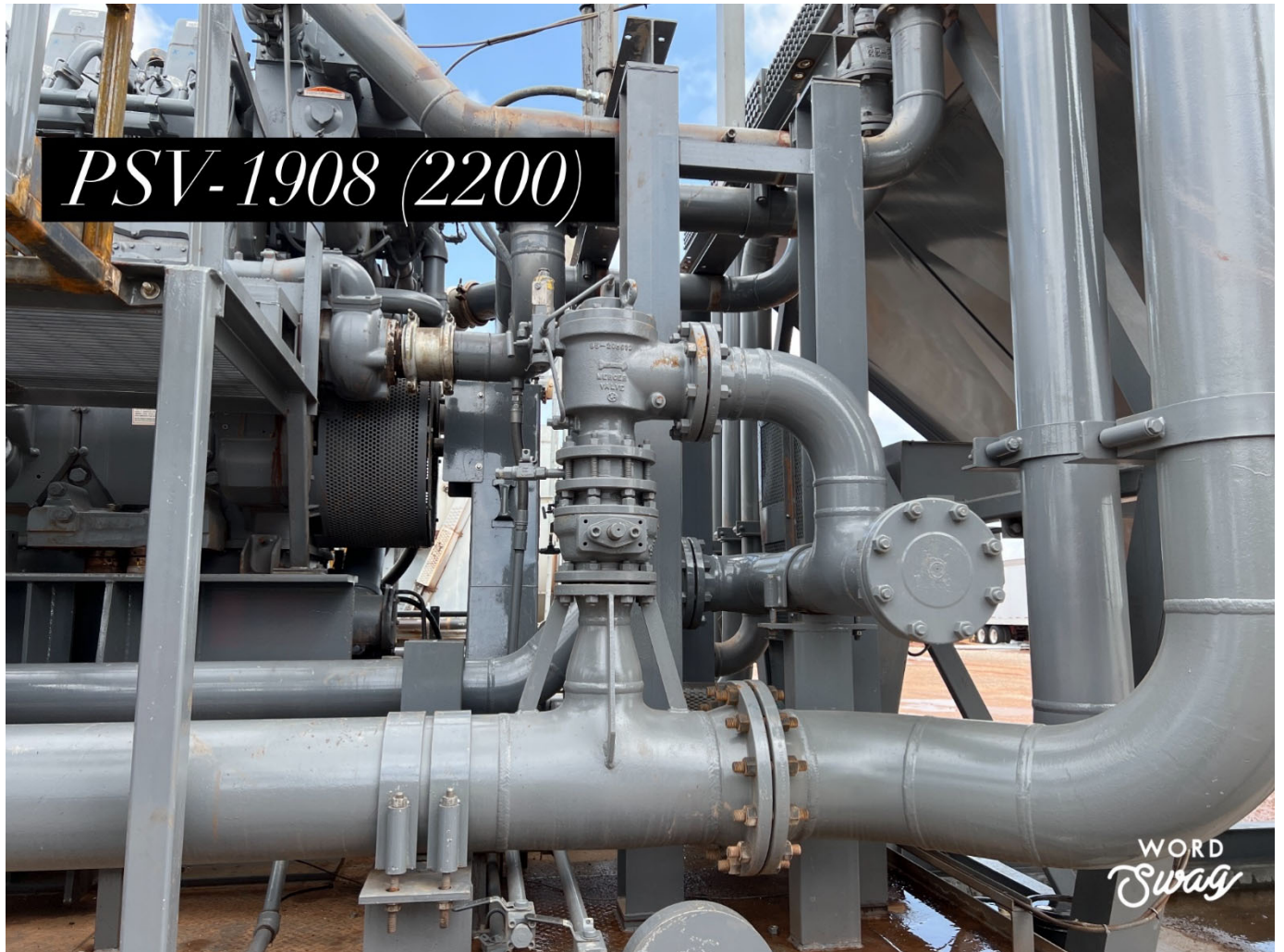
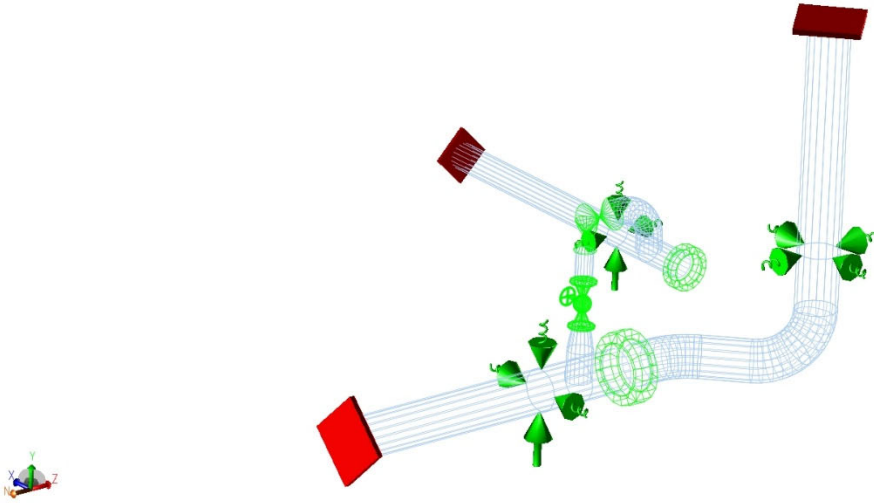


PSV-1908(2200) PIPE STRESS ANALYSIS – REVISION A

PSV-1908(2200) - PASSED





Scope Summary

This evaluation determines the impact of the applied forces on the inlet and outlet piping that are developed when the relief valve opens. The relief valve is assumed to open instantaneously achieving actual capacity. The flow is then modeled in time steps as the flow travels down the discharge piping. A dynamic load factor (DLF) of 2.0 was multiplied to the applied and forces on the leading edge of the flow while a DLF of 1.0 was used for upstream bends when flow has been established. These cases have been identified as occasional (OCC) in CAESAR. In addition, one case has been run to model the system after flow has been completely established based on the reaction forces at the pipe exit at the established boundary of the system. This case has been categorized as sustained (SUS).

Both the reaction applied forces which is based on the design case for the relief valve have been determined based on guidance and equations from API STD 520 Part II below. The applied (momentum) force is the first term in the equation and yields approximately the same result as using Mass Flow x Velocity / Gravitational Constant. The “P” in the below equation is the choke pressure or zero if not choked based on the ID of the pipe in question. For this reason, the reaction force may differ from the value listed in the relief valve documentation binder where the reaction force is quantified based on the final (exit) fitting diameter.

It should be noted that the overall impact of thermal contraction or expansion on the system as a whole has not been evaluated. Identification of any concerns with thermal growth would require a wider evaluation of the overall vent header system that is beyond the scope of this effort. Furthermore, seismic and wind considerations are also beyond the scope of the evaluation.

PSV-1908(2200) PIPE STRESS ANALYSIS – REVISION A

4.4.1.1 Vapor Discharge

The following formula is based on a condition of critical steady-state flow of a compressible fluid that discharges to the atmosphere through an elbow and a vertical discharge pipe. The reaction force (F) includes the effects of both momentum and static pressure; thus, for any gas, vapor, or steam.

In U.S. customary units,

$$F = \frac{W}{366} \sqrt{\frac{kT}{(k+1)M}} + (AP)$$

Inputs

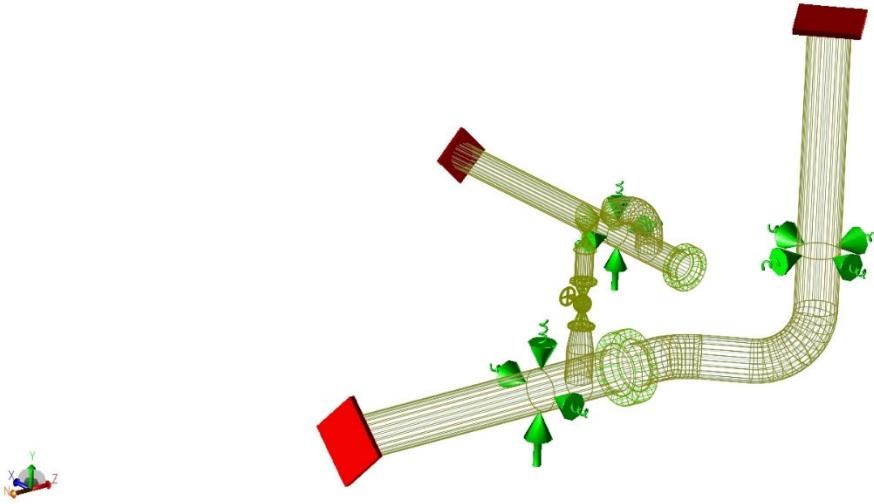
Inlet Pipe Material = A106B
Outlet Pipe Material = A106B
PSV = 4L6 Set @ 215 psig
Design Case = Blocked Discharge
Actual Relief Valve Capacity = 40,242 lb/hr
Fluid Molecular Weight = 21.6
Upstream Relief Pressure (P1) = 236.5 psig
Upstream Relief Temperature (T1) = 290° F
Downstream Static Pressure (P1) = 82.5 psig
Downstream Static Pipe Temperature (T1) = 282° F
Downstream Relief Fluid K Value = 1.25
Pipe ID for Choke Pressure Calculation = 6.065"
Exit Choke Pressure for Reaction Forces (P) = 0 psig
Velocity = 1,050 fps
Applied Total Momentum Force (DLF = 1.0) = 475 lb_f
Resultant Applied Force 90° Elbow (DLF = 1.0) = 672 lb_f @ 45°
Total Reaction Force (DLF = 1.0) = 475 lb_f

