$$

$$Sg' = -7.618 \text{ psi} \qquad S'_1 = -27.703 \text{ psi}$$

Hoop Stress (S₂)

At x = 0.0 in. from bottom of containment.

$$S_2 = \frac{2\lambda^2 R M_0 e^{-\lambda x} (\cos \lambda x - \sin \lambda x)}{t} \text{ for } x = 0, S_2 = \text{Max } S_2$$

$$\text{Max } S_2 = S_2 = \frac{2\lambda^2 R M_0}{t}$$

$$\lambda^2 = 0.476$$

$$R = 7.0 \text{ in}$$

$$M_0 = 1.1543 \frac{\text{in-lbf}}{\text{in}}$$

$$S_2 = 15.388 \text{ psi}$$

$$t = 0.50 \text{ in}$$

Maximum Hoop Stress (Max S₂)

$$\text{Max } S_2 = \frac{2\lambda^2 R M_0}{t} \qquad \text{previously calculated}$$

$$\text{Max } S_2 = S_2$$

Shear Stress (S_s)

At x = 0.0 in. from bottom of containment

$$S_s = \frac{2 M_0 e^{-\lambda x} \sin \lambda x}{t}$$

$$x = 0.0 \text{ in}$$

$$\sin(0) = 0.0$$

$$S_s = 0.0 \text{ by inspection}$$

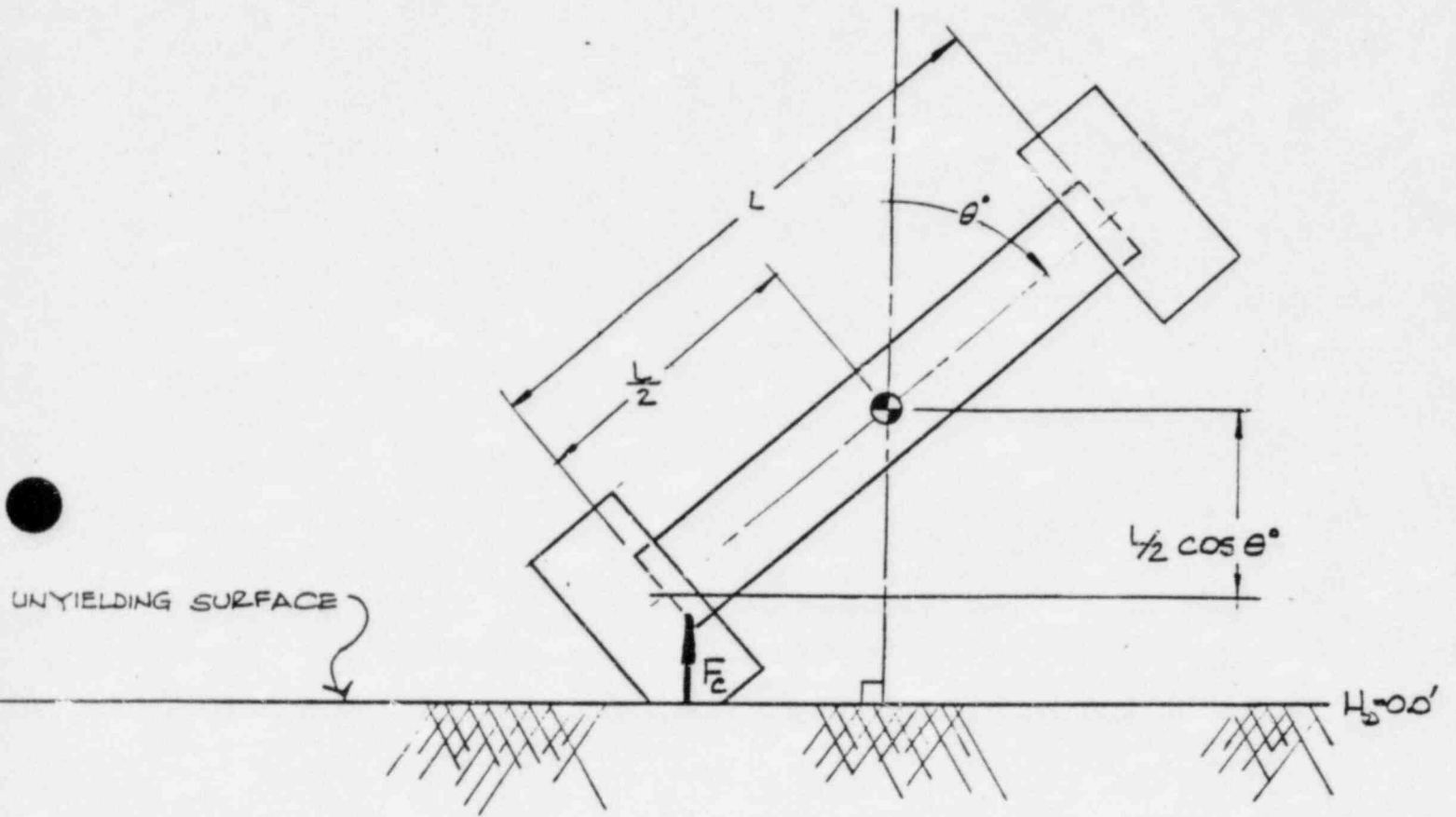


Figure 2-38r Additional Center of Mass Height $\frac{L}{2} \cos \theta$

(Region 5) $L_t = 4.80$ inches

$$P_{I5} = a_1 + 20.6b_2 + 5.00b_3 + 140.9b_4 + 672.5 + 6.27L$$

$$\delta_{I5} = \frac{0.218a_1 + 4.49b_2 + 1.09b_3 + 30.8b_4 + 150.1}{E} \quad (13)$$