Model Assumptions

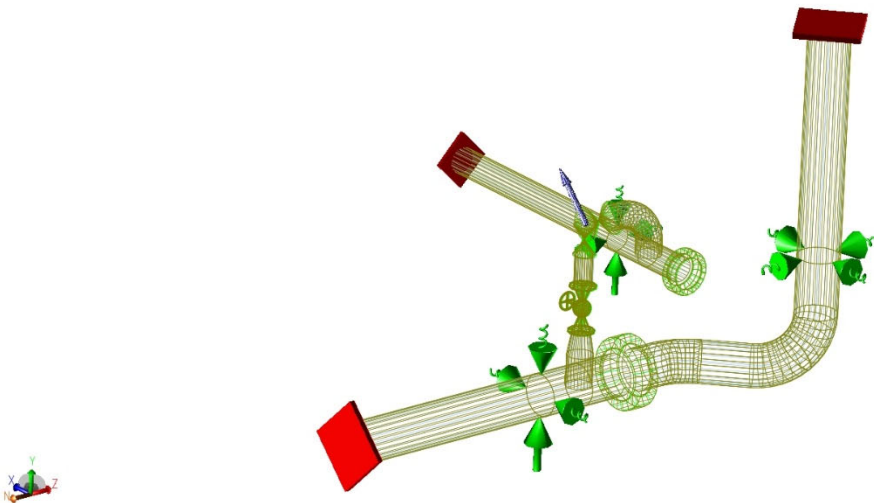
U Clamp Stiffness = 10,000 lb_f/in
U Clamp Coefficient of Friction = 0.3
SIF's = CAESAR II Defaults
Applicable Codes and Standards = ASME B31.1, ASME B31.3 and API STD 520 PT 2

PSV-1908(2200) PIPE STRESS ANALYSIS – REVISION A

Case 1 – Displacement Plot

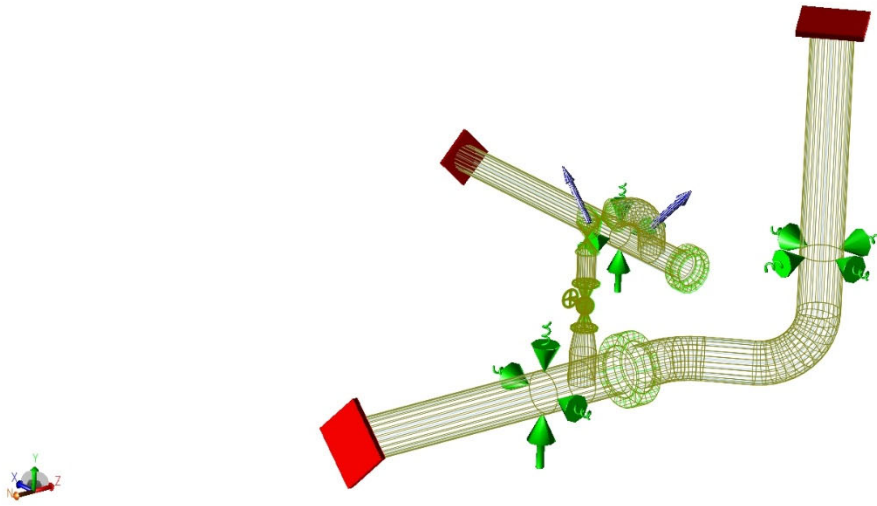


Case 2 – Displacement Plot

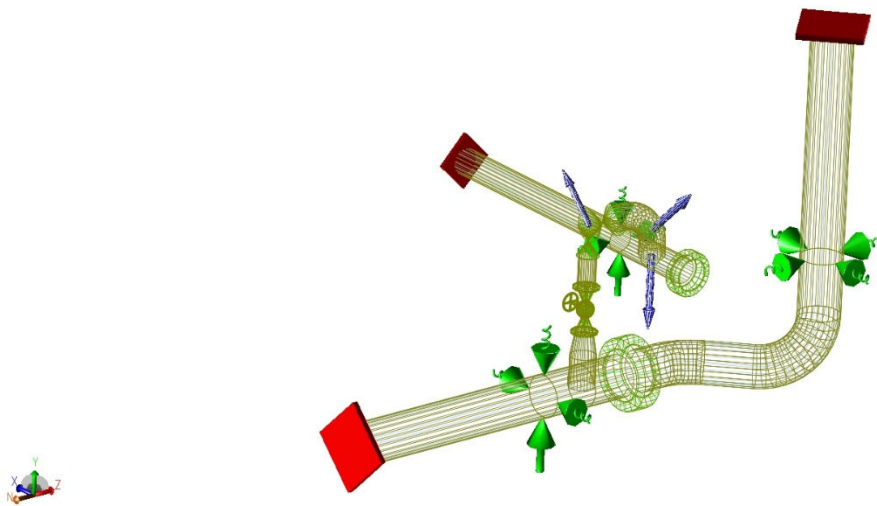


PSV-1908(2200) PIPE STRESS ANALYSIS – REVISION A

Case 3 – Displacement Plot



Case 4 – Displacement Plot



PSV-1908(2200) PIPE STRESS ANALYSIS – REVISION A

Case 5 – Displacement Plot

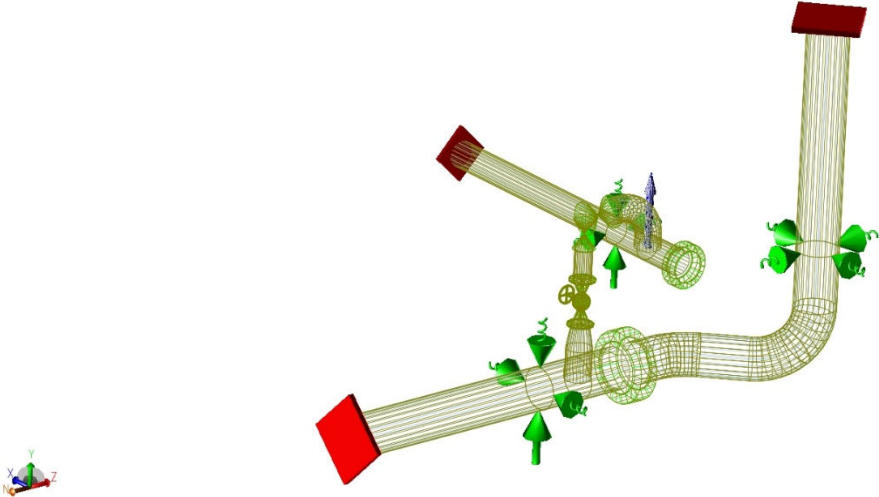


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CAESAR II Ver.13.00.00.0890, (Build 220811) Date: JAN 17, 2024 Time: 12:36
Job:: PSV-1908 (2200) STRESS ANALYSIS REV A
Licensed To:: RKR Engineering and Consulting

LISTING OF STATIC LOAD CASES FOR THIS ANALYSIS

1 (SUS) W+P1
2 (OCC) W+P1+F1
3 (OCC) W+P1+F2
4 (OCC) W+P1+F3
5 (SUS) W+P1+F4 CAESAR II Ver.13.00.00.0890, (Build 220811) Date:JAN
17,2024 @12:36 Pg: 1

CAESAR II LOAD CASE REPORT
DATE:JAN 17,2024

CASE 1 (SUS) W+P1
SUSTAINED

Keep/Discard: Keep
Display: Disp/Force/Stress
Elastic Modulus: EC
Friction Mult.: 1.0000
Fluid Den Mult.: 1.0000
SUS/OCC case SH: SH_MIN
OCC Load Factor: 0.0000
Flg Analysis Temp: None

CASE 2 (OCC) W+P1+F1
TIME STEP 1 - NO THERMAL

Keep/Discard: Keep
Display: Disp/Force/Stress
Elastic Modulus: EC
Friction Mult.: 1.0000
Fluid Den Mult.: 1.0000
SUS/OCC case SH: SH_MIN
OCC Load Factor: 0.0000
Flg Analysis Temp: None

CASE 3 (OCC) W+P1+F2
TIME STEP 2 - NO THERMAL

Keep/Discard: Keep
Display: Disp/Force/Stress
Elastic Modulus: EC
Friction Mult.: 1.0000
Fluid Den Mult.: 1.0000
SUS/OCC case SH: SH_MIN
OCC Load Factor: 0.0000
Flg Analysis Temp: None

CASE 4 (OCC) W+P1+F3
TIME STEP 3- NO THERMAL

Keep/Discard: Keep
Display: Disp/Force/Stress
Elastic Modulus: EC
Friction Mult.: 1.0000
Fluid Den Mult.: 1.0000
SUS/OCC case SH: SH_MIN
OCC Load Factor: 0.0000
Flg Analysis Temp: None

CASE 5 (SUS) W+P1+F4
SUSTAINED FLOW

Keep/Discard: Keep
Display: Disp/Force/Stress
Elastic Modulus: EC
Friction Mult.: 1.0000
Fluid Den Mult.: 1.0000
SUS/OCC case SH: SH_MIN

CAESAR II Ver.13.00.00.0890, (Build 220811) Date: JAN 17, 2024 Time: 12:36
Job:: PSV-1908 (2200) STRESS ANALYSIS REV A
Licensed To:: RKR Engineering and Consulting

CAESAR II LOAD CASE REPORT
DATE:JAN 17,2024

OCC Load Factor: 0.0000
Flg Analysis Temp: None

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 1 (SUS) W+P1

Piping Code (1 of 1): B31.3 -2020, June 18, 2021

The SLP column shows the longitudinal pressure stress.

Stresses Evaluation CHECK PASSED : LOADCASE 1 (SUS) W+P1

Highest Stresses: (lb./sq.in.)

Ratio (%):	9.3	@Node	20
Code:	1858.6	Allowable:	20000.0
SLP	1566.1	@Node	10
F/A	305.7	@Node	110
Bending	660.1	@Node	110
Torsion	22.7	@Node	30
SIF/Index In-Plane	2.5	@Node	55
SIF/Index Out-Plane	2.1	@Node	55
SIF/Index Torsion	1.0	@Node	10
SIF/Index Axial	1.0	@Node	10

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out- Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
10	1566.1	-0.7	73.3	11.9	1.000	1.000	1.000	1.000	1638.8	20000.0	8.2	
20	1566.1	-0.7	293.1	-11.9	1.000	1.000	1.000	1.000	1858.6	20000.0	9.3	
20	1566.1	-0.9	293.1	11.9	1.000	1.000	1.000	1.000	1858.5	20000.0	9.3	
30	1566.1	-0.9	137.1	-11.9	1.000	1.000	1.000	1.000	1702.5	20000.0	8.5	
30	1224.2	-177.5	205.1	0.6	1.000	1.000	1.000	1.000	1251.8	20000.0	6.3	
100	1224.2	-175.2	167.8	-0.6	1.000	1.000	1.000	1.000	1216.8	20000.0	6.1	
100	1224.2	-175.2	299.4	0.6	1.784	1.784	1.000	1.000	1348.4	20000.0	6.7	
110	948.5	-305.7	660.1	-1.7	1.784	1.784	1.000	1.000	1303.0	20000.0	6.5	
30	1566.1	2.4	83.8	22.7	1.000	1.000	1.000	1.000	1652.9	20000.0	8.3	

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 1 (SUS) W+P1

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out-Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
40	1566.1	2.4	94.9	-22.7	1.000	1.000	1.000	1.000	1663.9	20000.0	8.3	
40												
50												
50	1566.1	2.4	91.6	22.7	1.000	1.000	1.000	1.000	1660.6	20000.0	8.3	
55	1566.1	3.0	165.5	-6.7	2.504	2.086	1.000	1.000	1734.6	20000.0	8.7	
55	1566.1	3.0	165.5	6.7	2.504	2.086	1.000	1.000	1734.6	20000.0	8.7	
60	1566.1	3.3	127.5	7.3	2.504	2.086	1.000	1.000	1696.9	20000.0	8.5	
60	1566.1	3.3	60.9	-7.3	1.000	1.000	1.000	1.000	1630.3	20000.0	8.2	
65	1566.1	13.3	112.3	7.5	2.504	2.086	1.000	1.000	1691.7	20000.0	8.5	
65	1566.1	13.3	112.3	-7.5	2.504	2.086	1.000	1.000	1691.7	20000.0	8.5	
70	1566.1	19.0	153.6	3.3	2.504	2.086	1.000	1.000	1738.6	20000.0	8.7	
70	1566.1	19.0	61.9	-3.3	1.000	1.000	1.000	1.000	1646.9	20000.0	8.2	
80	1566.1	23.3	43.4	3.3	1.000	1.000	1.000	1.000	1632.8	20000.0	8.2	
80	1566.1	23.3	43.4	-3.3	1.000	1.000	1.000	1.000	1632.8	20000.0	8.2	
90	1566.1	40.5	37.4	3.3	1.000	1.000	1.000	1.000	1643.9	20000.0	8.2	
110												
120												
120	948.5	-53.3	225.0	1.7	1.000	1.000	1.000	1.000	1120.2	20000.0	5.6	
130	948.5	-51.0	133.2	-1.7	1.000	1.000	1.000	1.000	1030.7	20000.0	5.2	
130												
140												
140												

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 1 (SUS) W+P1

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out-Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
150												
150	164.6	-6.9	15.2	-12.9	1.000	1.000	1.000	1.000	174.8	20000.0	0.9	
155	164.6	-11.7	87.5	3.2	2.259	1.882	1.000	1.000	240.5	20000.0	1.2	
155	164.6	-11.7	87.5	-3.2	2.259	1.882	1.000	1.000	240.5	20000.0	1.2	
160	164.6	-11.7	76.8	-11.5	2.259	1.882	1.000	1.000	230.9	20000.0	1.2	
160	164.6	-11.7	39.6	11.5	1.000	1.000	1.000	1.000	193.9	20000.0	1.0	
170	164.6	-12.5	40.3	-11.5	1.000	1.000	1.000	1.000	193.7	20000.0	1.0	
170	164.6	-0.0	54.1	0.0	1.000	1.000	1.000	1.000	218.7	20000.0	1.1	
180	164.6	-0.0	5.3	-0.0	1.000	1.000	1.000	1.000	169.9	20000.0	0.8	
180												
190												
200	164.6	-1.3	190.8	-0.7	1.000	1.000	1.000	1.000	354.1	20000.0	1.8	
210	164.6	-1.3	12.8	0.7	1.000	1.000	1.000	1.000	176.0	20000.0	0.9	
170	164.6	-1.8	26.8	-0.7	1.000	1.000	1.000	1.000	189.6	20000.0	0.9	
200	164.6	-1.8	190.8	0.7	1.000	1.000	1.000	1.000	353.6	20000.0	1.8	

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 2 (OCC) W+P1+F1

Piping Code (1 of 1): B31.3 -2020, June 18, 2021

The SLP column shows the longitudinal pressure stress.

Stresses Evaluation CHECK PASSED : LOADCASE 2 (OCC) W+P1+F1

Highest Stresses: (lb./sq.in.)

Ratio (%):	22.0	@Node	110
Code:	5854.0	Allowable:	26600.0
SLP	1566.1	@Node	10
F/A	259.9	@Node	130
Bending	4563.8	@Node	110
Torsion	978.0	@Node	110
SIF/Index In-Plane	2.5	@Node	55
SIF/Index Out-Plane	2.1	@Node	55
SIF/Index Torsion	1.0	@Node	10
SIF/Index Axial	1.0	@Node	10

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out- Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
10	1566.1	-10.7	73.3	114.3	1.000	1.000	1.000	1.000	1644.6	26600.0	6.2	
20	1566.1	-10.7	185.8	-114.3	1.000	1.000	1.000	1.000	1756.1	26600.0	6.6	
20	1566.1	-12.5	185.8	114.3	1.000	1.000	1.000	1.000	1754.3	26600.0	6.6	
30	1566.1	-12.5	231.5	-114.3	1.000	1.000	1.000	1.000	1799.6	26600.0	6.8	
30	1224.2	-0.7	1448.5	370.0	1.000	1.000	1.000	1.000	2772.6	26600.0	10.4	
100	1224.2	1.6	1173.9	-370.0	1.000	1.000	1.000	1.000	2511.2	26600.0	9.4	
100	1224.2	1.6	2094.0	370.0	1.784	1.784	1.000	1.000	3401.3	26600.0	12.8	
110	948.5	5.2	4563.8	-978.0	1.784	1.784	1.000	1.000	5854.0	26600.0	22.0	
30	1566.1	-2.3	171.9	-76.1	1.000	1.000	1.000	1.000	1742.3	26600.0	6.6	

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 2 (OCC) W+P1+F1

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out-Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
40	1566.1	-2.3	76.1	76.1	1.000	1.000	1.000	1.000	1647.0	26600.0	6.2	
40												
50												
50	1566.1	-2.3	37.6	-76.1	1.000	1.000	1.000	1.000	1608.6	26600.0	6.0	
55	1566.1	-1.3	83.4	71.5	2.504	2.086	1.000	1.000	1654.4	26600.0	6.2	
55	1566.1	-1.3	83.4	-71.5	2.504	2.086	1.000	1.000	1654.4	26600.0	6.2	
60	1566.1	-0.1	148.0	60.8	2.504	2.086	1.000	1.000	1718.3	26600.0	6.5	
60	1566.1	-0.1	70.5	-60.8	1.000	1.000	1.000	1.000	1641.0	26600.0	6.2	
65	1566.1	-1.2	122.0	55.5	2.504	2.086	1.000	1.000	1690.5	26600.0	6.4	
65	1566.1	-1.2	122.0	-55.5	2.504	2.086	1.000	1.000	1690.5	26600.0	6.4	
70	1566.1	1.7	220.6	23.1	2.504	2.086	1.000	1.000	1789.0	26600.0	6.7	
70	1566.1	1.7	104.9	-23.1	1.000	1.000	1.000	1.000	1673.3	26600.0	6.3	
80	1566.1	6.0	87.0	23.1	1.000	1.000	1.000	1.000	1659.7	26600.0	6.2	
80	1566.1	6.0	87.0	-23.1	1.000	1.000	1.000	1.000	1659.7	26600.0	6.2	
90	1566.1	23.2	18.8	23.1	1.000	1.000	1.000	1.000	1608.8	26600.0	6.0	
110												
120												
120	948.5	257.6	1472.6	978.0	1.000	1.000	1.000	1.000	3316.8	26600.0	12.5	
130	948.5	259.9	755.3	-978.0	1.000	1.000	1.000	1.000	2771.6	26600.0	10.4	
130												
140												
140												

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 2 (OCC) W+P1+F1

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out-Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
150												
150	164.6	-21.9	107.4	18.9	1.000	1.000	1.000	1.000	253.0	26600.0	1.0	
155	164.6	-27.0	1174.7	-178.7	2.259	1.882	1.000	1.000	1360.1	26600.0	5.1	
155	164.6	-27.0	1174.7	178.7	2.259	1.882	1.000	1.000	1360.1	26600.0	5.1	
160	164.6	-18.3	1303.4	-446.2	2.259	1.882	1.000	1.000	1702.4	26600.0	6.4	
160	164.6	-18.3	691.0	446.2	1.000	1.000	1.000	1.000	1223.8	26600.0	4.6	
170	164.6	-19.1	929.9	-446.2	1.000	1.000	1.000	1.000	1397.5	26600.0	5.3	
170	164.6	-0.0	54.1	0.0	1.000	1.000	1.000	1.000	218.7	26600.0	0.8	
180	164.6	-0.0	5.3	-0.0	1.000	1.000	1.000	1.000	169.9	26600.0	0.6	
180												
190												
200	164.6	-121.0	969.1	-12.2	1.000	1.000	1.000	1.000	1013.0	26600.0	3.8	
210	164.6	-121.0	489.7	12.2	1.000	1.000	1.000	1.000	533.9	26600.0	2.0	
170	164.6	-122.7	1250.2	-12.2	1.000	1.000	1.000	1.000	1292.3	26600.0	4.9	
200	164.6	-122.7	969.1	12.2	1.000	1.000	1.000	1.000	1011.3	26600.0	3.8	

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 3 (OCC) W+P1+F2

Piping Code (1 of 1): B31.3 -2020, June 18, 2021

The SLP column shows the longitudinal pressure stress.

Stresses Evaluation CHECK PASSED : LOADCASE 3 (OCC) W+P1+F2

Highest Stresses: (lb./sq.in.)