$$P_{\theta 5} = c_1 + 20.6d_2 + 5.00d_3 + 140.9d_4 + 10280. + 59.6L$$

$$\delta_{\theta 5} = \frac{0.218a_1 + 0.875d_2 + 0.213d_3 + 5.99d_4 + 442.9}{E} \quad (14)$$

Since the total axial shortening of the inner and outer shells are equal,

$$\delta_{I1} + \delta_{I2} + \delta_{I3} + \delta_{I4} + \delta_{I5} - \delta_{\theta 1} - \delta_{\theta 2} - \delta_{\theta 3} - \delta_{\theta 4} - \delta_{\theta 5} = 0$$

The concentrated end load is distributed to the inner and outer shells based on their cross-sectional areas:

$$103.1a_1 - 22.0c_1 = 0.00 \quad (16)$$

The relative portions of the weight of the lead supported by the inner and outer shells is a function of the surface area of each.

$$\text{(Inner Shell)} A_S = 44.4 \text{ in.}^2$$

$$\text{(Upper Outer Shell)} A_S = 78.5 \text{ in.}^2$$

$$\text{(Lower Outer Shell)} A_S = 86.4 \text{ in.}^2$$

then,

$$\frac{b_4}{d_4} = \frac{78.5}{86.4} \frac{b_2}{d_2} = \frac{78.5}{86.4} \frac{b_3}{d_3}$$

This relationship is satisfied when the following equations are used in conjunction with those previously developed:

$$b_2 - 0.137d_2 = 0.00 \quad (17)$$

$$b_3 - 0.137d_3 = 0.00 \quad (18)$$

Since the solution of these eighteen (18) simultaneous equations is a function of the modulus of elasticity of the shells which varies with temperature, solutions are obtained for the following three bounding case temperatures:

- (1) $T = -20^\circ\text{F}$ $E = 28.9 \times 10^6 \text{ psi}$
- (2) $T = +170^\circ\text{F}$ $E = 27.8 \times 10^6 \text{ psi}$
- (3) $T = +295^\circ\text{F}$ $E = 27.1 \times 10^6 \text{ psi}$

The loads calculated are essentially identical for all three cases, and the displacements are slightly larger at $T = +295^\circ\text{F}$. Since the allowable stress limits are more limiting at $T = +295^\circ\text{F}$ also, all stress calculations for the unit load end drop cases are based on this temperature. The solution of the eighteen simultaneous equations at $T = +295^\circ\text{F}$ is presented in Table 2-154.

Table 2-154
LOAD DISTRIBUTION SOLUTION FOR THE
FREE DROP BOTTOM END IMPACT

$a_1 = 545 \text{ lbs.}$	$\delta_{I1} = 0.432 \times 10^{-5} \text{ in.}$
$c_1 = 2,555 \text{ lbs.}$	$\delta_{\theta 1} = 0.442 \times 10^{-5} \text{ in.}$
$b_2 = 18.7 \text{ lbs.}$	$\delta_{I2} = 0.450 \times 10^{-4} \text{ in.}$
$d_2 = 144.2 \text{ lbs.}$	$\delta_{\theta 2} = 0.359 \times 10^{-4} \text{ in.}$
$b_3 = 18.7 \text{ lbs.}$	$\delta_{I3} = 0.149 \times 10^{-4} \text{ in.}$
$d_3 = 144.2 \text{ lbs.}$	$\delta_{\theta 3} = 0.642 \times 10^{-5} \text{ in.}$
$b_4 = 20.8 \text{ lbs.}$	$\delta_{I4} = 0.110 \times 10^{-2} \text{ in.}$
$d_4 = 164.6 \text{ lbs.}$	$\delta_{\theta 4} = 0.100 \times 10^{-2} \text{ in.}$
	$\delta_{I5} = 0.373 \times 10^{-4} \text{ in.}$
	$\delta_{\theta 5} = 0.623 \times 10^{-4} \text{ in.}$

Inner Shell (Reference 2.9, Page 239, Case 80)

$$a = 14.375 \text{ in.} \quad b = 6.906 \text{ in.} \quad W = 4,630 \text{ lbs.}$$

$$S_r = S_h = 14 \text{ psi} \quad (\text{center of end casting})$$

Then the total stresses at Point P are:

$$S_r = S_h = 96.0 + 14.0 = 110 \text{ psi}$$

All other stress components are = 0. psi

(Point Q) The analysis utilizes the same cases as were used for Point P, except that the stresses are calculated at the edge of the plate.

Outer Shell

$$S_r = 150 \text{ psi}$$

(Edge of end casting)

$$S_h = 40 \text{ psi}$$

Inner Shell

$$S_r = 20 \text{ psi} \quad (\text{Edge of end casting})$$

At Point Q where $r = 6.75 \text{ in.}$,

$$S_a = -\frac{Wt}{A} = -\frac{52,000}{\pi(30.0)^2/4} = -74.0 \text{ psi}$$

$$S_r = -110 + \frac{(110 + 170)}{14.375} (6.75) = 21 \text{ psi}$$

$$S_h = -110 + \frac{(110 + 40)}{14.375} (6.75) = -39 \text{ psi}$$

All other stress components are = 0. psi

(Point T) (Reference Points P and Q calculations)

Point T is on the top face of the end casting.

$$S_r = 110 - (3.0) \left(\frac{110 + 170}{14.375} \right) = 52 \text{ psi}$$

$$S_h = 110 - (3.0) \left(\frac{110 + 40}{14.375} \right) = 78 \text{ psi}$$

All other stress components are = 0. psi

(Point V) (Reference Point S calculations)

Point V is 4.5 inches below the top face of the end casting on an 11.25 inch radius.

(Interpolating axially)

$$\text{At the center, } S_r = S_h = (-110) \left(\frac{0.5}{4.0} \right) = -14 \text{ psi}$$

$$\text{At the edge, } S_r = (170) \left(\frac{0.5}{4.0} \right) = 21 \text{ psi}$$

$$S_h = (40) \left(\frac{0.5}{4.0} \right) = 5 \text{ psi}$$

(Interpolating radially)

$$S_r = -14 - (11.25) \left(\frac{14 + 21}{14.375} \right) = 13 \text{ psi}$$

$$S_h = -14 - (11.25) \left(\frac{14 + 5}{14.375} \right) = 1 \text{ psi}$$

$S_A = -92$ psi (Reference Point S calculations)

All other stress components are = 0. psi

(Point JJ) (Reference Point Q calculations)

$$S_r = -110 + (13.81) \left(\frac{110 + 170}{14.375} \right) = 159 \text{ psi}$$

$$S_h = -110 + (13.81) \left(\frac{110 + 40}{14.375} \right) = 35 \text{ psi}$$

$$S_A = -74 \text{ psi}$$

All other stress components are = 0. psi

(Point W) The upper end casting is analyzed as a circular plate with a circular hole loaded by the weight of the closure lid, Reference 2.9, Page 237, Case 76:

$$\begin{array}{lll} a = 15.0 \text{ in.} & a/b = 1.71 & w = \frac{600}{\pi(15.0^2 - 8.75^2)} \\ b = 8.75 \text{ in.} & \beta = 0.124 & = 1.29 \text{ lbs/in.} \\ t = 7.5 \text{ in.} & W_{LID} = 600 \text{ lbs.} & \end{array}$$

$$S_r = 1.0 \text{ psi}$$

$$S_A = - \frac{600}{\pi(12.75^2 - 8.75^2)} = -2.0 \text{ psi}$$

All other stress components are = 0. psi

(Point X) $S_r = 1.0 \text{ psi}$ (Reference Point W calculations)

$$S_A = -2.0 \text{ psi}$$

All other stress components are = 0. psi

(Point Y) $S_r = 1.0 \text{ psi}$ (Reference Point W calculations)

$$S_A = -2.0 \text{ psi}$$

All other stress components are = 0. psi

(Point Z) The closure lid is analyzed as a rigid central plug with a 2.0-inch thick flange which has a 12.75-inch outer radius and an 8.75-inch inner radius (also the plug's outer radius). The effective center of pressure on the flange is assumed to be at a radius of 10.75 inches.

$$W_{LID} = 600 \text{ lbs.}$$

$$w = \frac{600}{(2)(\pi)(10.75)} = 8.88 \text{ lbs/in.}$$

$$M = (8.88)(10.75-8.75) = 17.8 \text{ in-lb/in.}$$

$$S_r = S_h = \frac{6M}{t^2} = 2.0 \text{ psi} \quad (t = 7.5 \text{ inches in central plug region})$$

All other stress components are = 0. psi

(Point AA) $S_r = S_h = -2.0 \text{ psi}$ (Reference Point Z calculations)

All other stress components are = 0. psi

(Point BB) $S_r = S_h = -2.0 \text{ psi}$ (Reference Point Z calculations)

All other stress components are = 0. psi

(Point CC) $S_r = S_h = \frac{6M}{t^2} = -27 \text{ psi}$ ($t = 2.0 \text{ inches in flange region}$)

$$S_A = -\frac{600}{(\pi)(12.75^2-8.75^2)} = -2.0 \text{ psi}$$

All other stress components are = 0. psi