Ratio (%):	26.1	@Node	110
Code:	6940.5	Allowable:	26600.0
SLP	1566.1	@Node	10
F/A	296.4	@Node	130
Bending	5863.8	@Node	110
Torsion	546.1	@Node	110
SIF/Index In-Plane	2.5	@Node	55
SIF/Index Out-Plane	2.1	@Node	55
SIF/Index Torsion	1.0	@Node	10
SIF/Index Axial	1.0	@Node	10

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out- Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %
10	1566.1	-1.8	65.7	64.1	1.000	1.000	1.000	1.000	1635.0	26600.0	6.1
20	1566.1	-1.8	70.9	-64.1	1.000	1.000	1.000	1.000	1640.1	26600.0	6.2
20	1566.1	-2.2	70.9	64.1	1.000	1.000	1.000	1.000	1639.8	26600.0	6.2
30	1566.1	-2.2	150.1	-64.1	1.000	1.000	1.000	1.000	1718.8	26600.0	6.5
30	1224.2	20.1	1373.1	206.6	1.000	1.000	1.000	1.000	2649.8	26600.0	10.0
100	1224.2	22.4	1295.8	-206.6	1.000	1.000	1.000	1.000	2575.7	26600.0	9.7
100	1224.2	22.4	2311.4	206.6	1.784	1.784	1.000	1.000	3581.8	26600.0	13.5
110	948.5	41.7	5863.8	-546.1	1.784	1.784	1.000	1.000	6940.5	26600.0	26.1
30	1566.1	-2.0	224.2	-54.7	1.000	1.000	1.000	1.000	1791.5	26600.0	6.7

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 3 (OCC) W+P1+F2

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out-Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
40	1566.1	-2.0	120.7	54.7	1.000	1.000	1.000	1.000	1688.3	26600.0	6.3	
40												
50												
50	1566.1	-2.0	78.4	-54.7	1.000	1.000	1.000	1.000	1646.1	26600.0	6.2	
55	1566.1	-1.7	112.0	45.0	2.504	2.086	1.000	1.000	1678.8	26600.0	6.3	
55	1566.1	-1.7	112.0	-45.0	2.504	2.086	1.000	1.000	1678.8	26600.0	6.3	
60	1566.1	-1.0	122.3	33.9	2.504	2.086	1.000	1.000	1688.7	26600.0	6.3	
60	1566.1	-1.0	58.5	-33.9	1.000	1.000	1.000	1.000	1625.0	26600.0	6.1	
65	1566.1	-3.1	63.8	30.7	2.504	2.086	1.000	1.000	1627.9	26600.0	6.1	
65	1566.1	-3.1	63.8	-30.7	2.504	2.086	1.000	1.000	1627.9	26600.0	6.1	
70	1566.1	0.0	119.2	12.8	2.504	2.086	1.000	1.000	1685.5	26600.0	6.3	
70	1566.1	0.0	57.1	-12.8	1.000	1.000	1.000	1.000	1623.3	26600.0	6.1	
80	1566.1	4.3	45.9	12.8	1.000	1.000	1.000	1.000	1616.5	26600.0	6.1	
80	1566.1	4.3	45.9	-12.8	1.000	1.000	1.000	1.000	1616.5	26600.0	6.1	
90	1566.1	21.5	22.3	12.8	1.000	1.000	1.000	1.000	1610.1	26600.0	6.1	
110												
120												
120	948.5	294.1	3061.3	546.1	1.000	1.000	1.000	1.000	4440.3	26600.0	16.7	
130	948.5	296.4	2952.7	-546.1	1.000	1.000	1.000	1.000	4337.4	26600.0	16.3	
130												
140												
140												

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 3 (OCC) W+P1+F2

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out-Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
150												
150	164.6	-0.3	491.0	74.3	1.000	1.000	1.000	1.000	672.0	26600.0	2.5	
155	164.6	-86.6	663.7	-115.3	2.259	1.882	1.000	1.000	776.8	26600.0	2.9	
155	164.6	-86.6	663.7	115.3	2.259	1.882	1.000	1.000	776.8	26600.0	2.9	
160	164.6	-124.1	1130.7	-192.7	2.259	1.882	1.000	1.000	1232.9	26600.0	4.6	
160	164.6	46.1	513.4	192.7	1.000	1.000	1.000	1.000	820.2	26600.0	3.1	
170	164.6	45.2	469.7	-192.7	1.000	1.000	1.000	1.000	781.2	26600.0	2.9	
170	164.6	0.0	54.1	0.0	1.000	1.000	1.000	1.000	218.7	26600.0	0.8	
180	164.6	0.0	5.3	-0.0	1.000	1.000	1.000	1.000	169.9	26600.0	0.6	
180												
190												
200	164.6	110.2	439.7	-234.8	1.000	1.000	1.000	1.000	855.0	26600.0	3.2	
210	164.6	110.2	569.7	234.8	1.000	1.000	1.000	1.000	966.3	26600.0	3.6	
170	164.6	110.2	390.8	-234.8	1.000	1.000	1.000	1.000	814.6	26600.0	3.1	
200	164.6	110.2	439.7	234.8	1.000	1.000	1.000	1.000	855.0	26600.0	3.2	

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 4 (OCC) W+P1+F3

Piping Code (1 of 1): B31.3 -2020, June 18, 2021

The SLP column shows the longitudinal pressure stress.

Stresses Evaluation CHECK PASSED : LOADCASE 4 (OCC) W+P1+F3

Highest Stresses: (lb./sq.in.)

Ratio (%):	9.6	@Node	110
Code:	2545.6	Allowable:	26600.0
SLP	1566.1	@Node	10
F/A	177.8	@Node	110
Bending	1575.2	@Node	110
Torsion	494.1	@Node	110
SIF/Index In-Plane	2.5	@Node	55
SIF/Index Out-Plane	2.1	@Node	55
SIF/Index Torsion	1.0	@Node	10
SIF/Index Axial	1.0	@Node	10

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out- Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
10	1566.1	-6.8	62.4	55.9	1.000	1.000	1.000	1.000	1625.5	26600.0	6.1	
20	1566.1	-6.8	245.5	-55.9	1.000	1.000	1.000	1.000	1808.2	26600.0	6.8	
20	1566.1	-8.0	245.5	55.9	1.000	1.000	1.000	1.000	1807.0	26600.0	6.8	
30	1566.1	-8.0	141.9	-55.9	1.000	1.000	1.000	1.000	1703.7	26600.0	6.4	
30	1224.2	-104.7	601.2	186.9	1.000	1.000	1.000	1.000	1760.8	26600.0	6.6	
100	1224.2	-102.4	447.9	-186.9	1.000	1.000	1.000	1.000	1613.5	26600.0	6.1	
100	1224.2	-102.4	798.9	186.9	1.784	1.784	1.000	1.000	1956.7	26600.0	7.4	
110	948.5	-177.8	1575.2	-494.1	1.784	1.784	1.000	1.000	2545.6	26600.0	9.6	
30	1566.1	0.5	26.7	-18.3	1.000	1.000	1.000	1.000	1593.6	26600.0	6.0	

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 4 (OCC) W+P1+F3

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out-Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
40	1566.1	0.5	28.8	18.3	1.000	1.000	1.000	1.000	1595.8	26600.0	6.0	
40												
50												
50	1566.1	0.5	41.2	-18.3	1.000	1.000	1.000	1.000	1608.2	26600.0	6.0	
55	1566.1	1.3	67.8	26.2	2.504	2.086	1.000	1.000	1636.1	26600.0	6.2	
55	1566.1	1.3	67.8	-26.2	2.504	2.086	1.000	1.000	1636.1	26600.0	6.2	
60	1566.1	1.9	30.1	30.1	2.504	2.086	1.000	1.000	1599.2	26600.0	6.0	
60	1566.1	1.9	12.7	-30.1	1.000	1.000	1.000	1.000	1581.8	26600.0	5.9	
65	1566.1	7.5	104.6	28.2	2.504	2.086	1.000	1.000	1679.0	26600.0	6.3	
65	1566.1	7.5	104.6	-28.2	2.504	2.086	1.000	1.000	1679.0	26600.0	6.3	
70	1566.1	12.0	157.5	11.9	2.504	2.086	1.000	1.000	1735.7	26600.0	6.5	
70	1566.1	12.0	69.4	-11.9	1.000	1.000	1.000	1.000	1647.6	26600.0	6.2	
80	1566.1	16.3	56.5	11.9	1.000	1.000	1.000	1.000	1639.1	26600.0	6.2	
80	1566.1	16.3	56.5	-11.9	1.000	1.000	1.000	1.000	1639.1	26600.0	6.2	
90	1566.1	33.6	17.5	11.9	1.000	1.000	1.000	1.000	1617.3	26600.0	6.1	
110												
120												
120	948.5	74.6	324.9	494.1	1.000	1.000	1.000	1.000	1671.4	26600.0	6.3	
130	948.5	76.9	277.9	-494.1	1.000	1.000	1.000	1.000	1635.6	26600.0	6.1	
130												
140												
140												

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 4 (OCC) W+P1+F3

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out-Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
150												
150	164.6	-18.0	124.8	-59.8	1.000	1.000	1.000	1.000	296.6	26600.0	1.1	
155	164.6	-10.9	766.8	-40.2	2.259	1.882	1.000	1.000	924.1	26600.0	3.5	
155	164.6	-10.9	766.8	40.2	2.259	1.882	1.000	1.000	924.1	26600.0	3.5	
160	164.6	0.7	912.7	-223.5	2.259	1.882	1.000	1.000	1167.0	26600.0	4.4	
160	164.6	85.8	484.8	223.5	1.000	1.000	1.000	1.000	860.4	26600.0	3.2	
170	164.6	84.9	441.5	-223.5	1.000	1.000	1.000	1.000	823.1	26600.0	3.1	
170	164.6	0.0	54.1	-0.0	1.000	1.000	1.000	1.000	218.7	26600.0	0.8	
180	164.6	0.0	5.3	0.0	1.000	1.000	1.000	1.000	169.9	26600.0	0.6	
180												
190												
200	164.6	17.1	474.4	26.5	1.000	1.000	1.000	1.000	658.3	26600.0	2.5	
210	164.6	17.1	170.2	-26.5	1.000	1.000	1.000	1.000	355.9	26600.0	1.3	
170	164.6	23.4	589.5	26.5	1.000	1.000	1.000	1.000	779.3	26600.0	2.9	
200	164.6	23.4	474.4	-26.5	1.000	1.000	1.000	1.000	664.5	26600.0	2.5	

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 5 (SUS) W+P1+F4

Piping Code (1 of 1): B31.3 -2020, June 18, 2021

The SLP column shows the longitudinal pressure stress.

Stresses Evaluation CHECK PASSED : LOADCASE 5 (SUS) W+P1+F4

Highest Stresses: (lb./sq.in.)

Ratio (%):	13.8	@Node	110
Code:	2763.9	Allowable:	20000.0
SLP	1566.1	@Node	10
F/A	228.0	@Node	110
Bending	2043.3	@Node	110
Torsion	93.9	@Node	200
SIF/Index In-Plane	2.5	@Node	55
SIF/Index Out-Plane	2.1	@Node	55
SIF/Index Torsion	1.0	@Node	10
SIF/Index Axial	1.0	@Node	10

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out- Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
10	1566.1	2.3	41.6	15.8	1.000	1.000	1.000	1.000	1610.3	20000.0	8.1	
20	1566.1	2.3	216.8	-15.8	1.000	1.000	1.000	1.000	1785.4	20000.0	8.9	
20	1566.1	2.7	216.8	15.8	1.000	1.000	1.000	1.000	1785.8	20000.0	8.9	
30	1566.1	2.7	133.2	-15.8	1.000	1.000	1.000	1.000	1702.2	20000.0	8.5	
30	1224.2	-133.3	409.4	5.9	1.000	1.000	1.000	1.000	1500.3	20000.0	7.5	
100	1224.2	-131.0	423.1	-5.9	1.000	1.000	1.000	1.000	1516.3	20000.0	7.6	
100	1224.2	-131.0	754.7	5.9	1.784	1.784	1.000	1.000	1847.9	20000.0	9.2	
110	948.5	-228.0	2043.3	-15.7	1.784	1.784	1.000	1.000	2763.9	20000.0	13.8	
30	1566.1	1.5	22.5	10.2	1.000	1.000	1.000	1.000	1590.2	20000.0	8.0	

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 5 (SUS) W+P1+F4

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out-Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
40	1566.1	1.5	48.1	-10.2	1.000	1.000	1.000	1.000	1615.8	20000.0	8.1	
40												
50												
50	1566.1	1.5	53.8	10.2	1.000	1.000	1.000	1.000	1621.5	20000.0	8.1	
55	1566.1	2.1	108.3	0.2	2.504	2.086	1.000	1.000	1676.5	20000.0	8.4	
55	1566.1	2.1	108.3	-0.2	2.504	2.086	1.000	1.000	1676.5	20000.0	8.4	
60	1566.1	2.3	82.3	9.3	2.504	2.086	1.000	1.000	1650.7	20000.0	8.3	
60	1566.1	2.3	39.2	-9.3	1.000	1.000	1.000	1.000	1607.7	20000.0	8.0	
65	1566.1	9.9	81.3	9.0	2.504	2.086	1.000	1.000	1657.4	20000.0	8.3	
65	1566.1	9.9	81.3	-9.0	2.504	2.086	1.000	1.000	1657.4	20000.0	8.3	
70	1566.1	15.1	117.2	3.8	2.504	2.086	1.000	1.000	1698.4	20000.0	8.5	
70	1566.1	15.1	47.8	-3.8	1.000	1.000	1.000	1.000	1629.0	20000.0	8.1	
80	1566.1	19.4	34.8	3.8	1.000	1.000	1.000	1.000	1620.2	20000.0	8.1	
80	1566.1	19.4	34.8	-3.8	1.000	1.000	1.000	1.000	1620.2	20000.0	8.1	
90	1566.1	36.6	25.1	3.8	1.000	1.000	1.000	1.000	1627.8	20000.0	8.1	
110												
120												
120	948.5	24.3	1200.2	15.7	1.000	1.000	1.000	1.000	2173.3	20000.0	10.9	
130	948.5	26.6	1236.9	-15.7	1.000	1.000	1.000	1.000	2212.2	20000.0	11.1	
130												
140												
140												

B31.3-2020 STRESSES REPORT: Stresses on Elements
 CASE 5 (SUS) W+P1+F4

Node	SLP lb./sq.in.	F/A lb./sq.in.	Bending lb./sq.in.	Torsion lb./sq.in.	SIF/Index In-Plane	SIF/Index Out-Plane	SIF/Index Torsion	SIF/Index Axial	Code lb./sq.in.	Allowable lb./sq.in.	Ratio %	
150												
150	164.6	2.5	248.5	35.5	1.000	1.000	1.000	1.000	421.6	20000.0	2.1	
155	164.6	-36.3	197.8	-24.9	2.259	1.882	1.000	1.000	329.9	20000.0	1.6	
155	164.6	-36.3	197.8	24.9	2.259	1.882	1.000	1.000	329.9	20000.0	1.6	
160	164.6	-55.8	430.4	-1.7	2.259	1.882	1.000	1.000	539.2	20000.0	2.7	
160	164.6	-55.8	193.8	1.7	1.000	1.000	1.000	1.000	302.6	20000.0	1.5	
170	164.6	-56.7	197.8	-1.7	1.000	1.000	1.000	1.000	305.7	20000.0	1.5	
170	164.6	-0.0	54.1	0.0	1.000	1.000	1.000	1.000	218.7	20000.0	1.1	
180	164.6	-0.0	5.3	-0.0	1.000	1.000	1.000	1.000	169.9	20000.0	0.8	
180												
190												
200	164.6	-1.2	39.8	-93.9	1.000	1.000	1.000	1.000	276.7	20000.0	1.4	
210	164.6	-1.2	162.4	93.9	1.000	1.000	1.000	1.000	376.1	20000.0	1.9	
170	164.6	-1.2	116.1	-93.9	1.000	1.000	1.000	1.000	336.8	20000.0	1.7	
200	164.6	-1.2	39.8	93.9	1.000	1.000	1.000	1.000	276.7	20000.0	1.4	

DISPLACEMENTS REPORT: Nodal Movements
 CASE 1 (SUS) W+P1

Node	DX in.	DY in.	DZ in.	RX deg.	RY deg.	RZ deg.
10	0.0000	0.0000	-0.0000	-0.0000	0.0000	-0.0000
20	-0.0001	-0.0000	-0.0000	0.0016	-0.0003	-0.0007
30	-0.0001	-0.0006	-0.0000	0.0020	-0.0004	-0.0008
40	-0.0002	-0.0010	-0.0000	0.0016	-0.0005	-0.0011
50	-0.0003	-0.0011	-0.0000	0.0016	-0.0005	-0.0011
55	-0.0004	-0.0013	-0.0000	0.0001	-0.0004	-0.0015
60	-0.0004	-0.0012	-0.0000	-0.0009	-0.0003	-0.0022
65	-0.0003	-0.0002	-0.0002	-0.0008	-0.0002	-0.0018
70	-0.0001	-0.0001	-0.0003	0.0000	-0.0002	-0.0005
80	-0.0000	-0.0001	-0.0002	0.0002	-0.0002	-0.0003
90	0.0000	-0.0000	-0.0000	0.0000	-0.0000	0.0000
100	-0.0001	-0.0006	0.0002	0.0011	-0.0004	-0.0005
110	-0.0000	-0.0007	0.0003	0.0001	-0.0004	-0.0000
120	-0.0000	-0.0007	0.0003	0.0001	-0.0004	0.0000
130	-0.0001	-0.0007	0.0002	-0.0009	-0.0005	0.0008
140	-0.0002	-0.0007	0.0001	-0.0009	-0.0005	0.0008
150	-0.0003	-0.0006	0.0001	-0.0009	-0.0005	0.0008
155	-0.0003	-0.0004	0.0001	-0.0006	-0.0000	0.0011
160	-0.0001	-0.0004	0.0001	-0.0001	0.0003	0.0019
170	0.0000	-0.0004	0.0001	-0.0001	0.0004	0.0019
180	0.0000	-0.0008	0.0002	-0.0001	0.0004	0.0021
190	0.0000	-0.0010	0.0002	-0.0001	0.0004	0.0021
200	0.0000	-0.0000	0.0000	-0.0001	0.0004	0.0012
210	0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000

DISPLACEMENTS REPORT: Nodal Movements
 CASE 2 (OCC) W+P1+F1

Node	DX in.	DY in.	DZ in.	RX deg.	RY deg.	RZ deg.
10	0.0000	-0.0000	-0.0000	-0.0000	0.0000	-0.0000
20	0.0001	-0.0000	-0.0000	0.0006	-0.0007	-0.0064
30	-0.0000	-0.0002	-0.0000	0.0009	-0.0015	-0.0077
40	-0.0004	-0.0005	-0.0000	0.0014	-0.0015	-0.0069
50	-0.0005	-0.0007	-0.0000	0.0014	-0.0015	-0.0068
55	-0.0008	-0.0009	-0.0001	0.0018	-0.0015	-0.0059
60	-0.0010	-0.0007	-0.0001	0.0023	-0.0014	-0.0051
65	-0.0010	-0.0001	-0.0004	0.0019	-0.0013	-0.0033
70	-0.0007	-0.0000	-0.0002	0.0007	-0.0016	-0.0014
80	-0.0004	-0.0000	-0.0001	0.0004	-0.0013	-0.0010
90	0.0000	-0.0000	0.0000	-0.0000	-0.0000	-0.0000
100	0.0015	-0.0002	-0.0001	-0.0014	-0.0060	-0.0134
110	0.0033	-0.0002	-0.0004	-0.0042	-0.0130	-0.0206
120	0.0077	-0.0002	-0.0013	-0.0044	-0.0137	-0.0211
130	0.0113	-0.0001	-0.0021	-0.0065	-0.0312	-0.0285
140	0.0152	-0.0001	-0.0030	-0.0065	-0.0317	-0.0286
150	0.0106	0.0008	-0.0030	-0.0065	-0.0317	-0.0286
155	0.0043	0.0017	-0.0028	-0.0037	-0.0235	-0.0256
160	0.0010	0.0019	-0.0026	-0.0014	-0.0151	-0.0134
170	0.0003	0.0019	-0.0025	-0.0013	-0.0131	-0.0120
180	0.0003	0.0043	-0.0053	-0.0013	-0.0131	-0.0118
190	0.0003	0.0051	-0.0061	-0.0013	-0.0131	-0.0118
200	0.0002	-0.0000	-0.0004	-0.0011	-0.0074	-0.0066
210	0.0000	-0.0000	0.0000	-0.0000	0.0000	0.0000

DISPLACEMENTS REPORT: Nodal Movements
 CASE 3 (OCC) W+P1+F2

Node	DX in.	DY in.	DZ in.	RX deg.	RY deg.	RZ deg.
10	0.0000	-0.0000	-0.0000	0.0000	0.0000	-0.0000
20	0.0001	-0.0000	-0.0000	-0.0003	-0.0003	-0.0036
30	-0.0000	0.0000	-0.0000	-0.0005	-0.0008	-0.0043
40	-0.0002	0.0000	-0.0000	0.0002	-0.0008	-0.0037
50	-0.0003	-0.0000	-0.0000	0.0003	-0.0008	-0.0037
55	-0.0004	-0.0001	-0.0000	0.0011	-0.0008	-0.0030
60	-0.0005	-0.0001	-0.0001	0.0018	-0.0007	-0.0023
65	-0.0006	-0.0000	-0.0001	0.0013	-0.0007	-0.0015
70	-0.0004	-0.0000	-0.0000	0.0004	-0.0009	-0.0007
80	-0.0002	-0.0000	0.0000	0.0002	-0.0007	-0.0005
90	0.0000	-0.0000	0.0000	-0.0000	-0.0000	-0.0000
100	0.0009	0.0000	-0.0004	-0.0056	-0.0033	-0.0080
110	0.0020	0.0001	-0.0013	-0.0136	-0.0072	-0.0127
120	0.0047	0.0001	-0.0043	-0.0144	-0.0076	-0.0131
130	0.0070	0.0001	-0.0077	-0.0342	-0.0174	-0.0193
140	0.0096	0.0001	-0.0123	-0.0347	-0.0176	-0.0194
150	0.0071	0.0052	-0.0123	-0.0349	-0.0177	-0.0195
155	0.0033	0.0112	-0.0106	-0.0351	-0.0154	-0.0196
160	0.0005	0.0128	-0.0072	-0.0265	-0.0123	-0.0164
170	-0.0003	0.0128	-0.0058	-0.0257	-0.0115	-0.0162
180	-0.0003	0.0161	-0.0082	-0.0257	-0.0115	-0.0160
190	-0.0003	0.0171	-0.0089	-0.0257	-0.0115	-0.0160
200	-0.0002	0.0093	-0.0037	-0.0214	-0.0087	-0.0156
210	-0.0000	0.0000	0.0000	-0.0000	-0.0000	-0.0000

DISPLACEMENTS REPORT: Nodal Movements
 CASE 4 (OCC) W+P1+F3

Node	DX in.	DY in.	DZ in.	RX deg.	RY deg.	RZ deg.
10	0.0000	0.0000	-0.0000	-0.0000	0.0000	-0.0000
20	0.0000	-0.0000	-0.0000	0.0012	-0.0005	-0.0031
30	-0.0001	-0.0005	-0.0000	0.0016	-0.0009	-0.0038
40	-0.0003	-0.0008	-0.0000	0.0016	-0.0010	-0.0036
50	-0.0004	-0.0010	-0.0000	0.0016	-0.0010	-0.0036
55	-0.0006	-0.0012	-0.0000	0.0008	-0.0009	-0.0035
60	-0.0007	-0.0010	-0.0001	0.0004	-0.0008	-0.0035
65	-0.0007	-0.0002	-0.0003	0.0003	-0.0007	-0.0025
70	-0.0004	-0.0001	-0.0003	0.0003	-0.0008	-0.0009
80	-0.0002	-0.0001	-0.0002	0.0003	-0.0007	-0.0006
90	0.0000	-0.0000	-0.0000	0.0000	-0.0000	0.0000
100	0.0006	-0.0005	0.0001	0.0004	-0.0032	-0.0059
110	0.0014	-0.0005	0.0001	-0.0008	-0.0068	-0.0085
120	0.0032	-0.0005	-0.0001	-0.0008	-0.0071	-0.0086
130	0.0046	-0.0005	-0.0002	0.0003	-0.0160	-0.0097
140	0.0059	-0.0005	-0.0002	0.0003	-0.0162	-0.0097
150	0.0035	-0.0005	-0.0002	0.0004	-0.0162	-0.0097
155	0.0006	-0.0007	-0.0003	0.0025	-0.0114	-0.0067
160	-0.0002	-0.0009	-0.0006	0.0030	-0.0065	0.0020
170	-0.0000	-0.0009	-0.0008	0.0029	-0.0055	0.0028
180	-0.0000	-0.0015	-0.0019	0.0029	-0.0055	0.0030
190	-0.0000	-0.0017	-0.0023	0.0029	-0.0055	0.0030
200	-0.0000	-0.0000	0.0000	0.0024	-0.0028	0.0029
210	-0.0000	0.0000	0.0000	0.0000	0.0000	-0.0000

DISPLACEMENTS REPORT: Nodal Movements
CASE 5 (SUS) W+P1+F4

Node	DX in.	DY in.	DZ in.	RX deg.	RY deg.	RZ deg.
10	0.0000	0.0000	0.0000	-0.0000	0.0000	-0.0000
20	-0.0000	-0.0000	0.0000	0.0011	-0.0003	-0.0009
30	-0.0001	-0.0004	0.0000	0.0013	-0.0004	-0.0011
40	-0.0002	-0.0007	0.0000	0.0012	-0.0004	-0.0012
50	-0.0002	-0.0008	0.0000	0.0012	-0.0004	-0.0012
55	-0.0003	-0.0010	-0.0000	0.0002	-0.0004	-0.0014
60	-0.0004	-0.0009	-0.0000	-0.0005	-0.0003	-0.0018
65	-0.0003	-0.0002	-0.0001	-0.0005	-0.0002	-0.0015
70	-0.0001	-0.0001	-0.0002	0.0001	-0.0003	-0.0005
80	-0.0000	-0.0001	-0.0002	0.0001	-0.0002	-0.0003
90	0.0000	-0.0000	-0.0000	0.0000	-0.0000	0.0000
100	0.0000	-0.0005	0.0001	-0.0006	-0.0004	-0.0013
110	0.0002	-0.0005	-0.0001	-0.0038	-0.0005	-0.0016
120	0.0005	-0.0005	-0.0010	-0.0041	-0.0006	-0.0017
130	0.0008	-0.0005	-0.0021	-0.0125	-0.0008	-0.0028
140	0.0012	-0.0005	-0.0038	-0.0127	-0.0008	-0.0028
150	0.0011	0.0013	-0.0038	-0.0127	-0.0008	-0.0028
155	0.0008	0.0036	-0.0031	-0.0137	-0.0012	-0.0036
160	0.0003	0.0042	-0.0018	-0.0106	-0.0016	-0.0048
170	0.0000	0.0042	-0.0012	-0.0103	-0.0016	-0.0049
180	0.0000	0.0052	-0.0015	-0.0103	-0.0016	-0.0047
190	0.0000	0.0055	-0.0016	-0.0103	-0.0016	-0.0047
200	0.0000	0.0031	-0.0009	-0.0086	-0.0015	-0.0052
210	0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000

RESTRAINTS REPORT: Loads On Restraints
 CASE 1 (SUS) W+P1

Node	FX lb.	FY lb.	FZ lb.	MX ft.lb.	MY ft.lb.	MZ ft.lb.	Restraint Type/Tag
10	21	79	-9	-181.9	18.1	-59.4	TYPE=Rigid ANC;
20	-1	0	0	0.0	0.0	0.0	TYPE=Flex GUI;
20	-57	-1368	-2	0.0	0.0	0.0	TYPE=Rigid +Y;
20	0	0	0	0.0	0.0	0.0	TYPE=Flex -Y;
80	0	0	-2	0.0	0.0	0.0	TYPE=Flex GUI;
80	-0	0	0	0.0	0.0	0.0	TYPE=Flex GUI;
90	27	-482	-26	86.0	-16.2	35.8	TYPE=Rigid ANC;
200	0	0	0	0.0	0.0	0.0	TYPE=Flex GUI;
200	3	-208	44	0.0	0.0	0.0	TYPE=Rigid +Y;
200	0	0	0	0.0	0.0	0.0	TYPE=Flex -Y;
210	7	-20	-6	-1.0	-8.0	-4.3	TYPE=Rigid ANC;

RESTRAINTS REPORT: Loads On Restraints
 CASE 2 (OCC) W+P1+F1

Node	FX lb.	FY lb.	FZ lb.	MX ft.lb.	MY ft.lb.	MZ ft.lb.	Restraint Type/Tag
10	104	-36	-127	-12.0	182.1	-569.6	TYPE=Rigid ANC;
20	1	0	0	0.0	0.0	0.0	TYPE=Flex GUI;
20	135	-471	-22	0.0	0.0	0.0	TYPE=Rigid +Y;
20	0	0	0	0.0	0.0	0.0	TYPE=Flex -Y;
80	0	0	-1	0.0	0.0	0.0	TYPE=Flex GUI;
80	-4	0	0	0.0	0.0	0.0	TYPE=Flex GUI;
90	29	-277	28	-24.7	-115.4	-39.8	TYPE=Rigid ANC;
200	0	0	-4	0.0	0.0	0.0	TYPE=Flex GUI;
200	10	-71	-18	0.0	0.0	0.0	TYPE=Rigid +Y;
200	0	0	0	0.0	0.0	0.0	TYPE=Flex -Y;
210	675	-194	145	-17.2	213.4	273.2	TYPE=Rigid ANC;

RESTRAINTS REPORT: Loads On Restraints
CASE 3 (OCC) W+P1+F2

Node	FX lb.	FY lb.	FZ lb.	MX ft.lb.	MY ft.lb.	MZ ft.lb.	Restraint Type/Tag
10	54	-134	-22	131.9	97.2	-319.7	TYPE=Rigid ANC;
20	1	0	0	0.0	0.0	0.0	TYPE=Flex GUI;
20	78	-278	-4	0.0	0.0	0.0	TYPE=Rigid +Y;
20	0	0	0	0.0	0.0	0.0	TYPE=Flex -Y;
80	0	0	0	0.0	0.0	0.0	TYPE=Flex GUI;
80	-2	0	0	0.0	0.0	0.0	TYPE=Flex GUI;
90	9	-256	24	-41.0	-63.5	-37.7	TYPE=Rigid ANC;
200	0	0	-37	0.0	0.0	0.0	TYPE=Flex GUI;
200	0	0	0	0.0	0.0	0.0	TYPE=Rigid +Y;
200	0	93	0	0.0	0.0	0.0	TYPE=Flex -Y;
210	-615	1	38	-332.5	-79.6	-395.4	TYPE=Rigid ANC;

RESTRAINTS REPORT: Loads On Restraints
CASE 4 (OCC) W+P1+F3

Node	FX lb.	FY lb.	FZ lb.	MX ft.lb.	MY ft.lb.	MZ ft.lb.	Restraint Type/Tag
10	62	36	-81	-119.1	100.1	-278.4	TYPE=Rigid ANC;
20	0	0	0	0.0	0.0	0.0	TYPE=Flex GUI;
20	42	-1002	-14	0.0	0.0	0.0	TYPE=Rigid +Y;
20	0	0	0	0.0	0.0	0.0	TYPE=Flex -Y;
80	0	0	-2	0.0	0.0	0.0	TYPE=Flex GUI;
80	-2	0	0	0.0	0.0	0.0	TYPE=Flex GUI;
90	28	-400	-4	43.5	-59.3	2.5	TYPE=Rigid ANC;
200	0	0	0	0.0	0.0	0.0	TYPE=Flex GUI;
200	-35	-650	37	0.0	0.0	0.0	TYPE=Rigid +Y;
200	0	0	0	0.0	0.0	0.0	TYPE=Flex -Y;
210	-96	16	64	37.6	103.1	-62.4	TYPE=Rigid ANC;

RESTRAINTS REPORT: Loads On Restraints
CASE 5 (SUS) W+P1+F4

Node	FX lb.	FY lb.	FZ lb.	MX ft.lb.	MY ft.lb.	MZ ft.lb.	Restraint Type/Tag
10	19	25	27	-102.3	17.3	-78.9	TYPE=Rigid ANC;
20	-0	0	0	0.0	0.0	0.0	TYPE=Flex GUI;
20	-45	-1114	5	0.0	0.0	0.0	TYPE=Rigid +Y;
20	0	0	0	0.0	0.0	0.0	TYPE=Flex -Y;
80	0	0	-2	0.0	0.0	0.0	TYPE=Flex GUI;
80	-0	0	0	0.0	0.0	0.0	TYPE=Flex GUI;
90	21	-436	-17	57.9	-19.0	23.8	TYPE=Rigid ANC;
200	0	0	-9	0.0	0.0	0.0	TYPE=Flex GUI;
200	0	0	0	0.0	0.0	0.0	TYPE=Rigid +Y;
200	0	31	0	0.0	0.0	0.0	TYPE=Flex -Y;
210	6	-31	-5	-133.0	-42.1	-107.0	TYPE=Rigid ANC;

Job Description:

PROJECT: MPLX Sigma PSV Study

CLIENT : MPLX

ANALYST: Rob Kreder

NOTES :
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PIPE DATA

From 10 To 20 DZ= 5.000 ft.

PIPE

Dia= 10.750 in. Wall= .365 in.

GENERAL

T1= 290 F P1= 236.5000 lb./sq.in. Mat= (106)A106 Grade B
E= 29,400,000 lb./sq.in. EH1= 28,350,000 lb./sq.in.
EH2= 29,400,000 lb./sq.in. EH3= 29,400,000 lb./sq.in.
EH4= 29,400,000 lb./sq.in. EH5= 29,400,000 lb./sq.in.
EH6= 29,400,000 lb./sq.in. EH7= 29,400,000 lb./sq.in.
EH8= 29,400,000 lb./sq.in. EH9= 29,400,000 lb./sq.in. v = .292
Pipe Den= .2830000 lb./cu.in. Fluid Den= .0006000 lb./cu.in.
Insul Thk= .000 in.

RESTRAINTS

Node 10 ANC
Node 20 Guide K= 10,000 lb./in.
Node 20 +Y Mu = .30
Node 20 -Y K= 10,000 lb./in.

ALLOWABLE STRESSES

B31.3 (2020) Cycle Max Switch = --- Sc= 20,000 lb./sq.in.
Sh1= 20,000 lb./sq.in. Sh2= 20,000 lb./sq.in. Sh3= 20,000 lb./sq.in.
Sh4= 20,000 lb./sq.in. Sh5= 20,000 lb./sq.in. Sh6= 20,000 lb./sq.in.
Sh7= 20,000 lb./sq.in. Sh8= 20,000 lb./sq.in. Sh9= 20,000 lb./sq.in.
Sy= 35,000 lb./sq.in.

From 20 To 30 DZ= 1.000 ft.

SIF's & TEE's

Node 30 Girth Butt Weld

From 30 To 100 DY= .667 ft.

PIPE

Dia= 6.625 in. Wall= .280 in.
Insul Thk= .000 in.

From 100 To 110 DY= .500 ft.

PIPE

Dia= 6.625 in. Wall= .280 in.
Insul Thk= .000 in.

REDUCER

Diam2= 4.500 in. Wall2= .237 in.

From 30 To 40 DZ= 1.000 ft.

PIPE

Dia= 10.750 in. Wall= .365 in.

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Insul Thk= .000 in.
-----
From 40 To 50 DZ= .500 ft.
Element Name=FLANGE_FLG_150
RIGID Weight= 53.00 lb. Type=Flange
-----
From 50 To 60 DZ= 1.000 ft.
BEND at "TO" end
Radius= 15.000 in. (LONG) Bend Angle= 45.000 Angle/Node @1= 22.50 55
-----
From 60 To 70 DX= -2.000 ft. DZ= 2.000 ft.
BEND at "TO" end
Radius= 15.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 65
-----
From 70 To 80 DY= 2.500 ft.
RESTRAINTS
Node 80 Guide K= 10,000 lb./in.
-----
From 80 To 90 DY= 5.000 ft.
RESTRAINTS
Node 90 ANC
-----
From 110 To 120 DY= 1.000 ft.
PIPE
Dia= 4.500 in. Wall= .237 in. Element Name=BALL_FLG_150
Insul Thk= .000 in.
RIGID Weight= 801.00 lb. Type=Flange Valve
-----
From 120 To 130 DY= .667 ft.
-----
From 130 To 140 DY= .646 ft.
RIGID Weight= 100.00 lb. Type=Unspecified
FORCES & MOMENTS
Node 140 FX1= 950.00 lb. FY1= 950.00 lb. FX2= 475.00 lb.
FY2= 475.00 lb. FX3= 475.00 lb. FY3= 475.00 lb.
-----
From 140 To 150 DZ= .687 ft.
PIPE
Dia= 6.625 in. Wall= .280 in.
GENERAL
T1= 25 F P1= 31.8000 lb./sq.in. Fluid Den= .0001000 lb./cu.in.
Insul Thk= .000 in.
RIGID Weight= 100.00 lb. Type=Unspecified
ALLOWABLE STRESSES
B31.3 (2020) Cycle Max Switch = --- Sc= 20,000 lb./sq.in.
Sh1= 20,000 lb./sq.in. Sh2= 20,000 lb./sq.in. Sh3= 20,000 lb./sq.in.
Sh4= 20,000 lb./sq.in. Sh5= 20,000 lb./sq.in. Sh6= 20,000 lb./sq.in.
Sh7= 20,000 lb./sq.in. Sh8= 20,000 lb./sq.in. Sh9= 20,000 lb./sq.in.
Sy= 35,000 lb./sq.in.
-----
From 150 To 160 DZ= 1.000 ft.
BEND at "TO" end
Radius= 9.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 155
FORCES & MOMENTS
Node 160 FX2= -950.00 lb. FY2= 950.00 lb. FX3= -475.00 lb.
FY3= 475.00 lb.
ALLOWABLE STRESSES
B31.3 (2020) Cycle Max Switch = --- Sc= 20,000 lb./sq.in.

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Sh1= 20,000 lb./sq.in. Sh2= 20,000 lb./sq.in. Sh3= 20,000 lb./sq.in.
Sh4= 20,000 lb./sq.in. Sh5= 20,000 lb./sq.in. Sh6= 20,000 lb./sq.in.
Sh7= 20,000 lb./sq.in. Sh8= 20,000 lb./sq.in. Sh9= 20,000 lb./sq.in.
Sy= 35,000 lb./sq.in.

From 160 To 170 DY= -1.000 ft.

FORCES & MOMENTS

Node 170 FY3= -950.00 lb. FY4= 475.00 lb.

SIF's & TEE's

Node 170 Girth Butt Weld

From 170 To 180 DX= -1.000 ft.

ALLOWABLE STRESSES

B31.3 (2020) Cycle Max Switch = --- Sc= 20,000 lb./sq.in.
Sh1= 20,000 lb./sq.in. Sh2= 20,000 lb./sq.in. Sh3= 20,000 lb./sq.in.
Sh4= 20,000 lb./sq.in. Sh5= 20,000 lb./sq.in. Sh6= 20,000 lb./sq.in.
Sh7= 20,000 lb./sq.in. Sh8= 20,000 lb./sq.in. Sh9= 20,000 lb./sq.in.
Sy= 35,000 lb./sq.in.

From 180 To 190 DX= -.302 ft.

Element Name=FLANGE_FLG_150

RIGID Weight= 25.00 lb. Type=Flange

From 200 To 210 DX= 5.000 ft.

RESTRAINTS

Node 210 ANC

From 170 To 200 DX= 1.000 ft.

RESTRAINTS

Node 200 Guide K= 10,000 lb./in.

Node 200 +Y Mu = .30

Node 200 -Y K= 10,000 lb./in.

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MATERIAL Changes:

10

20

Mat= (106)A106 Grade B E= 29,400,000 lb./sq.in. v = .292

Density= .2830 lb./cu.in.

CAESAR II Ver.13.00.00.0890, (Build 220811)

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JOBNAME: C:\USERS\ROBKR\ONEDRIVE\MPLX\SIGMA CS OVERPRESSURE EVALUATION\STRESS A

ALLOWABLE STRESS Changes

10

20

B31.3 (2020) Cycle Max Switch = --- Sc= 20,000 lb./sq.in.
Sh1= 20,000 lb./sq.in. Sh2= 20,000 lb./sq.in. Sh3= 20,000 lb./sq.in.
Sh4= 20,000 lb./sq.in. Sh5= 20,000 lb./sq.in. Sh6= 20,000 lb./sq.in.
Sh7= 20,000 lb./sq.in. Sh8= 20,000 lb./sq.in. Sh9= 20,000 lb./sq.in.
Sy= 35,000 lb./sq.in.

140

150

B31.3 (2020) Cycle Max Switch = --- Sc= 20,000 lb./sq.in.

Sh1= 20,000 lb./sq.in. Sh2= 20,000 lb./sq.in. Sh3= 20,000 lb./sq.in.
 Sh4= 20,000 lb./sq.in. Sh5= 20,000 lb./sq.in. Sh6= 20,000 lb./sq.in.
 Sh7= 20,000 lb./sq.in. Sh8= 20,000 lb./sq.in. Sh9= 20,000 lb./sq.in.
 Sy= 35,000 lb./sq.in.
 150 160

B31.3 (2020) Cycle Max Switch = --- Sc= 20,000 lb./sq.in.
 Sh1= 20,000 lb./sq.in. Sh2= 20,000 lb./sq.in. Sh3= 20,000 lb./sq.in.
 Sh4= 20,000 lb./sq.in. Sh5= 20,000 lb./sq.in. Sh6= 20,000 lb./sq.in.
 Sh7= 20,000 lb./sq.in. Sh8= 20,000 lb./sq.in. Sh9= 20,000 lb./sq.in.
 Sy= 35,000 lb./sq.in.
 170 180

B31.3 (2020) Cycle Max Switch = --- Sc= 20,000 lb./sq.in.
 Sh1= 20,000 lb./sq.in. Sh2= 20,000 lb./sq.in. Sh3= 20,000 lb./sq.in.
 Sh4= 20,000 lb./sq.in. Sh5= 20,000 lb./sq.in. Sh6= 20,000 lb./sq.in.
 Sh7= 20,000 lb./sq.in. Sh8= 20,000 lb./sq.in. Sh9= 20,000 lb./sq.in.
 Sy= 35,000 lb./sq.in.

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BEND ELEMENTS

50 60

Radius= 15.000 in. (LONG) Bend Angle= 45.000 Angle/Node @1= 22.50 55
 60 70

Radius= 15.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 65
 150 160

Radius= 9.000 in. (LONG) Bend Angle= 90.000 Angle/Node @1= 45.00 155
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RIGIDS

40 50

Weight= 53.00 lb. Type=Flange
 110 120

Weight= 801.00 lb. Type=Flange Valve
 130 140

Weight= 100.00 lb. Type=Unspecified
 140 150

Weight= 100.00 lb. Type=Unspecified

180

190

Weight= 25.00 lb. Type=Flange

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SIF's & TEE's

20

30

Node 30 Girth Butt Weld

160

170

Node 170 Girth Butt Weld

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REDUCERS

100

110

Diam2= 4.500 in. Wall2= .237 in.

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RESTRAINTS

10

20

RESTRAINTS

Node	10	Type	ANC	Dir Vec=	.000	.000	.000
Node	20	Type	Guide	STIF1=	10,000 lb./in.	Dir Vec=	.000
.000	.000						
Node	20	Type	+Y	MU/YIELD/FORCE =		.30	
Dir Vec=	.000		1.000	.000			
Node	20	Type	-Y	STIF1=	10,000 lb./in.	Dir Vec=	.000
1.000	.000						

70

80

RESTRAINTS

Node	80	Type	Guide	STIF1=	10,000 lb./in.	Dir Vec=	.000
.000	.000						

80

90

RESTRAINTS

Node	90	Type	ANC	Dir Vec=	.000	.000	.000
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200

210

RESTRAINTS

Node 210 Type ANC Dir Vec= .000 .000 .000

170

200

RESTRAINTS

Node 200 Type Guide STIF1= 10,000 lb./in. Dir Vec= .000
.000 .000

Node 200 Type +Y MU/YIELD/FORCE = .30

Dir Vec= .000 1.000 .000

Node 200 Type -Y STIF1= 10,000 lb./in. Dir Vec= .000
1.000 .000

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FORCES AND MOMENTS

130

140

Node 140 FX1= 950.00 lb. FY1= 950.00 lb. FX2= 475.00 lb.
FY2= 475.00 lb. FX3= 475.00 lb. FY3= 475.00 lb.

150

160

Node 160 FX2= -950.00 lb. FY2= 950.00 lb. FX3= -475.00 lb.
FY3= 475.00 lb.

160

170

Node 170 FY3= -950.00 lb. FY4= 475.00 lb.

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INPUT UNITS USED...

UNITS= ENGLISH NOM/SCH INPUT= ON

LENGTH	inches	x	1.000	=	in.
FORCE	pounds	x	1.000	=	lb.
MASS (dynamics)	pounds	x	1.000	=	lbm
MOMENTS (INPUT)	inch-pounds	x	1.000	=	in.lb.
MOMENTS (OUTPUT)	inch-pounds	x	0.083	=	ft.lb.
STRESS	lbs./sq.in.	x	1.000	=	lb./sq.in.
TEMP. SCALE	degrees F.	x	1.000	=	F
PRESSURE	psig	x	1.000	=	lb./sq.in.
ELASTIC MODULUS	lbs./sq.in.	x	1.000	=	lb./sq.in.
PIPE DENSITY	lbs./cu.in.	x	1.000	=	lb./cu.in.
INSULATION DENS.	lbs./cu.in.	x	1.000	=	lb./cu.in.
FLUID DENSITY	lbs./cu.in.	x	1.000	=	lb./cu.in.
TRANSL. STIF	lbs./in.	x	1.000	=	lb./in.
ROTATIONAL STIF	in.lb./deg.	x	1.000	=	in.lb./deg
UNIFORM LOAD	lb./in.	x	1.000	=	lb./in.

G LOAD	g's	x	1.000	=	g's
WIND LOAD	lbs./sq.in.	x	144.000	=	lb./sq.ft.
ELEVATION	inches	x	0.083	=	ft.
COMPOUND LENGTH	inches	x	0.083	=	ft.
DIAMETER	inches	x	1.000	=	in.
WALL THICKNESS	inches	x	1.000	=	in.

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SETUP FILE PARAMETERS

CONNECT GEOMETRY THRU CNODES = YES
MIN ALLOWED BEND ANGLE = 5.00000
MAX ALLOWED BEND ANGLE = 95.0000
BEND LENGTH ATTACHMENT PERCENT = 1.00000
MIN ANGLE TO ADJACENT BEND PT = 5.00000
LOOP CLOSURE TOLERANCE = 1.00000 in.
THERMAL BOWING HORZ TOLERANCE = 0.100000E-03
AUTO NODE NUMBER INCREMENT= 5.00000
Z AXIS UP= NO
USE PRESSURE STIFFENING = DEFAULT
ALPHA TOLERANCE = 0.500000E-01
RESLD-FORCE = NO
HGR DEF RESWGT STIF = 0.100000E+13 lb./in.
DECOMP SNG TOL = 0.100000E+11
BEND AXIAL SHAPE = YES
FRICT STIF = 0.100000E+07 lb./in.
FRICT NORM FORCE VAR = 0.150000
FRICT ANGLE VAR = 15.0000
FRICT SLIDE MULT = 1.00000
ROD TOLERANCE = 1.00000
ROD INC = 2.00000
INCORE NUMERICAL CHECK = NO
OUTCORE NUMERICAL CHECK = NO
DEFAULT TRANS RESTRAINT STIFF= 0.100000E+13 lb./in.
DEFAULT ROT RESTRAINT STIFF= 0.100000E+13 in.lb./deg
IGNORE SPRING HANGER STIFFNESS = NO
MISSING MASS ZPA = EXTRACTED
MIN WALL MILL TOLERANCE = 12.5000
WRC-107 VERSION = MAR 79 1B1/2B1
WRC-107 INTERPOLATION = LAST VALUE
DEFAULT AMBIENT TEMPERATURE= 70.0000 F
BOURDON PRESSURE= NONE
COEFFICIENT OF FRICTION (MU) = 0.000000
INCLUDE SPRG STIF IN HGR OPE = NO
INCLUDE INSULATION IN HYDROTEST = NO
REDUCED INTERSECTION = B31.1 (POST1980)
USE WRC329 NO
NO REDUCED SIF FOR RFT AND WLT NO
B31.1 REDUCED Z FIX = YES
CLASS 1 BRANCH FLEX NO
ALL STRESS CASES CORRODED = NO
ADD TORSION IN SL STRESS = DEFAULT
ADD F/A IN STRESS = DEFAULT
OCCASIONAL LOAD FACTOR = 0.000000
DEFAULT CODE = B31.3 2020
B31.3 SUS CASE SIF FACTOR = 0.000000
ALLOW USERS BEND SIF = NO
USE SCHNEIDER NO

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YIELD CRITERION STRESS =          MAX 3D SHEAR
USE PD/4T                      NO
BASE HOOP STRESS ON ? =         ID
EN13480 USE IN OUTPLANE SIFS=    NO
LIBERAL EXPANSION ALLOWABLE=     YES
B31.3 SEC 319.2.3C SAXIAL=      Default
B31.3 WELDING/CONTOUR TEE ISB16.9 FALSE
PRESSURE VARIATION IN EXP CASE=  DEFAULT
IMPLEMENT B313 APP-P             NO
IMPLEMENT B313 CODE CASE 178    YES
IGNORE B31.1/B31.3 Wc FACTOR=   YES
APPLY B31J SIFS & FLEX=         DEFAULT
ENFORCE B31J SIFS ONLY=        FALSE
USE FRP SIF =                   YES
USE FRP FLEX =                  YES
BS 7159 Pressure Stiffening=    Design Strain
FRP Property Data File=         CAESAR.FRP
FRP Emod (axial) =              0.320000E+07 lb./sq.in.
FRP Ratio Gmod/Emod (axial) =   0.250000
FRP Ea/Eh*Vh/a =               0.152730
FRP Laminate Type =            THREE
FRP Alpha =                     12.0000          F
FRP Density =                   0.600000E-01 lb./cu.in.
EXCLUDE f2 FROM UKOOA BENDING = NO
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EXECUTION CONTROL PARAMETERS

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Rigid/ExpJt Print Flag ..... 1.000
Bourdon Option ..... .000
Loop Closure Flag ..... 2.000
Thermal Bowing Delta Temp .. .000 F
Liberal Allowable Flag ..... 1.000
Uniform Load Option ..... .000

Ambient Temperature ..... 70.000 F
Plastic (FRP) Alpha ..... 12.000
Plastic (FRP) GMOD/EMODa ... .250
Plastic (FRP) Laminate Type. 3.000
Eqn Optimizer ..... .000
Node Selection ..... .000
Eqn Ordering ..... .000
Collins ..... .000
Degree Determination ..... .000
User Eqn Control ..... .000
North Direction ..... -Z
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COORDINATE REPORT

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/----- (in.) -----/
NODE      X      Y      Z
   10     .000   .000   .000
   20     .000   .000  60.000
   30     .000   .000  72.000
  100     .000   8.000  72.000
  110     .000  14.000  72.000

```

30	.000	.000	72.000
40	.000	.000	84.000
50	.000	.000	90.000
60	.000	.000	102.000
70	-24.000	.000	126.000
80	-24.000	30.000	126.000
90	-24.000	90.000	126.000
110	.000	14.000	72.000
120	.000	26.000	72.000
130	.000	34.000	72.000
140	.000	41.750	72.000
150	.000	41.750	80.250
160	.000	41.750	92.250
170	.000	29.750	92.250
180	-12.000	29.750	92.250
190	-15.625	29.750	92.250
200	12.000	29.750	92.250
210	72.000	29.750	92.250
170	.000	29.750	92.250
200	12.000	29.750	92.250